The 2003 Coastside / RFA Groundfish Survey Report

A cooperative analysis by the Coastside Fishing Club and the Recreational Fishing Alliance.

October 2003

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Coastside Director,
RFA Member

Table of Contents

Had powerpoint.

Acknowledgements

Analysis of the Coastside Fishing Club database, and creation and analysis of the Coastside survey was a major undertaking requiring many hours of volunteer labor. The following Coastside and RFA members were instrumental in making this analysis possible: Bob Franko, Randy Fry, Mike Giraudo, Chris Hall, Don Lopker, and Dan Wolford. This report would not be possible without their dedicated effort.

Introduction / Objectives

All aspects of the fishery management team have repeatedly acknowledged the need for quality data concerning the health of the groundfish fishery. In particular, the groundfish catch attributed to the recreational fishing community has been difficult to quantify, because of the distributed and individual nature of the recreational fishing segment, which makes data collection difficult.

From its inception, the Coastside Fishing Club has collected voluntary data from its members in order to share our catch data among our membership for the purpose of enhancing our fishing experiences. The leadership of the Coastside Fishing Club and the Recreational Fishing Alliance have recognized that the resulting database can be also be used to enhance the data available to the fishery managers. It is our intention to make this data available in order to augment and enhance the data traditionally used to manage the fishery.

Executive Summary

The Coastside/RFA analysis of the recreational rockfish catch for Northern California for the months of July and August 2003 utilizes the combined information contained in the unique database of the Coastside Fishing Club, Harbormaster data, and the traditional fishery management MRFSS database. Our analysis focuses on the recreational catch of the private boaters in Northern California. These results must be combined with the catch data from the Northern California CPFVs to determine the overall recreational rockfish catch.

In essence, the Coastside data assesses the relative frequency that recreational fishermen target rockfish, finding that it constitutes less than 20% of their fishing effort. When combined with the launch data, it demonstrates that during the months of July and August 2003, the private boating segment of the recreational community took approximately 45 Metric Tons of rockfish in Northern California waters.

Additionally the availability of the Coastside data, and this effort, open the door to future opportunities to work cooperatively to improve the management of the various Pacific fisheries pertinent to the recreational fishing community.

Analysis Methodology

This report brings forth two independent catch assessments of the Coastside membership: one based exclusively on the daily postings of our membership, and another based on a solicited survey of our membership. These two independent data sources assess the quality of our data, and are then combined with data elements from the MRFSS database to create a new assessment of the recreational groundfish catch in Northern California.

Daily Coastside Postings – This database consists of voluntary postings from our membership of our daily fishing experiences. The essential feature of these postings is the credibility of the database. Since its purpose is to advise "tomorrow's" fisherman of where "today's" fishermen were successful, or not successful, the database relies of the openness and honesty of the reporting members. The success of the Club is in large part attributed to the quality of the data on the daily postings – since we rely on the data to guide our fishing plans. If the data were found by our membership to not be helpful in enhancing our fishing experience, the Club would have failed long ago. That the Club prospers is a testament to the quality of the data contained in the database.

The database itself consists of postings from individual fisherman on where they caught (or did not catch) fish (usually by lat / long), what and how many fish were caught, and by what technique or tackle. The postings are made the day of the trip, contributing to the quality of the data – timeliness is as essential as accuracy when planning "tomorrow's" trip.

To acquire the data for this report, approximately 1246 individual postings were reviewed, line by line, by Coastside volunteers to extract the number of fishing trips taken by our members during the months of July and August 2003. Each posting was reviewed and categorized according to the targeted species (Tuna, Salmon, Rockfish, or Halibut). These data were then used to compute the percentage of our membership's effort devoted to these categories of fish. Since the postings are voluntary, and were not planned for the purpose of fishery management, they cannot be used to represent the actual numbers of fishing trips or effort – but they do accurately reflect the percentage of our effort devoted to these categories.

Solicited Survey – This instrument (see Appendix B) was created expressly for assessing the accuracy of our analysis of our daily postings. It consisted of a direct questionnaire to our roughly 4000 members, asking them to recount their fishing trips for the months of July, August, September, and October, by the targeted species, and their results. We received 520 responses, which were analyzed to again provide the percentage of our membership's effort, by month, devoted to Tuna, Salmon, Rockfish, or Other categories. While the response rate is somewhat lower than desired, the actual number of responses is significantly greater than other fishing data surveys.

Additional Data Sources – Other sources of data are required to create the assessment of the recreational rockfish catch. While the Coastside data discussed above provides a credible assessment of the frequency that the recreational fishing community targets rockfish, it does not address the actual numbers of fishing trips, the success rate of the trip, nor the size of the fish caught. For these data, we needed to acquire additional data.

To accurately assess the total fishing effort, we surveyed the 13 harbors (launch ramps) that serve the Northern California coastal fishing community. These range from Morro Bay in the south, to Crescent City in the north. Where possible we received precise data from the harbormasters, based on their launch ramp receipts, indicating the total number of skiffs launched during the months of July and August 2003. In two instances (Eureka and Bodega Bay), we used Coast Guard estimates of launches in this period. Where no other sources of data were available, Coastside and RFA members, based on their local knowledge of the particular harbor, estimated the number of launches. See Table 01 for the details of the total ocean sport fishing launches in Northern California by harbor.

Still other data is needed to compute the total recreational private boater rockfish catch. We needed to estimate the number of fishermen per boat (launch), which we did based on our Club's collective assessment of boatloads. In addition, we needed estimates for the number of rockfish caught per person-trip, and of the average size of the fish caught. For these two pieces of data, we used the traditional MRFSS data. These data are typically derived from direct launch ramp surveys, which are of similar quality to our Coastside database.

Analysis Assumptions and Approach

In conducting this analysis, we were guided by the following basic premise: that the safety and health of the rockfish fishery is paramount. If we were to error, it would be on the side that would provide the most protection to the fishery, not the fisherman. To that end, we made several assumptions discussed below.

In assessing the total fishing effort, we relied on launch ramp data. While we recognize that not all boats that launch actually engage in fishing (particularly in the large harbors like Monterey and San Francisco where many launches are purely pleasure boaters – sail, whale watching, etc.), we assumed that all launches were fishermen. While this will overestimate the number of fishing trips, this assumption compensates for those recreational fishermen who berth their boats, rather than launch, and so provides a reasonable estimate of the number of trips.

When we used two methods to arrive at a computational element, we chose to use the number that would compute the larger catch, and used the lower number purely as a quality check on the methodology.

We did not attempt to discount the fishing effort due to weather. That is, even though bad weather (wind, swells, fog, and wind waves) many times will prevent a launched vessel from reaching the fishing grounds, or shorten the duration of the fishing effort, we counted each launch as a full fishing trip.

By utilizing the information in the 1246 daily Coastside posts and the 520 Coastside survey responses, we are able to achieve a significant sample size, and significantly enhance the quality of the fishery management data. By its nature, those fishermen who actively participate in a fishing club, and those of the Coastside Fishing Club in particular, tend to be the most dedicated, skilled, and successful fishermen. Never the less we attributed all fishermen with the same prowess as our Coastside membership.

In addition, we are confident that the Coastside database is true and valid for the purposes and methods of this analysis. Particularly so, since it was created to provide unbiased, accurate, and timely information to our club members. In both of these Coastside sources, the relative frequency information includes data from those who berth their boats and those who launch their boats.

Results

Computing the total private boat recreational rockfish catch is reasonably straight forward according to the following formula:

Rockfish Catch = (# Avg launches per harbor) * (# anglers per boat) * (% targeting rockfish) * (# rockfish caught per angler) * (average rockfish weight) * (# of harbors).

For the months of July and August 2003, for Northern California, the private boater total Rockfish Catch is determined to be:

= 1428 * 2 * 18% * 5 * 3 * 13

= 100,245.6 lbs

= 45.46 Metric Tons.

Table 01 provides the data indicating an average of 1428 launches per harbor. While there is considerable variation from harbor to harbor, the average is applied to all harbors. Since some of the best rockfishing occurs from those harbors with smaller numbers of launches, using the average will tend to overestimate the catch.

San Francisco Ports represent an aggregate of various launch ramps utilized by recreational fishermen in the Bay Area, including Sausalito, Richmond, Emeryville, Berkeley, San Leandro, Coyote Point, Oyster Point....

Our best estimate of the number of fishermen per boat, based on our personal fishing knowledge is 2. While some variation on this number was explored, our assessment of reasonable excursions did not significantly change the outcome.

We utilized the Coastside daily posting database and the solicited survey to arrive at the percent of the fishing effort devoted to rockfishing. Both methods arrived at very similar rates of targeting rockfish – approximately 18 percent from the survey and 13 percent from the daily posts. Both clearly reflect the preference of the recreational fishing community for Tuna and Salmon. Rockfish are often targeted only as a backup in those instances when Tuna or Salmon are not available, and then only enough fish are caught to salvage an otherwise unproductive day, and to provide something for that night's dinner table. In computing the Rockfish catch, we used the larger of the two percentages (18%).

Table 02 provides the detailed breakout of the Coastside Daily Postings for the months of July and August 2003, and Table 03 provides the similar data from the Solicited Survey. Figures 01, 02, and 03 graphically portray the data in Table 03.

Table 01: Ocean Sportfishing Effort of Northern California Private Boaters for the Months of July and August 2003, compiled by the Coastside Fishing Club and RFA.

Port	Jul/Aug Skiff Launches	Quality	Info provided by
Crescent City	534	Actual	Harbormaster
Eureka	1,000	Estimate	Coast Guard
Shelter Cove	530	Estimate	RFA / Coastside
Fort Bragg	1,944	Actual	Harbormaster
Point Arena	250	Estimate	RFA / Coastside
Timber Cove	200	Estimate	RFA / Coastside
Bodega Bay	2,200	Estimate	Coast Guard
SF ports	4,000	Estimate	RFA / Coastside
Pillar Point	2,121	Actual	Harbormaster
Moss Landing	178	Actual	Harbormaster
Santa Cruz	3,385	Actual	Harbormaster
Monterey	1,200	Estimate	Harbormaster
Morro Bay	1,022	Actual	Harbormaster
Total	18,564		
Average Launches	1,428		

Table 02: Analysis of 1246 Coastside Daily Postings Showing the Number of Trips for Popular Fish Categories

Date	Number of trips					Percent of trips			
	Tuna	Salmon	Rockfish	Halibut	total	Tuna	Salmon	Rockfish	Halibut
1-Jul	0	9	11	1	21	0.0%	42.9%	52.4%	4.8%
2-Jul	2	7	4	1	14	14.3%	50.0%	28.6%	7.1%
3-Jul	1	6	2	0	9	11.1%	66.7%	22.2%	0.0%
4-Jul	0	12	8	3	23	0.0%	52.2%	34.8%	13.0%
5-Jul	0	8	4	3	15	0.0%	53.3%	26.7%	20.0%
6-Jul	0	9	2	1	12	0.0%	75.0%	16.7%	8.3%
7-Jul	0	6	3	1	10	0.0%	60.0%	30.0%	10.0%
8-Jul	0	7	2	2	11	0.0%	63.6%	18.2%	18.2%
9-Jul	0	4	1	0	5	0.0%	80.0%	20.0%	0.0%
10-Jul	0	7	1	0	8	0.0%	87.5%	12.5%	0.0%
11-Jul	1	6	2	2	11	9.1%	54.5%	18.2%	18.2%
12-Jul	0	17	3	2	22	0.0%	77.3%	13.6%	9.1%
13-Jul	1	13	7	3	24	4.2%	54.2%	29.2%	12.5%
14-Jul	0	3	1	0	4	0.0%	75.0%	25.0%	0.0%
15-Jul	0	4	1	0	5	0.0%	80.0%	20.0%	0.0%
16-Jul	0	4	1	3	8	0.0%	50.0%	12.5%	37.5%
17-Jul	0	10	3	0	13	0.0%	76.9%	23.1%	0.0%
18-Jul	1	5	1	0	7	14.3%	71.4%	14.3%	0.0%
19-Jul	0	20	1	0	21	0.0%	95.2%	4.8%	0.0%
20-Jul	1	24	4	2	31	3.2%	77.4%	12.9%	6.5%
21-Jul	4	23	2	0	29	13.8%	79.3%	6.9%	0.0%
22-Jul	3	22	1	3	29	10.3%	75.9%	3.4%	10.3%
23-Jul	0	9	0	0	9	0.0%	100.0%	0.0%	0.0%
24-Jul	0	12	1	1	14	0.0%	85.7%	7.1%	7.1%
25-Jul	3	15	1	0	19	15.8%	78.9%	5.3%	0.0%
26-Jul	8	28	4	3	43	18.6%	65.1%	9.3%	7.0%
27-Jul	6	19	1	1	27	22.2%	70.4%	3.7%	3.7%
28-Jul	5	12	1	0	18	27.8%	66.7%	5.6%	0.0%
29-Jul	9	12	1	0	22	40.9%	54.5%	4.5%	0.0%
30-Jul	17	5	4	1	27	63.0%	18.5%	14.8%	3.7%
31-Jul	12	7	5	1	25	48.0%	28.0%	20.0%	4.0%
July Total	**74**	**345**	**83**	**34**	**536**	**13.8%**	**64.4%**	**15.5%**	**6.3%**

Table 02: Analysis of 1246 Coastside Daily Postings Showing the Number of Trips for Popular Fish Categories - continued

Date	Number of trips					Percent of trips			
	Tuna	Salmon	Rockfish	Halibut	total	Tuna	Salmon	Rockfish	Halibut
1-Aug	18	7	1	1	27	66.7%	25.9%	3.7%	3.7%
2-Aug	22	7	3	1	33	66.7%	21.2%	9.1%	3.0%
3-Aug	28	7	1	0	36	77.8%	19.4%	2.8%	0.0%
4-Aug	21	10	0	0	31	67.7%	32.3%	0.0%	0.0%
5-Aug	17	7	1	1	26	65.4%	26.9%	3.8%	3.8%
6-Aug	15	5	1	1	22	68.2%	22.7%	4.5%	4.5%
7-Aug	17	2	1	1	21	81.0%	9.5%	4.8%	4.8%
8-Aug	33	5	2	0	40	82.5%	12.5%	5.0%	0.0%
9-Aug	32	10	4	2	48	66.7%	20.8%	8.3%	4.2%
10-Aug	17	7	5	4	33	51.5%	21.2%	15.2%	12.1%
11-Aug	3	1	3	0	7	42.9%	14.3%	42.9%	0.0%
12-Aug	1	2	0	1	4	25.0%	50.0%	0.0%	25.0%
13-Aug	0	5	0	2	7	0.0%	71.4%	0.0%	28.6%
14-Aug	0	6	1	1	8	0.0%	75.0%	12.5%	12.5%
15-Aug	0	12	4	0	16	0.0%	75.0%	25.0%	0.0%
16-Aug	0	13	6	0	19	0.0%	68.4%	31.6%	0.0%
17-Aug	3	12	10	0	25	12.0%	48.0%	40.0%	0.0%
18-Aug	4	3	2	2	11	36.4%	27.3%	18.2%	18.2%
19-Aug	7	5	5	0	17	41.2%	29.4%	29.4%	0.0%
20-Aug	7	6	1	3	17	41.2%	35.3%	5.9%	17.6%
21-Aug	11	8	1	5	25	44.0%	32.0%	4.0%	20.0%
22-Aug	20	4	1	5	30	66.7%	13.3%	3.3%	16.7%
23-Aug	33	10	5	2	50	66.0%	20.0%	10.0%	4.0%
24-Aug	19	5	5	2	31	61.3%	16.1%	16.1%	6.5%
25-Aug	16	3	2	1	22	72.7%	13.6%	9.1%	4.5%
26-Aug	6	3	1	1	11	54.5%	27.3%	9.1%	9.1%
27-Aug	11	6	2	1	20	55.0%	30.0%	10.0%	5.0%
28-Aug	10	3	1	0	14	71.4%	21.4%	7.1%	0.0%
29-Aug	3	1	1	2	7	42.9%	14.3%	14.3%	28.6%
30-Aug	7	7	1	7	22	31.8%	31.8%	4.5%	31.8%
31-Aug	13	7	6	4	30	43.3%	23.3%	20.0%	13.3%
August Total	**394**	**189**	**77**	**50**	**710**	**55.5%**	**26.6%**	**10.8%**	**7.0%**
July and August total	**468**	**534**	**160**	**84**	**1246**	**37.6%**	**42.9%**	**12.8%**	**6.7%**

Appendix A: The Coastside Daily Postings

The daily posting board is found on the Coastside Fishing Club website at

http://www.coastside.juicyweb.com

Appendix B: The Coastside Solicited Survey Instrument

An e-mailing to our Club membership asked for voluntary submission of recent fishing history, and directed the members to a website that contained the survey questions, and allowed for on-line submission of completed forms. Of the roughly 4000 members invited to participate, 522 completed forms were returned. The actual questions are included below.

For July 2003

0 How many days in July did you fish for Tuna?

0 How many days in July did you fish for Salmon?

0 How many days in July did you fish for Rockfish?

0 How many days in July did fish for a species not listed here (halibut, sturgeon, sharks etc..)

Please Enter a number, put in a 0 if you did not catch any

In July, how many Ling Cod did you (or you boat) catch?

In July, how many Cabezon did you catch?

In July, how many Rockfish did you catch?

For August 2003

0 How many days in August did you fish for Tuna?

0 How many days in August did you fish for Salmon?

0 How many days in August did you fish for Rockfish?

0 How many days in August did fish for a species not listed here (halibut, sturgeon, sharks etc..)

Please Enter a number, put in a 0 if you did not catch any

In August, how many Ling Cod did you catch?

In August, how many Cabezon did you catch?

In August, how many Rockfish did you catch?

For September 2003

0 How many days in September did you fish for Tuna?

0 How many days in September did you fish for Salmon?

0 How many days in September did you fish for Rockfish?

0 How many days in September did fish for a species not listed here (halibut, sturgeon, sharks etc..)

Please Enter a number, put in a 0 if you did not catch any

In September, how many Ling Cod did you catch?

In September, how many Cabezon did you catch?

In September, how many Rockfish did you catch?

For October 2003

0 How many days in October did you fish for Tuna?

0 How many days in October did you fish for Salmon?

0 How many days in October did you fish for Rockfish?

0 How many days in October did fish for a species not listed here (halibut, sturgeon, sharks etc..)

Please Enter a number, put in a 0 if you did not catch any

In October, how many Ling Cod did you catch?

In October, how many Cabezon did you catch?

In October, how many Rockfish did you catch?

NATIONAL MARINE FISHERIES SERVICE REPORT ON GROUNDFISH MANAGEMENT

Situation: The National Marine Fisheries Service (NMFS) will report on its regulatory activities and developments relevant to groundfish fisheries. Specific items for discussion include an update on 2003 and 2004 regulations, progress on implementation of a Vessel Monitoring System and Amendments 16-1 and 16-2, and other issues of interest to the Council.

Council Task:

1. Discussion.

Reference Materials:

None.

Agenda Order:

a. Regulatory Matters — Bill Robinson
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. Council Discussion

PFMC
10/15/03

Exhibit D.2
Situation Summary
November 2003

MAKAH ROCKFISH ENHANCEMENT PROPOSAL

Situation: The following proposal statement was submitted by the Makah Tribe for consideration at the Council meeting.

> Fewer issues in fisheries management are more divisive than the use of hatcheries. Much of this is due to experience gained from the century long use, and mis-use of hatcheries for Pacific salmon. Given the life-history differences between salmonids and rockfish, and the lessons learned from other species, we propose research to identify risks and benefits that might accrue to depleted rockfish populations from hatchery releases. This research is in response to the extremely long rebuilding times of depleted rockfish species and their historically low abundance levels. Research will seek to identify the risks and benefits associated with hatcheries in four key areas: 1) husbandry and early life history requirements, 2) genetics, 3) ecology, and 4) population dynamics. Each area of research will seek to identify risks, benefits, and develop risk management strategies that maximize benefits. Eventually, a linked decision support model will be developed to guide fishery mangers prior to large-scale releases. To date research has focused on husbandry and resulted in the successful culture of yelloweye, china and brown rockfish in captivity. We are asking the Council to consider including this research as a part of its rockfish rebuilding plan.

The Makah Rockfish Enhancement Proposal will be discussed in detail as one of three issues at a joint meeting of Advisory Bodies Monday, November 3 from 8:30 to noon, Council Members have been encourage to attend. Additionally, the Council entourage, including the public, has been invited to a field-trip presentation at Hubbs Sea World Monday evening beginning at 6 p.m. to see various elements of initial culturing aspects of the proposal. Because of these two events, only a synopsis of the proposal will be presented under this agendum on the Council floor.

Council Task:

1. Consider Providing Comments on Makah Proposal.

Reference Materials:

1. None.

Agenda Order:

a. Agendum Overview	John DeVore
b. Synopsis of Proposal	Steve Joner/Michael Rust/Mark Drawbridge
c. Reports and Comments of Advisory Bodies	
d. Public Comment	
e. **Council Action:** Consider Providing Comments on Makah Proposal	

PFMC
10/21/03

FEASIBILITY OF USING REAL-TIME ELECTRONIC LOGBOOK DATA IN GROUNDFISH FISHERY MANAGEMENT

Situation: Logbook data from West Coast groundfish fisheries has been an important part of fishery management and stock assessment since its inception. Currently, each state administers a logbook program and adjusts the logbook data, in part, by comparison with fishticket information. Processing the hand written logs and compiling the adjusted data is a time consuming process. The Council has expressed concern that management decisions are often based on data series that are dated by a year or more. There is a strong desire to utilize more current information. Bycatch modeling in the limited entry trawl fishery is a recent example of how the existing logbook program can delay the application of new information. The process of updating models used to estimate bycatch and project landings relies on logbook data, including the incorporation of data gathered in the West Coast Groundfish Observer Program. Estimates of retained catch, verification of tow location, and target species catch distribution among depth strata and target fisheries are derived from adjusted logbook data. In the absence of logbook data, less desirable sources such as fishticket data may be substituted. An electronic logbook program has the potential of improving the availability and quality of fishery data and this emerging technology has been recommended as a means of streamlining the flow of data from at-sea collection to the management process

Electronic logbook programs have been successfully implemented by the North Pacific Fishery Management Council and are currently being tested on a small scale on the West Coast by NMFS. A joint session of the Groundfish Advisory Subpanel, the Groundfish Management Team, and other participants is scheduled for Monday, November 3 from 8:30 A.M. until noon. The joint session will cover three topics, including real-time electronic logbooks; during this segment of the joint topic meeting, there will be presentations by organizations familiar with the use and development of electronic logbook programs. Participation in this joint session is strongly encouraged as the electronic logbook presentations will not be repeated during the Council session. However, a brief summary of the joint session on electronic logbooks will be given by Council staff and presenters will be available to answer questions during Council discussions.

The Council is to consider information presented at the joint session and input from the Advisory Bodies and the public and discuss the feasibility of incorporating electronic logbook technology into West Coast groundfish fisheries.

Council Action:

1. Consider feasibility and further steps.

Reference Materials:

None.

Agenda Order:

a. Agendum Overview Mike Burner
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Consider Feasibility and Further Steps

PFMC
10/17/03

Exhibit D.4
Situation Summary
November 2003

OBSERVER DATA FLOW FOR FISHERY YEARS 2004-2006

Situation: While there have been many positive aspects about the new, highly anticipated data from the West Coast Observer Program, there have also been concerns about the orderly use of this new information for active fishery management decision making. At the April Council meeting, despite concern expressed about adequate notice to the public, the Council reviewed and adopted observer-based bycatch rates for overfished species for use in April formulating inseason adjustments to commercial trawl fisheries. At the September Council meeting, observer-based discard rates for trawl non-overfished, target species were presented to the Council. However, in response to concerns about the limited opportunity to fully analyze all implications about the use of this new information, the Council elected to not use this new information for inseason management. Nevertheless, these target species discard rates, as well as the bycatch rates for overfished species that were adopted in April, were incorporated for modeling preliminary trawl management measures for the 2004 annual specifications.

To help gain a higher degree of order and stability in the use of new observer information, the Council requested a presentation, at the November Council Meeting, of a proposed long-term schedule showing when new observer data will be available for decision-making during the first multi-year management cycle. Further, in response to concerns about a proliferation of new information presented at Council meetings, the Council requested an ad hoc committee prepare a report for the March 2004 Council meeting on policy regarding the use of new information from the observer program (and other sources) for fisheries management.

Under this agendum, Dr. Elizabeth Clarke will present current thinking about a proposed schedule of when new observer data will be available for modeling and management decision making over the next several Council meetings (Exhibit D.4.b, NMFS Report).

The Council should consider the timing of new data releases from the observer program in synchrony with inseason fisheries management in 2004, the preseason 2005-2006 multi-year management schedule, and the expected 2007-2008 management schedule. (Exhibit D.8, Supplemental Attachment 3, shows a draft preseason multi-year management schedule and process.)

Council Task:

1. Review proposed schedule of new information from the Groundfish Observer Program and provide guidance regarding implementation for multi-year management.

Reference Materials:

1. Exhibit D.4.b, NMFS Report: Proposed Observer Data Flow for Fishery Years 2004-2006.
2. Exhibit D.8, Supplemental Attachment 3: Proposed Preseason Management Schedule for Setting 2005-2006 Groundfish Fishery Specifications and Management Measures.

Agenda Order:

a. Agendum Overview — Jim Seger
b. NMFS Report — Elizabeth Clarke
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. Council Discussion: Provide Guidance for Integrating New Data into the Management Process

PFMC
10/22/03

Proposed Observer Data Flow For Fishery Years 2004-2006
Northwest Fisheries Science Center
October 2003

The Northwest Fisheries Science Center (NWFSC) is currently in the process of reconciling observer data from the period September 2002 through August 2003 with fishticket data. This will be followed by a period of data and model review that will be initiated in November and will likely continue through February. This review will include possible revisions to the existing trawl bycatch model--including the stratification used for incorporating bycatch data into the model–and also the development of a new model for evaluating bycatch and discard in the limited-entry primary fixed-gear sablefish fishery.

A report summarizing the second year of observer data will be made available by the end of January, 2004. This will be followed, in February, by presentations to the Groundfish Management Team that provide 1) an overview of bycatch ratios from the first and second years of the program, utilizing the same stratification as the Fall 2003 model, and 2) an overview of developments in modeling the fixed-gear sablefish fishery.

At the March Council meeting, the Scientific and Statistical Committee (SSC) will be briefed on changes to the trawl model, and on changes in bycatch ratios that result from pooling the first two years of observer data. Preliminary recommendations and analysis for stratification of trawl bycatch ratios would also be presented. The SSC would also be presented with recommendations for estimating sablefish discard within the LE fixed-gear fishery, for purposes of finalizing 2004 tier-limit recommendations at the March meeting.

At the April Council meeting, final recommendations for data stratification and modeling that will be used in evaluating 2005-06 management measures will be presented to the SSC. These recommendations will underlie preliminary analysis of 2005-06 management measures that will be presented to the GMT and the Groundfish Advisory Panel by staff from the NWFSC and the NW Region. The SSC may also elect to consider whether to recommend use of the updated data and model in managing the 2004 trawl fishery.

Based on feedback from the SSC, the model may be revised further before it is used in developing the NEPA analysis of management measures for 2005-06 during April and May. At its June meeting, the Council and advisory bodies would be presented with a final analysis of 2005-06 measures, based on the updated model.

The process of de-briefing observer data for the 12-month period ending in August, 2004, will commence in September, with evaluation of data and models continuing into early 2005. If sufficient data are available, development of a model for estimating bycatch and discard in the open-access fisheries may be feasible by the spring of 2005. If it is not, this task will be a very high priority for completion by March, 2006, for inclusion in the analysis of management options for the 2007-08 fishery.

The remaining schedule for 2005, will be similar to 2004, except that biennial specifications will not be addressed. The schedule during 2006 will be very similar to that outlined for 2004. However, it is expected that by that time, modeling changes will focus more on routine updating of data sources than on structural issues.

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How Many Eyes Do We Need on the Ocean?
Oceana Releases New Science for Fishery Observer Programs

Our nation's fisheries are in trouble. Many of our most valuable commercial fisheries are facing hardships, endangered species are in peril, and the fish we like to eat are becoming increasingly scarce. "Dirty-Fishing" – the catch and discard of unwanted marine life -- is depleting America's fish populations and unnecessarily killing endangered and threatened species. A major contributing factor to these declines is the U.S. government's failure to collect the information it needs to make fisheries sustainable.

The Solution: Fishery Observers

One of the best ways to collect important information is to put observers on fishing boats. Fishery observers are independent scientists who collect important information about fishing practices by accompanying fishermen at sea. Because fishermen do not bring everything they catch back to port, observers are the best way to sufficiently estimate how much marine life is caught and discarded at sea.

A "How-To" Guide for Fishery Observer Programs

An innovative new study* published by Oceana in November 2003 shows fishery managers how to design and run effective observer programs. The study was authored by premier fishery assessment scientists Elizabeth Babcock and Ellen Pikitch, formerly of the Wildlife Conservation Society and now with the Pew Institute for Ocean Science, along with Charlotte Gray Hudson, a marine wildlife scientist at Oceana.

A critical issue for managers is determining how to produce reliable and accurate results from observer programs in many different fisheries, each with unique characteristics. Another important issue is how fishery observer programs can account for the bias created by a change in behavior by fishermen when observers are present. This study provides specific guidelines of how to address these challenges.

- MORE -

The study also provides recommendations of how to determine how much observer coverage is needed to suitably estimate the catch and discard of unwanted fish, marine mammals, sea turtles, and other ocean wildlife. Generally, if a particular species is routinely caught in a fishery, lower observer coverage levels are needed than if the species is rarely caught. The report determined that to initially construct a good observer program, at least 50 percent coverage is needed where the catch of rare species is a concern, and there should be at least 20 percent coverage where the catch is of more common species.

* Babcock, Elizabeth,. Pikitch, Ellen,. & Charlotte Hudson, 2003. "How much observer coverage is enough to adequately estimate bycatch?" Oceana, Washington, DC.

For more information, including a full copy of the report, visit http://www.oceana.org/dirtyfishing_press

Oceana is a non-profit international advocacy organization dedicated to restoring and protecting the world's oceans through policy advocacy, science, law and public education. Founded in 2001, Oceana's constituency includes members and activists from more than 150 countries and territories who are committed to saving the world's marine environment. Oceana, headquartered in Washington, D.C., has additional offices in key U.S. coastal areas, a South American office in Santiago, Chile, and a European office in Madrid, Spain. For more information, please visit www.Oceana.org or call 202-833-3900.

10/29/03

HOW MANY EYES DO WE NEED ON THE OCEAN?

GUIDELINES FOR FISHERY OBSERVER PROGRAMS

Our nation's fisheries are in trouble. Many of our most valuable commercial fisheries are facing hardships, endangered species are in peril, and the fish we like to eat are becoming more scarce.

Why?
Poor management is one reason. A major contributing factor is the failure of the U.S. government to collect the information it needs to make fisheries sustainable. Because much of the marine life killed in the course of fishing each year is not counted, the real amount of marine life killed is usually greater than the official estimates, and fish populations can collapse.

The result?
Fewer fish in the ocean and the fish market, and less money in fishermen's pockets.

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DISCARDED CATCH: THE UNNECESSARY WASTE OF MARINE LIFE

We particularly lack information on the marine life that is incidentally caught during fishing and is thrown back, either dead or dying, because it is a protected species, or because fishermen do not want it or are not allowed to keep it. Examples may include whales, sea turtles, birds and other protected species, as well as undersized fish that are not marketable or are prohibited through regulations. Laws require the federal government to count, cap, and control this unnecessary waste, which results from dirty fishing practices. To comply with these requirements, managers must account for all marine life caught at sea.

OBSERVERS: GATHERING IMPORTANT SCIENTIFIC INFORMATION

One of the best ways to collect information is to put observers on fishing boats. Fishery observers are scientists who collect important information about fishing practices by accompanying fishermen at sea. Observers don't work for the fishermen on a vessel—their only job is to count and classify the fish and other marine life that are caught. Their job can include weighing or measuring fish, identifying birds or mammals, or sampling what comes on board. Because fishermen do not bring everything they catch back to port, observers are the best way to adequately estimate how much marine life is caught and discarded at sea.

WHAT MAKES A GOOD OBSERVER PROGRAM?

In an ideal world, the entire catch of every fishing boat would be accurately recorded. Unfortunately, that's not possible for many fisheries. When boats do not carry observers, scientists need to estimate what those boats caught, based on the catch of the boats that did carry observers--a method referred to as extrapolation. For the information to be useful for managers, the design of the observer program must ensure that the extrapolated estimates of catch are both accurate and precise.

Precision and Accuracy

Precise, but inaccurate

Accurate, but not precise

Precise and Accurate

Accuracy and precision are statistical measures of how close estimated numbers are to the real number. If we have several estimates of total bycatch, accuracy measures how close the average of the estimates is to the actual total bycatch, while precision gauges how close the estimates are to each other. For example, picture a group of arrows hitting a target; accurate estimates may be distributed all over the target, but would be centered around the bulls-eye. Precise estimates are a group of arrows clustered closely together, wherever they are on the target. An ideal estimate is both precise and accurate (all the arrows close together, centered on the bulls-eye). Fishery managers must account for both accuracy and precision to ensure that their estimates are close enough to the real values to be useful.

Larger numbers of observations usually result in more precise estimates. Determining how precise an estimate needs to be for a specific fishery depends on many different aspects of the fishery. For example, if a species is extremely unlikely to be caught, as may be the case for rare or endangered sea turtles or marine mammals which already are few in number, many more vessels will need to carry observers to properly estimate the bycatch.

What Causes Bias and How Can It Be Reduced?

Scientists try to obtain accurate estimates of fisheries information--such as how many turtles are caught by a specific fishery each year--without bias, so that the extrapolated number is close to the true value. If estimates of fish discards, for example, are biased low, more fish are being killed than managers believe, and the fish populations could be at risk from too much fishing. On the other hand, if estimates are biased high, the fishing industry may be unnecessarily restrained from catching fish. "Observer effect" bias can be a problem any time observed fishing trips are not typical or representative of the fishery.

For example:

- Fishing boats that carry an observer may fish in different places or target different species to avoid unwanted species when an observer is present. They may keep fish that they otherwise would have thrown overboard or operate their gear differently.

- Where participation in an observer program is voluntary, bias can result if the volunteers fish differently from those who do not volunteer. If, for example, the volunteers fish more cleanly, discard estimates for the whole fishery would be biased low, because the trips with higher discard rates wouldn't be represented.

- Observed fishing trips may not be representative for logistical reasons. Observers may only be accommodated on boats over a certain size, certain ports may be harder to reach, or it may be harder to find observers for enough trips in the winter.

- Finally, bias can result simply because too few fishing trips are observed, leading to underestimates of discards for purely statistical reasons.

- Fishery managers often assume that the observer data are unbiased, even when the observers are being placed on vessels that have volunteered to carry observers (presumably not the boats that fish dirty). To get unbiased data, scientists should compare the landings from boats with observers to landings from boats without observers to see whether vessels with observers fish differently. If the observer data are biased, the most effective solution is simply to increase the number of fishing trips that are observed, while ensuring that the fishery is sampled randomly.

HOW MUCH OBSERVER COVERAGE IS NEEDED FOR PRECISE ESTIMATES OF DISCARDS?

Generally, if fisheries routinely catch and discard a species, lower observer coverage levels are needed than if the species is rarely caught. For example, in simulated fisheries that differed only in the rarity of the bycatch species, the observer coverage needed to adequately estimate total discards was 17 percent for commonly caught species and 50 percent for rarely caught species. Species that are "clumped" instead of being evenly distributed across the ocean also require higher levels of coverage. Finally, fisheries with many gear types and fishing methods require higher levels of coverage. Bias may also be introduced if some areas, gear and seasons of a fishery are not well sampled. For these reasons, the exact level of coverage required for a particular fishery would depend on the distribution of the fishery, and the discard and catch species.

Two Fishery Case Studies

Two specific fisheries were examined to show how adequate observer coverage levels can be determined.

The first example modeled the Pacific groundfish bottom trawl fishery. In this fishery, fishermen sometimes keep and sometimes discard some species of fish that routinely appear in their catches. Catches were simulated of two common species in this fishery -- Dover sole and sablefish, which are commonly found in deep-water catches, even when untargeted. The results indicated that approximately 30 to 40 percent of the fishing effort needed to be observed to achieve adequate estimates of total catches of these common species.

The second example modeled the Atlantic coastal gillnet fishery, which occasionally entangles and drowns bottlenose dolphins. This fishery is a good example of one where a species is caught very infrequently, but every instance is significant because the species is protected under U.S. law. This simulation indicated that more than 50 percent of fishing trips should be observed to achieve adequate estimates.

Although the simulations are a simplification, the results clearly indicate that the fisheries needed substantially higher observer coverage than is currently allocated to provide precise and accurate estimates of catch.

GUIDELINES AND RECOMMENDATIONS FOR OBSERVER PROGRAMS

This report outlines steps that fishery managers can take to develop an effective observer program. The analyses suggest that certain guidelines be followed when setting up observer programs.

Each observer program should:

- Simulate observer samples from actual data to find coverage levels that estimate discards with an appropriate level of precision for assessment and management. Unless managers can show that the lower levels of coverage give sufficient precision and accuracy, from our simulated data applications, we suggest that if the bycatch species is rare, observer programs should adopt coverage levels of at least 50 percent, and if the bycatch species is common, observer programs should adopt coverage levels of at least 20 percent.

- Compare landings and other characteristics of observed and non-observed trips to determine whether there is evidence of observer effect bias. If bias exists, the sampling design must either improve randomization or increase sample size, or both.

- Determine the level of precision required for discard estimates by examining how the data will be used in scientific assessment of the status of bycatch species, and in fishery management.

- Sample the fishery randomly or systematically and cover all components of the fishery, allocating observer coverage levels high enough to adequately sample all gears, areas and seasons of the fishery.

The information provided in this document is based on a study by Babcock, Elizabeth,. Pikitch, Ellen,. & Charlotte Hudson, 2003. "How much observer coverage is enough to adequately estimate bycatch?" Oceana, Washington, DC.

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We Need More Eyes on the Ocean: Congress Proposes Additional Funding for Fishery Observer Programs

Fishery observer programs are the critical first step in developing scientifically-based management plans for America's fisheries. The data they provide is essential to manage valuable fish stocks, rebuild vulnerable populations and avert fisheries collapse – yet there are only about 20 observer programs that provide coverage in very few of the approximately 300 federally-managed fisheries. Additional funding is needed to improve and expand these programs.

What are Fishery Observers?

Fishery observers are independent scientists who work alongside fishermen at sea. Observers collect important information about what is actually caught, as compared to landings data, which only records what is brought to port. Observers are critical in addressing bycatch or what fishermen often call "dirty-fishing." Dirty-fishing includes the catch and subsequent destruction of unwanted fish and marine life – fish that are the wrong type, size, sex, or quality as well as marine mammals, sea turtles, and seabirds.

The Need for Increased Federal Funding for Fishery Observer Programs

Unpublished agency estimates of the costs to fully fund a national observer program for fisheries of highest concern range from $50 to $100 million annually. Since the mid-1990s there has been a slight increase in federal funding for fishery observer programs, with support from both political parties. While this represents some progress, increased investment is still critically needed.

Proposed New Federal Funding for Fishery Observers

Both Congress and the Bush Administration have proposed funding increases for fishery observer programs in the National Marine Fisheries Service (NMFS) FY04 budget. NMFS is the federal agency responsible for the management of marine fisheries in U.S. waters.

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The following table highlights the current and proposed funding for observer programs

Program	**FY 03 Enacted**	**FY 04 Bush Request**	**FY 04 Senate Committee**	**FY 04 House Floor**
National observer program	$745,125	$7.0 million	$0	$3.944 million
Atlantic Coast	$3.328 million	$3.35 million	$3.35 million	$3.328 million
East Coast	$347,725	$350,000	$350,000	$400,000
Hawaii Longline	$2.908 million	$3.0 million	$4.0 million	$2.981 million
New England Groundfish	--	--	$7.5 million	see report language*
North Pacific Marine Resources	$1.863 million	$1.875 million	$1.875 million	$1.875 million
North Pacific	$794,800	$650,000	$800,000	$650,000
West Coast	$3.706 million	$3.730 million	$5.0 million	$3.85 million
Total	**$13.765 million**	**$22.955 million**	**$22.875 million**	**$17.028 million**

*No specific line item. However, Report language says, "The Committee is concerned that NMFS has not provided adequate observer coverage for the New England groundfish fishery and recommends $17,028,000, which is $3,262,000 above current year, for fishery observers. The Committee expects NMFS to allocate sufficient funds to achieve 10 percent observer coverage in the directed fishery, and the non-directed fishery to the extent practicable, by no later than May 1, 2004.

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10/29/03

STATUS OF GROUNDFISH FISHERIES AND INSEASON ADJUSTMENTS

Situation: In the current groundfish management program, the Council sets annual harvest targets (optimum yield [OY] levels) and various management measures, with the understanding these management measures will likely need to be adjusted periodically through the year in order to attain, but not exceed, the OYs.

The Groundfish Management Team (GMT) will present information on the status of ongoing fisheries, and any need for adjustments in typical management measures, such as trip limits and seasons. It is not expected that there will be new information from the West Coast Groundfish Observer Program (WCGOP) for use in inseason management decision making for the remainder of the 2003 season.

The Council is to consider advice from Advisory Bodies and the public on the status of ongoing fisheries and recommended inseason adjustments and adopt changes as necessary.

Council Action:

1. **Consider information on the status of ongoing fisheries.**
2. **Consider and adopt inseason adjustments as necessary.**

Reference Materials:

None.

Agenda Order:

a. Agendum Overview — Mike Burner
b. GMT Report — Michele Robinson
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action:** Consider and Adopt Inseason Adjustments as needed.

PFMC
10/15/03

Exhibit D.5.b
Supplemental GMT Report
November 2003

GROUNDFISH MANAGEMENT TEAM REPORT ON STATUS OF GROUNDFISH FISHERIES AND INSEASON ADJUSTMENTS

The Groundfish Management Team (GMT) discussed the status of groundfish fisheries for 2003. The Recreational Fishery Information Network (RecFIN) effort and average weight estimates for California recreational fisheries for Wave 4 (July-August), were considerably higher than anticipated. This results in catch estimates for canary rockfish and lingcod that are significantly higher than the catches projected in the bycatch scorecard. Estimated landings of shallow and deeper nearshore rockfish species categories were also higher than expected. Catch estimates through Wave 5 (in mt), produced from RecFIN estimates through Wave 4 plus projections for Wave 5 using recent fishery data, for these species are:

Canary Rockfish - 15.3 mt (14 mt through Wave 4)
Lingcod - 667.2 mt (509 mt through Wave 4)

Combining these California recreational catch estimates with the estimated catches in other recreational and commercial fisheries coastwide produces a total mortality estimate for canary rockfish of 52 mt (compared to a 44 mt optimum yield [OY]) and a total mortality estimate for lingcod of 956.4 mt, which exceeds the lingcod acceptable biological catch (ABC) of 841 mt. The California state harvest guidelines for shallow and deeper nearshore rockfish are also exceeded.

The GMT received a presentation from the Recreational Fishing Alliance (RFA) on California recreational fishery catch estimates. There was not sufficient data for the GMT to evaluate whether the methodology was sound; however, the catch and effort results presented were questionably low. The dataset and analysis was not complete enough to be considered for inseason action, and the GMT encourages RFA to work with California Department of Fish and Game (CDFG) to further develop and ground-truth this methodology.

The GMT also reviewed catch estimates from CDFG using different methodologies (which are detailed in Attachment 1), including stratifying the California data north and south of 40°10' and applying the effort and catch per unit effort (CPUE) estimates to those respective areas. This produced a slightly lower catch estimate of canary rockfish of 10.3 mt through Wave 4 (11.6 mt through Wave 5) for a total coastwide canary rockfish estimate of 48.3 mt; the lingcod estimate was reduced to 639 mt for California recreational, for a coastwide lingcod catch estimate of 928.2 mt.

Another CDFG strategy was reviewed, treating the Wave 4 effort estimate as an anomaly and applying a historical effort estimate. This produced a canary rockfish estimate of 11 mt and a lingcod estimate of 532 mt; resulting in a total catch estimate for lingcod of 821.2 mt which exceeds the lingcod OY, but would be 20 mt less than the ABC.
Based on this information, the GMT has identified two alternatives for inseason action for the Council to consider:

Option 1 - Inseason action that results in near-zero impacts to lingcod and canary rockfish

Under this option, the following inseason adjustments would apply:

Commercial Coastwide

- Change the trawl Rockfish Conservation Area (RCA) to extend from the shoreline to 200 fms and not accommodate petrale areas.

  The current trawl RCAs are:
  North of 40°10' - Extends from 50 fms to 200 fms
  Between 40°10' and 34°27' - Extends from 60 fms to 200 fms
  South of 34°27' - Extends from 100 fms to 200 fms

- Change the non-trawl RCA to extend from the shoreline to 200 fms

  The current non-trawl RCAs are:
  North of 46°16' - Extends from the shoreline to 100 fms
  Between 46°16' and 40°10' - Extends from 27 fms to 100 fms
  Between 40°10' and 34°27' - Extends from 20 fms to 150 fms
  South of 34°27' - Extends from 30 fms to 150 fms

California Selective Flatfish Trawl Exempted Fishing Permit (EFP)

- Close the California Selective Flatfish EFP, which is currently scheduled through November (Note: A request has been made to extend this EFP through December, but the extension has not yet been approved by NMFS.)

Recreational Coastwide

- Close recreational ocean and shore-based fisheries for Council-managed groundfish (currently open: Washington bottomfish fishery; Oregon bottomfish and lingcod fisheries; California bottomfish and lingcod fisheries)

Option 2 - Inseason action that results in minimal impacts, particularly to lingcod
In reviewing the depth closures available for inseason consideration, the coordinates for a 150-fm line north of 46°16' (Washington/Oregon border) were not specified in the final published rule and have not been publicly reviewed; however, coordinates for 150-fm line south of 46°16' were included. As a result, under this option, the following inseason adjustments would apply:

Commercial

Between U.S./Canada border and 46°16'

- Change the trawl RCA to extend from the shoreline to 200 fms and accommodate petrale areas

- Use the coordinates for the trawl RCA for the non-trawl RCA

South of 40°10'

- Change the trawl RCA to extend from the shoreline to 200 fms and accommodate petrale areas

- Change the non-trawl RCA to extend from the shoreline to 150 fms

Recreational Coastwide

- Close recreational ocean and shore-based fisheries for Council-managed groundfish (currently open: Washington bottomfish fishery; Oregon bottomfish and lingcod fisheries; California lingcod and bottomfish fisheries)

The GMT believes that these trawl measures would result in minimal impacts to lingcod because the NMFS Triennial Trawl Survey data through 1994 suggests that about 99% of the lingcod are caught in depths ≤150 fms north of 40°10', and lingcod tend to move to shallower depths (~ 100 fms) during the winter months coastwide. Using the NMFS observer data (~ 200 hauls), the GMT estimates that the lingcod impacts resulting from accommodating the trawl petrale areas is about 1 mt total catch (total mortality is expected to be less than this). The estimated impacts from the California Selective Flatfish EFP, if extended through December, would be about 0.4 mt of lingcod and < 0.2 mt of canary. The GMT cannot quantify what the total impacts of other fisheries would be on lingcod and canary if they remained open (e.g., recreational fisheries).

(Note: Under both options, the RCA changes would only apply to those fisheries currently subject to the RCA closures.)

Trip Limits

With regard to shortspine thornyhead, the GMT notes that the landings in the quota species monitoring (QSM) through mid-October are less than the range of projections through Period 5 that the GMT presented in September. However, the GMT recommends keeping the current trip limit of 900 lbs/two month in place for shortspine in Period 6 as a precautionary measure, particularly if inseason action is taken to close shelf fisheries.

Regarding differential trawl trip limits for small and large footrope, the GMT recommends the removal of differential limits for Period 6 if inseason action is taken to close nearshore and shelf fisheries. Under either of the options presented above, the GMT recommends keeping the current large footrope trip limits in place, which would apply seaward of the RCA regardless of gear type used (i.e., could use either small or large footrope).

B Platoon Depth Closures

The GMT defers to the GAP on when the changes to the depth closures would apply to the trawl B Platoon for the remainder of the year.

PFMC
11/05/03

Attachment 1

CDFG Technical Report

It is apparent that the RecFIN wave 4 recreational catch estimates for California nearshore rockfish, canary rockfish and lingcod were significantly higher than expected. This may be due in part to the unusual groundfish restrictions for 2003, which kept the recreational groundfish fishery closed for the first six months south of 40^0 10'. However, the magnitude of the catch and its variation from the norm warranted further evaluation. Several components of the RecFIN catch estimation inputs were above average during wave 4. For example, mean fish weights and most catch rates were higher than average (table 1), with the notable exception of canary rockfish catch rates.

Beyond the elevated catch rates and average weights, the principle reason the wave 4 catch estimate was exceptionally high was due to unusually high estimates of effort (angler days) for the private and rental boat mode in the area north of Point Conception. The wave 4 effort was estimated at 502.8 thousand angler days (table 2) which is 3 standard deviations above the long-term mean effort from 1980-2003 and is 50 percent greater than the next highest effort estimate reported for those years. There is considerable concern that this estimate may qualify as an outlier. If the next highest estimate of effort in the recorded history of the fishery (in 1985) were used to replace the current wave 4 estimate, the private and rental boat effort estimate north of Point Conception would be reduced by 33%. If this adjustment is applied to the wave 4 catch calculations, the total statewide California recreational catch estimates through wave 5 are lower (table 3), although coastwide total catch estimates for canary rockfish and lingcod still exceed the OYs.

Table 1 - Descriptive Statistics - Catch Rates

MRFSS Wave 4: 1980 - 2003

	Canary		Deeper NS		Lingcod		Shallow NS	
	CPFV	*Private*	*CPFV*	*Private*	*CPFV*	*Private*	*CPFV*	*Private*
Sample Variance	0.02	0.01	1.65	0.24	0.01	0.00	0.11	0.01
Range	0.46	0.23	5.82	2.13	0.34	0.19	0.98	0.40
Minimum	0.00	0.01	0.14	0.32	0.00	0.04	0.01	0.01
Maximum	0.47	0.24	5.96	2.45	0.34	0.23	0.98	0.42
Count	20.00	21.00	21.00	21.00	21.00	21.00	20.00	21.00
Confidence Level(95.0%)	0.07	0.03	0.59	0.22	0.05	0.02	0.16	0.04
2003 Value	0.01	0.03	3.30	1.43	**0.34**	**0.23**	**0.98**	0.25
Mean	0.22	0.10	2.24	0.96	**0.12**	**0.11**	**0.30**	0.17
Standard Deviation	0.16	0.07	1.29	0.49	**0.10**	**0.05**	**0.33**	0.09

Table 2 - Descriptive Statistics - Total Angler-Trips

MRFSS Private and Rental Vessels Wave 4: 1980 - 2003

	Southern Area	Northern Area	Both Areas
Sample Variance	30214.3	7009.5	45333.3
Range	810.8	394.0	1011.4
Minimum	183.3	108.8	292.1
Maximum	994.2	502.8	1303.5
Count	21.0	21.0	21.0
Confidence Level(95.0%)	79.1	38.1	96.9
2003 Values	400.8	**502.8**	903.6
Mean Value	457.5	**253.2**	710.8
Standard Deviation	173.8	**83.7**	212.9

Table 3. California's Estimated Recreational Catch (wt. in MT) for 2003

A. Unadjusted RecFIN

Area of California	Group	Wave 1-3[1]	Wave 4[1]	Wave 5[2]	Wave 6[3]	Wave 1-5	Wave 1-6	OY[6]
Cape Mendocino south to Mexican border	Shallow NS RF	2.3	86.2	48.2	18.6	136.7	155.3	66.1
	Deeper NS RF	21.6	378.0	43.3	37.0	442.8	479.8	303.1
	CA Scorpionfish	9.3	18.5	33.5	23.1	61.3	84.4	63.9
Cape Mendocino north to Oregon border	Shallow NS RF	0	2	0.4	0.3	2.4	2.7	
	Deeper NS RF	49.6	370.0	8.5	1.8	428.1	429.9	
Total Statewide	Shallow NS RF	2.3	88.2	48.6	18.9	139.1	158.0	
	Deeper NS RF	71.2	748.0	51.7	38.8	870.9	909.7	
	CA Scorpionfish	9.3	18.5	33.5	23.1	61.3	84.4	
	Lingcod	37.5	509.0	120.7	59.2	667.2	726.4	651.0
	Canary	0.4	14.0	0.8	0.4	15.3	15.7	42.0

B. Stratified Northern California

Area of California	Group	Wave 1-3[1]	Wave 4[4]	Wave 5[2]	Wave 6[3]	Wave 1-5	Wave 1-6	OY[6]
Cape Mendocino south to Mexican border	Shallow NS RF	2.3	91.6	48.2	18.6	142.2	160.7	66.1
	Deeper NS RF	21.6	281.8	43.3	37.0	346.6	383.6	303.1
	CA Scorpionfish	9.3	18.5	33.5	23.1	61.3	84.4	63.9
	Lingcod	30.5	244.1	72.0	50.4	346.6	397.0	
	Canary	0.4	2.2	0.8	0.4	3.4	3.8	
Cape Mendocino north to Oregon border	Shallow NS RF	0	1.4	0.4	0.3	1.8	2.1	
	Deeper NS RF	49.6	394.0	8.5	1.8	452.1	453.9	
	CA Scorpionfish	0	0.0	0	0	0.0	0.0	
	Lingcod	7.0	237.1	48.7	8.8	292.8	301.6	
	Canary	0.0	8.1	0.1	0.0	8.2	8.2	
Total Statewide	Shallow NS RF	2.3	93.0	48.6	18.9	144.0	162.8	
	Deeper NS RF	71.2	675.8	51.7	38.8	798.7	837.5	
	CA Scorpionfish	9.3	18.5	33.5	23.1	61.3	84.4	
	Lingcod	37.5	481.2	120.7	59.2	639.4	698.6	651.0
	Canary	0.4	10.3	0.8	0.4	11.5	11.9	42.0

C. Adjusted MRFSS Effort Estimate for Wave 4

Area of California	Group	Wave 1-3[1]	Wave 4[5]	Wave 5[2]	Wave 6[3]	Wave 1-5	Wave 1-6	OY
Total Statewide	Lingcod	37.5	373.4	120.7	59.2	531.6	590.8	651.0
	Canary	0.4	9.7	0.8	0.4	11.0	11.4	42.0

1. MRFSS estimated landings divided into areas north and south of Cape Mendocino using same methodology as used for generating Optimum Yields. 2. Landings estimated using MRFSS sample information for this wave and the average of 1999-2002 angler trips for this wave. 3. Landings were derived by averaging the 1993-2002 MRFSS estimated landings for this wave. 4. MRFSS catch rates from this wave for areas north and south of Cape Mendocino were applied to estimates of total effort for same areas. 5. Private rental catch component of the MRFSS estimate for Wave 4 reduced 33% (difference between the 2003 Wave 4 total effort estimate and the next highest MRFSS Wave 4 total effort estimate). 6. OYs for lingcod and canary are coastwide (Washington south through California).

ENFORCEMENT CONSULTANTS REPORT ON STATUS OF GROUNDFISH FISHERIES AND INSEASON ADJUSTMENTS

The Enforcement Consultants (EC) is concerned that the level of compliance in the recreational groundfish fishery has resulted in the harvest of fish that may not have been considered. We, therefore, urge a precautionary stance in making inseason adjustments for lingcod or other groundfish species. The EC would like to offer an example of a contact-to-violation ratio related to the recreational groundfish fishery for the Council to evaluate in order to determine whether or not this concern is substantial enough to warrant adjustments to recreational catch estimates in the future. Therefore, the EC requests an agenda item be identified under which this report may be provided at the March 2004 meeting.

PFMC
11/05/03

Status and Future Prospects for the Cabezon (*Scorpaenichthys marmoratus*) as Assessed in 2003

by

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Table of Contents

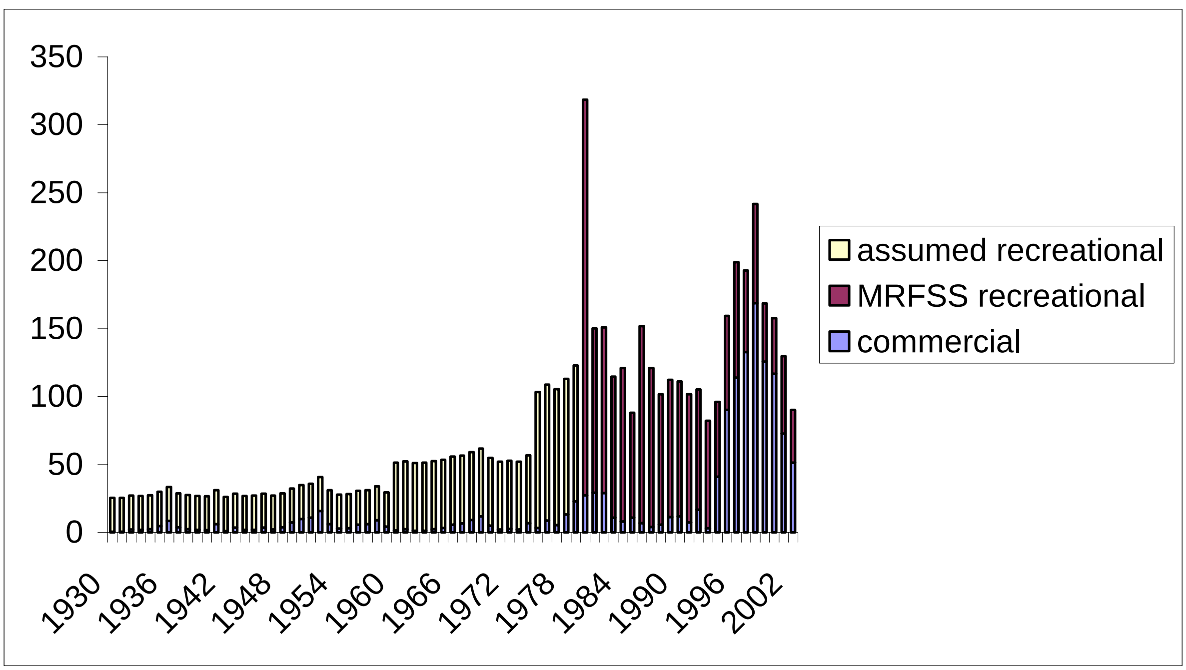
Executive Summary

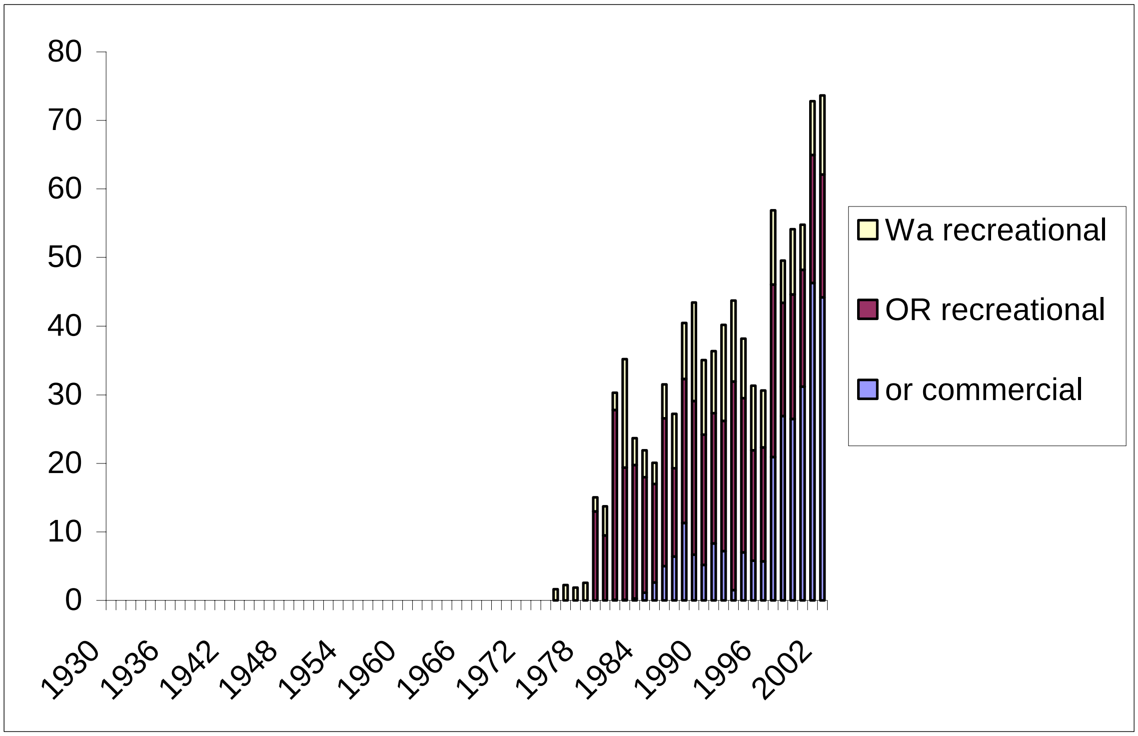
Stock

This is the first assessment pertaining to the status of cabezon (*Scorpaenichthys marmoratus*) on the west coast of the United States. Two stocks (north and south) were delineated for the purposes of this assessment at the Oregon-California border. This distinction was based on differences in the catch history, CPUE trends and biological parameters (mainly growth) between the two areas.

Catches

Cabezon removals were attributed to two fleets (commercial and recreational), but no distinctions among the gears employed were made. California recreational catch data were available from 1980 to 2002 and has historically been the predominant source of removals. California commercial catches were available from 1930 to 2002, but has become a major source of removals only in the last 10 years. Catches were assumed to increase over the years 1930 to 1979 because of the historically important contribution of recreational catch to the cabezon fishery. The sensitivity of the assessment results to the magnitude of this pre-1980 recreational catch was explored as part of the assessment. Catches by the Oregon commercial (1975-2002) and recreational (1975 to 2002) fisheries and Washington recreational fishery (1975 to 2002) were also available. Discard mortality was assumed to be negligible because cabezon can generally survive catch and release in the commercial nearshore fishery and cabezon have not been commonly sighted in the West Coast Observer Program.





Catch histories for California (top graph) and Oregon/Washington (bottom graph)

Year	California Commercial	California Recreational	Oregon Commercial	Oregon Recreational	Washington Recreational	California total	Ore/Wash total
1993	3	79	2	30	12	82	44
1994	41	55	7	23	9	96	38
1995	90	69	6	16	9	159	31
1996	114	85	6	17	8	199	31
1997	133	60	21	25	11	193	57
1998	169	73	27	16	6	242	50
1999	126	43	27	18	10	169	54
2000	117	41	31	17	7	158	55
2001	73	57	46	19	8	130	73
2002	51	39	44	18	12	90	74

Data and assessment

Seven potential indices of abundance (8 if the two CPFV indices are considered to be separate) were considered in this assessment: (1) California Logbook and Observer CPFV CPUE, (2) California RecFIN CPUE, (3) CalCOFI larval (southern population spawning) index, (4) Southern California Power Plant impingement (recruitment) index, (5) Oregon Recreational CPUE, (6) Washington Recreational CPUE, and (7) Alaska Fishery Science Center larval (northern population spawning) index. Each index was developed by fitting models to the proportion of non-zero records and the catch-rate (or whatever quantity is being measured) given that the catch was non-zero, and taking the product of the resultant estimates (delta method). In addition, catch length-composition data from each of the fisheries in both populations were available. This assessment is focused on the southern population (California) because it was determined that information for the northern stock was insufficient for population evaluation. For the southern stock, all indices (except the CPFV observer and CalCOFI larval index) and the length-composition data were included to fit an age- and sex-structured population dynamics model. The model uses maximum likelihood to estimate model parameters within the AD Model Builder ® (ADMB) non-linear minimization environment. Bayesian analyses using Markov Chain Monte Carlo methods were used to explore uncertainty in model outputs. An independent Stock Synthesis Model (Methot 2000) was constructed to verify the results obtained using the ADMB model.

Unresolved problems and major uncertainties

Several sources of uncertainty in the assessment were recognized and explored using sensitivity analyses. The inclusion and exclusion of indices proved to make little difference to the model outputs, although the reliability of each index is uncertain. Major uncertainties lie in the estimation of natural mortality (*M*) for each sex, the extent of variation in recruitment (σ_R^2), stock-recruitment parameters such as steepness (*h*), the correct number of years for which recruitment residuals are estimated, the size of the historical recreational catch, the effective sample size assigned to the catch length composition data, the length–at-age CVs, and the shape of the selectivity curve (asymptotic or domed). Additional uncertainty lies in the magnitude of the variability in the catchability coefficient and thus the extent of variation around each estimated abundance index value. For the northern stock (Oregon-Washington), the lack of informative data about changes in population abundance resulted in the STAT team abandoning formal modeling of that population.

Reference points

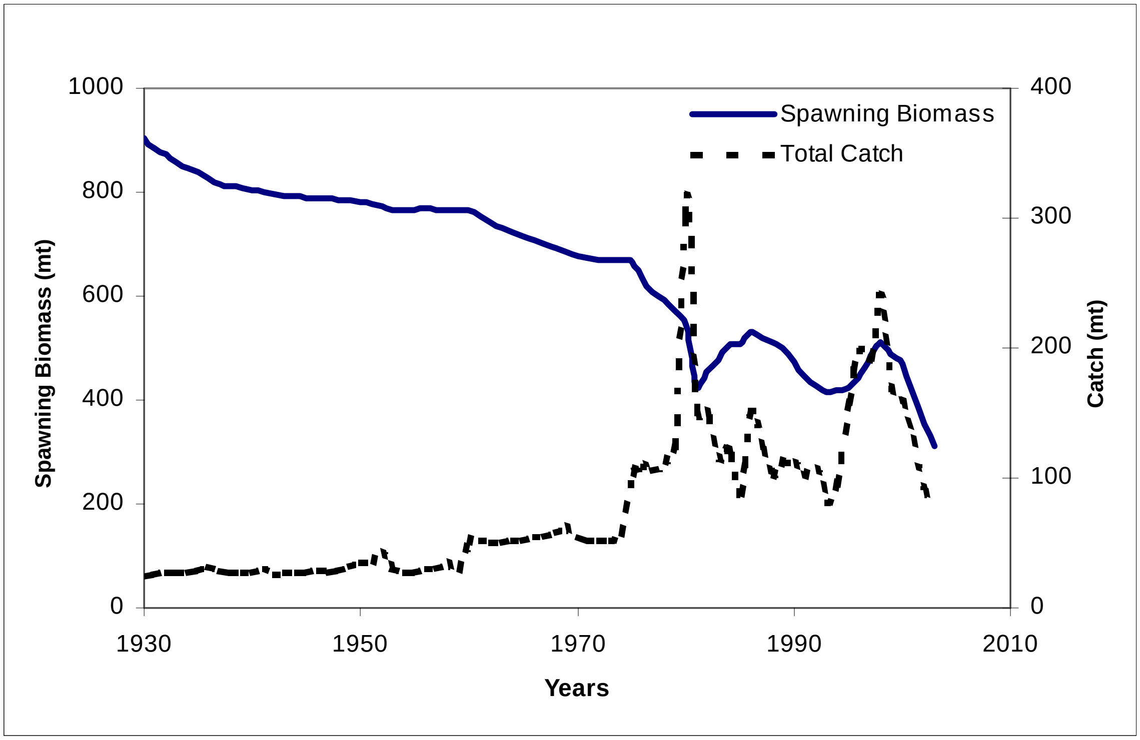
The current reproductive output of cabezon off the state of California is 34.7% of its unfished level. This is above the overfished threshold of 25%, but below the target of 40%. The median value of depletion from the posterior distribution however is above 40%. The target harvest rate is $F_{45\%}$=0.239. The state of California target harvest rate is $F_{50\%}$=0.197.

Stock biomass

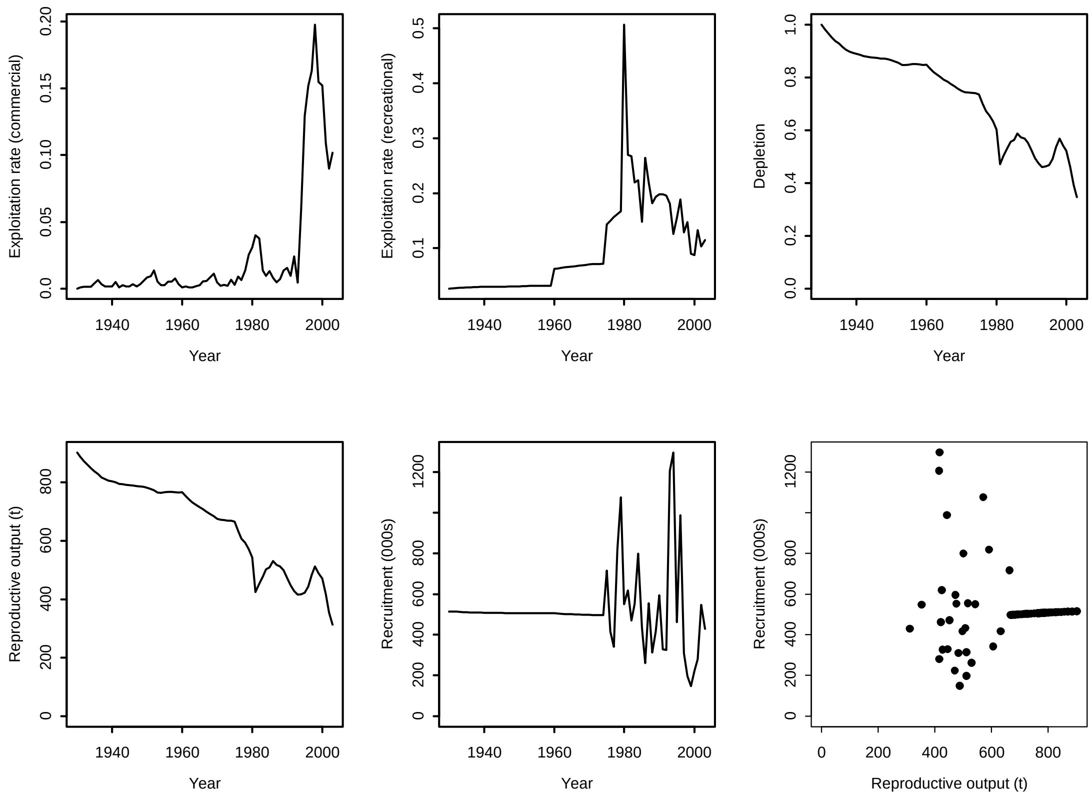
The estimated unfished reproductive output of the California cabezon resources is 902 mt, with an estimated reproductive output of 313 mt in 2003. This gives a depletion level of 34.7% for 2003.

Recruitment

A reparameterized Beverton-Holt equation with lognormal process error was used to characterize the spawner-recruitment relationship of cabezon. The steepness parameter was set to 0.7 and a likelihood profile was used to evaluate model outputs using steepness values from 0.2 to 1. Recruitment residuals were estimated for the years 1975 to 2002. Two major recruitment events are estimated to have occurred: one in the late 1970s and another in the early 1990s, both about twice the size of historical recruitment levels. The actual recruitment patterns are unclear because of a lack of information about year-specific recruitment.

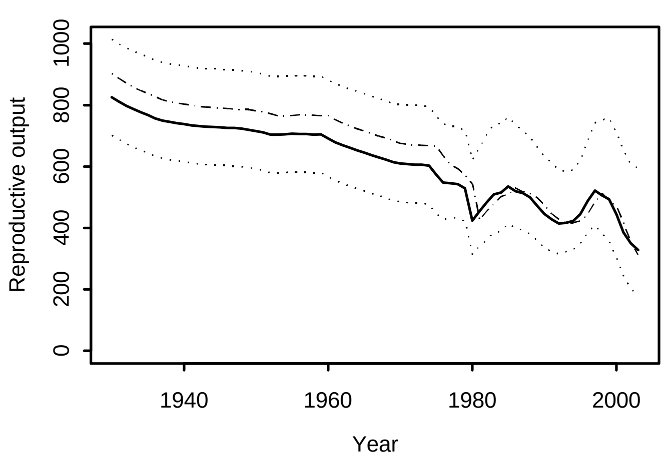


Year	Spawning Biomass	Recruitment	Total Catch
1930 (unfished)	902	515	25
1940	802	508	27
1950	781	507	35
1960	766	505	51
1970	675	497	55
1980	543	550	318
1990	473	595	111
1991	447	328	101
1992	428	326	106
1993	416	1205	82
1994	417	1296	96
1995	422	461	159
1996	443	987	199
1997	484	310	193
1998	512	197	242
1999	489	149	169
2000	471	223	158
2001	417	279	130
2002	354	547	90
2003	313	429	90



Exploitation status

The current reproductive output of the cabezon resource off California is estimated to be about 35% of its unfished level based on the base-case MPD and 42% based on the posterior median for the base-case analysis.



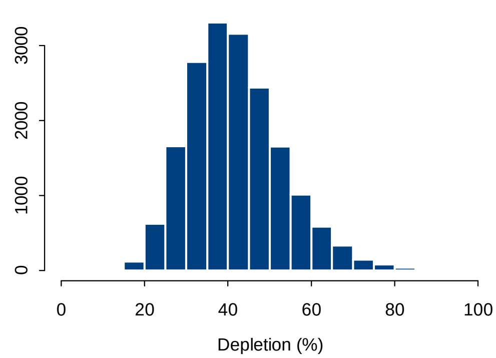
Posterior distributions (posterior medians and posterior 95% intervals) for the time-trajectory of reproductive output (1930-2003). The dashed lines are the MPD estimates of annual reproductive output.

Management performance

Few management regulations exist for cabezon. California imposed a 15-inch minimum size limit on retained cabezon in its recreational and commercial fisheries in 2001, an increase over the previous 14-inch size limit. Recreational bag limits have been 10 fish/day since 2000 in California. Oregon imposed a 16-inch commercial size limit and a 15-inch recreational size limit for cabezon in 2001. Oregon has a 10 fish/day bag limit for cabezon and greenling combined. California and Oregon are proposing slot limits for cabezon; cabezon must be within 15-22 inches in California and 15-19 inches in Oregon to be retained. There is no size limit in Washington and recreational fishers are limited to 15 bottom-type fishes daily. Commercial landings of cabezon are monitored as part of a mixed group called "Other Fish". The coastwise ABC for this entire group of species was 14,700mt during 1999-2002 (5,200mt for the Eureka, Monterey and Conception INPFC areas and 9,500mt for Columbia and Vancouver INPFC areas).

Forecasts

Twenty-year yield projections were based on the combined posterior of nine Bayesian analyses (combinations of values for M of 0.2yr^{-1}, 0.25yr^{-1} and 0.3yr^{-1} and values for h of 0.5, 0.7 and 0.9; see below figure). Four control rules were considered: (1) 40-10, (2) $F_{45\%}$, (3) 60-20, and (4) $F_{50\%}$ (see below table). Two of the control rules are based on the Groundfish FMP (ABCs based on the "other groundfish" F_{MSY} proxy of $F_{45\%}$ and OYs based on the 40-10 adjustment for stocks below $0.4S_0$) and the other two control rules are based on California's Nearshore FMP (ABCs based on a F_{MSY} proxy of $F_{50\%}$ and OYs based on a 60-20 adjustment for stocks below $0.6S_0$).



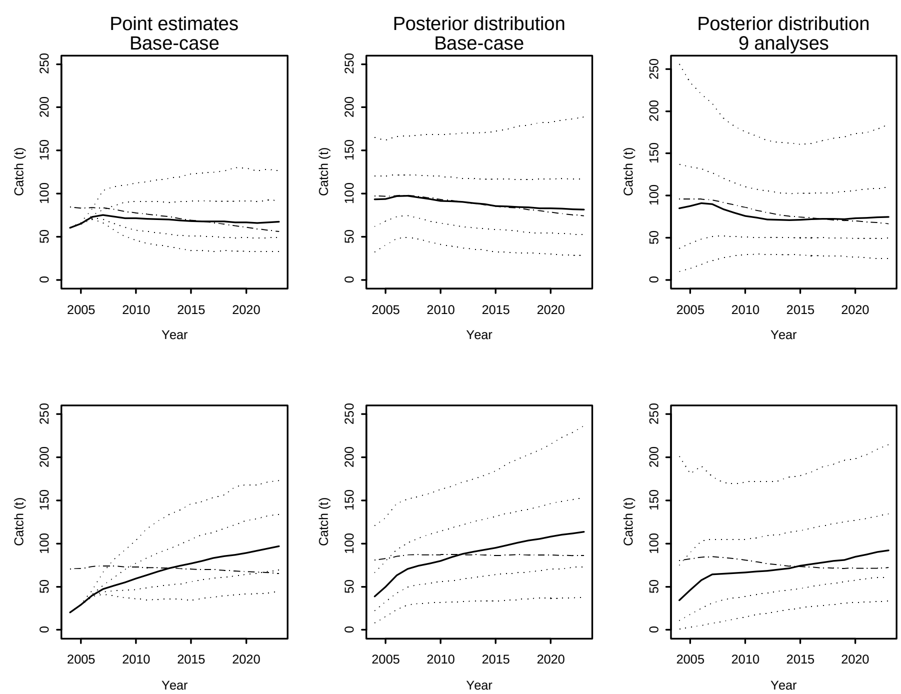
Posterior distribution for current depletion (i.e. S_{2003}/S_0) obtained by pooling the posterior distributions for the nine cases giving a weight of 1 to cases for which M=0.25yr^{-1} and 0.5 to cases for which M=0.2 yr^{-1} and M=0.3yr^{-1}.

Year	Posterior distribution (Nine analyses)			
	40-10 rule	$F_{45\%}$	60-20 rule	$F_{50\%}$
2004	85	96	35	80
2005	88	96	46	82
2006	91	96	58	84
2007	90	95	64	85
2008	84	92	65	84
2009	80	89	66	82
2010	76	86	66	81
2011	74	82	68	79
2012	72	80	68	77
2013	71	77	70	75
2014	71	76	72	74
2015	71	74	74	73
2016	72	74	76	72
2017	72	72	78	72
2018	72	71	80	71
2019	72	70	81	71
2020	73	70	85	72
2021	74	69	87	72
2022	74	68	90	72
2023	75	67	92	72

Decision table

Results are given below for three scenarios concerning the estimates on which the projections are based: (a) the MPD estimates (this is the basis for the bulk of projections presented to the Council in the past), (b) the posterior distribution for the base-case analysis, and (c) the posterior distribution for all nine cases combined. The widths of the 95% intervals generally increase with time.

Year	Point estimates (Base-case)				Posterior distribution (Base-case)				Posterior distribution (Nine analyses)			
	40-10 rule	$F_{45\%}$	60-20 rule	$F_{50\%}$	40-10 rule	$F_{45\%}$	60-20 rule	$F_{50\%}$	40-10 rule	$F_{45\%}$	60-20 rule	$F_{50\%}$
2004	61	85	20	71	93	97	39	81	85	96	35	80
2005	65	83	29	71	94	97	50	82	88	96	46	82
2006	73	84	40	73	97	98	63	85	91	96	58	84
2007	75	83	47	74	98	98	70	87	90	95	64	85
2008	74	82	52	74	96	96	74	87	84	92	65	84
2009	72	79	55	73	94	95	77	87	80	89	66	82
2010	71	78	59	72	92	93	80	87	76	86	66	81
2011	71	76	64	72	91	92	84	87	74	82	68	79
2012	70	75	68	72	90	90	88	87	72	80	68	77
2013	70	73	71	72	89	89	91	87	71	77	70	75
2014	69	71	74	71	88	87	93	87	71	76	72	74
2015	68	69	77	70	86	85	95	86	71	74	74	73
2016	68	68	80	70	85	84	98	87	72	74	76	72
2017	68	66	83	70	85	83	101	87	72	72	78	72
2018	68	64	85	69	84	81	104	87	72	71	80	71
2019	67	63	87	68	83	80	106	87	72	70	81	71
2020	67	61	89	67	83	78	108	87	73	70	85	72
2021	66	59	92	67	83	77	110	86	74	69	87	72
2022	67	58	94	66	82	75	112	86	74	68	90	72
2023	67	56	97	65	82	74	114	86	75	67	92	72



The above graph illustrates time-trajectories of yield. The solid lines are the median time-trajectories of 40-10 (upper panels) and 60-20 (lower panels) harvest, the dashed lines are F_{ABC} median time-trajectories of harvest, and the dotted lines and the 5^{th}, 25^{th}, 75^{th} and 95^{th} percentiles of 40-10 and 60-20 harvest.

Recommendations

1 Accurate accounting of removals, especially from recreational and live-fish fisheries: Fisheries primarily exploited by recreational and live-fish commercial fisheries are traditionally hard to monitor. More effort to monitor these fishery sectors may be necessary to accurately monitor fishing mortality.

2 A fishery-independent survey of cabezon population abundance: Cabezon primarily inhabit depths less 50m. Nearshore fishes, at this time, are not surveyed using fishery-independent methods. As fishing pressure builds in nearshore areas, a standardized and statistically-designed survey will be needed to adequately monitor population trends.

3 A study of the stock structure of cabezon: Cabezon along the west coast of the U.S were assumed to consist of two distinct biological populations (split at the California-Oregon border), but this assumption is based on very limited information. More work needs to be done to understand the stock structure of this and most other groundfish species.

4 Age validation/ age determination: Catch age-composition data were not available for this assessment. Accurate ageing is crucial to understand the population dynamics of a species, especially those for which there is limited survey information. Information on the age-structure of the catches for each fishery sector should substantially improve some aspects of the assessment.

5 A better understanding of the relationship between CPUE and population biomass: Changes in recreational CPUE are assumed to reflect changes in population biomass in a linearly proportional way. The results of the assessment would be severely in error if this assumption were substantially violated. Therefore, if future assessments depend on CPUE data, it is vital that the relationship between CPUE and population biomass be quantified. In principle, guidelines for dealing with this problem generically could be advanced through a workshop on methods and modeling approaches for the use of recreational data when developing indices of abundance.

6 A more standardized method of computing recreational CPUE. Recreational CPUE is becoming increasingly important as fishing effort moves into areas that have not been surveyed. Many decisions are necessary to use recreational information to develop CPUE indices. A more standardized method of developing these data would assist the development and review of assessments for those species that depend substantially on indices based on catch and effort information.

7 Effect of climate on cabezon: Several source of information in this assessment (e.g. the power-plant impingement index, the CalCOFI index and some length composition information) indicated that there was potentially good recruitment after 1999 (and before 1977 for the impingement data) whereas these same sources indicated that recruitment was very poor prior to 1999. This suggests that cabezon may be influenced by climatic/oceanic regimes. A better understanding of the relationship between cabezon population dynamics and climate would reduce the uncertainty of future assessments.

Purpose

This document describes the first assessment of the population status of cabezon (*Scorpaenichthys marmoratus*) on the west coast of the United States. The analyses are intended to provide information that will be of use by managers at both the state and federal levels. This document follows, to the extent possible given the available information, the Terms of Reference for stock assessments established by PFMC Scientific and Statistical Committee.

Several objectives are addressed in this document. First, the life history of cabezon is described and all the available data sources that were considered for use in the assessment are explained. The document only provides information for those data sources that were considered for use in the population modeling. Many other sources of information were considered but ultimately rejected, and for brevity they are not included in this document. Second, the assessment describes a population model built specifically for use in the assessment of cabezon status. Third, the assessment attempts to evaluate the assessment model through the use of an alternative model. The alternative model is used to evaluate and potentially validate the assessment results, but has not been put forward as a competing assessment.

This assessment differs from those performed for most other west coast groundfish species because of the lack of a dedicated fishery-independent biomass index. It consequently relies on indices of abundance based on recreational CPUE and information about larval abundance. Although no dedicated biomass indices exist for this species, these alternative data sources are viewed as sufficient for tuning the population dynamics model. Much uncertainty remains in regard to the assumption that changes in recreational CPUE are linearly proportional to changes in population size. There is no information on the age-structure of the catches. Therefore, although the model is age-structured, it is fit to length-composition data by converting the model-predicted catch age-compositions to catch size-compositions using a growth curve. The length frequency sample sizes are small and changes in length frequency distributions are not necessarily caused solely by changes in the age-structure and size-structure of the population. Nevertheless, although the results of this assessment are highly uncertain, this assessment is the best available for describing population changes and for providing management advice for cabezon and was considered to be of sufficient strength by the reviewers (STAR Panel) to be used for management.

Acronyms used in this document:

ABC – Allowable Biological Catch
AFSC – Alaska Fisheries Science Center
AIC – Akaike Information Criterion
CalCOFI - California Cooperative Oceanic Fisheries Investigation
CDF&G – California Department of Fish and Game
CPFV – Commercial Passenger Fishing Vessels
CPUE – Catch per unit of effort
CV – Coefficient of variation
FMP – Groundfish Fishery Management Plan
GLM – Generalized Linear Model
INPFC – International North Pacific Fishery Commission (spatial area units)
MCMC – Markov Chain Monte Carlo
MODE – Fishing Method (shore, private boat, charter boat)
MPD – Maximum of the posterior density function
MRFSS - Marine Recreational Fisheries Statistics Survey
NMFS – National Marine Fisheries Service
NWFSC – Northwest Fisheries Science Center
OBS – Ocean Boat Survey
ODF&W – Oregon Department of Fish and Wildlife
PFMC – Pacific Fishery Management Council
RecFIN – Recreational Fisheries Information Network
SWFSC – Southwest Fishery Science Center
WAVE – Bi-Monthly period
WDF&W- Washington Department of Fish and Wildlife
OY- Optimum Yield

INTRODUCTION

Very little is currently known about cabezon life history and even less is known about its population status. Cabezon are a member of the family Cottidae, which includes the sculpins. However, unlike most sculpins, cabezon grow to large size and are prized by both commercial and recreational fishers. Cabezon are currently managed as part of a nearshore complex of fishes that include several species of rockfishes and greenlings.

This is the first quantitative assessment of the population status of cabezon. Although the assessment considers the entire west coast of the continental United States, the data are very sparse, except for the state of California.

LIFE HISTORY

Distribution

Cabezon are distributed along the entire west coast of the continental United States (Figure 1), Canada and Alaska. They have been found as far south as central Baja California (Miller and Lea 1972) and as far north as Alaska (Quast 1968). Although cabezon are primarily a nearshore species (the majority of the recreational catch being inside of 15-20fm and approximately 99% within 30fm), they are nevertheless taken infrequently in depths that exceed 30 fm (Feder *et al.* 1974).

Species Associations

Cabezon is a member of a nearshore assemblage of fishes that include black-and-yellow rockfish, blue rockfish, brown rockfish, calico rockfish, china rockfish, copper rockfish, gopher rockfish, grass rockfish, kelp greenling and rock greenling, kelp rockfish, monkeyface prickleback, olive rockfish, quillback rockfish, California scorpionfish, California sheephead, and treefish. The population levels of most of these species have not yet been assessed, but their co-occurrence is indicative of the cabezon depth range.

Spawning and Early Life History

Cabezon are known to spawn in recesses of natural and manmade objects, and males are reported to show nest-guarding behavior (Garrison and Miller 1982). Spawning is protracted, and there appears to be a seasonal progression of spawning that begins off California in winter and proceeds northward to Washington by spring. Spawning off California peaks in January and February (O'Connell 1953) while spawning in Puget Sound (Washington State) occurs for up to 10 months (November-August), peaking in March-April. Laid eggs are sticky and adhere to the surface where laid. After hatching, the young of the year spend 3-4 months as pelagic larvae and juveniles. Settlement takes place after the young fish have attained 3-5 cm in length (Lauth 1987).

The number of eggs spawned appears to increase with fish size (weight or length) (O'Connell 1953, Lauth 1988). However, the actual relationship between age / size and number of eggs spawned is uncertain because cabezon may spawn more than once each year. Therefore, rather than attempting to determine this relationship, the reproductive output has, for this purposes of this assessment, been defined to be proportional to the product of maturity-at-age and body weight at the start of the year. Maturity ogives

(Figure 2; table 1) were estimated using the California Department of Fish and Game (CDF&G) visual inspection codes and ages provided by Joanna Grebel (Moss Landing Marine Laboratories), i.e.:

$$\phi_a = (1+\exp(-1.56a+4.1))^{-1} \qquad \text{age}$$
$$\phi_L = (1+\exp(-0.7a+25.7))^{-1} \qquad \text{length}$$

Females with gonads with early yolk stage eggs were assumed to be mature, although it is possible that some of these fish were maturing but not yet mature. This will lead to a more optimistic interpretation of the rate at which cabezon mature (younger and at smaller size)

Age and growth

Cabezon are among the largest of the cottids, attaining a length of nearly 1m and a weight in excess of 11 kg (Feder *et al.* 1974). Female cabezon are larger than males of the same age (Figure 3a). Little work has, however, been done on the relationship between age and length of cabezon. Joanna Grebel has recently concluded a study on age and growth of cabezon from California and her data form the basis for a growth curve for California cabezon (Grebel 2003). Ages were determined from a thin-section of the saggital otolith. The ages were all standardized to a 1 January birthdate to avoid bias caused by rapid growth during the first years of life and von Bertalanffy growth curves fitted to the resulting age-length data (Table 1). Partial "validation" of this growth curve was achieved by estimating the values for ℓ_∞ and κ from tag-recapture data (K. Karpov, CDF&G, pers. comm.) and setting t_0 so as to minimize the sums of squares of size at age from the combined sexes and the tag-recapture estimates. The ageing- and tagging-based growth curves do not appear to be in conflict (Figure 3b).

A von Bertalanffy growth curve for cabezon from Puget Sound, Washington was fitted by Lauth (1987). The age-length data reported by Lauth (1987) include very few young fish so these data were augmented by data on length-at-age for cabezon aged <2yr from the sample for California and the resultant data set fitted to sex-specific von Bertalanffy growth curves (Figure 3c). Cabezon in Oregon and Washington are estimated to reach larger size than those in California.

Weight-length relationships (both sexes combined; weight in g and length in cm) were determined for California and Oregon-Washington (Grebel 2003; Lauth 1987 respectively; Table 1):

$$W = 0.0089\,L^{3.19} \qquad \text{California}$$
$$W = 0.00684\,L^{3.16} \qquad \text{Oregon-Washington}$$

Natural Mortality (*M*)

Little is known about the natural mortality rate of cabezon. Cabezon currently reach an estimated age of 15 years (see Figure 3a) in California and of 17 years in Washington

(Figure 3c). These ages imply a natural mortality rate of approximately 0.25 yr^{-1} based upon maximum age methods for estimating *M* (Hoenig 1983; Royce 1972), but this value is highly uncertain.

HISTORY OF FISHERIES

The recreational sector has been the main source of cabezon removals until very recently. Cabezon have been a component of the catch in recreational fisheries for more than a century (Jordan and Everman 1898). The earliest modern commercial fishery information (O'Connell 1953) indicates that a small amount of cabezon was being sold in fish markets in the San Francisco area by the 1930s. However, it wasn't until the 1980s that a truly directed commercial fishery for cabezon was established.

The most significant change in the fishery for cabezon is likely the development of the live-fish commercial fishery that targets several species of nearshore fish including cabezon. This fishery started on the west coast in southern / central California in the late 1980s and spread northward in the late 1990s to Oregon (Starr *et al.* 2002). Fishermen routinely obtain much higher prices for fish brought back to markets alive. Cabezon are not subject to barotraumas because they lack a swim bladder and are usually found in shallow nearshore water. These traits make them an ideal target for both the live-fish and recreational fisheries. Gears that take cabezon include hook and line and pot/trap type gears, as they are successful at bringing up fish with relatively little damage. The live-fish fishery will continue to be an important contributor to the landings of cabezon, especially as the allowable catches of other marketable fish species are reduced.

<u>Fisheries Management</u>

Management of nearshore groundfish species is an area of active discussion. The Pacific Fishery Management Council (PFMC) and the National Marine Fisheries Service (NMFS) have management responsibility for all groundfish species included in the Groundfish Fishery Management Plan (FMP). Many nearshore species, including cabezon, that are included in this FMP also fall primarily within the 3-mile limit of states waters. States are currently seeking to be granted management authority over nearshore species by the PFMC.

Few management regulations exist for cabezon. California imposed a 15-inch minimum size limit on retained cabezon in its recreational and commercial fisheries in 2001, an increase over the previous 14-inch size limit. Recreational bag limits have been 10fish/day since 2000 in California. Oregon imposed a 16-inch commercial size limit and a 15-inch recreational size limit for cabezon in 2001 (see Appendix A for a complete list of California regulations). Oregon has a 10fish/day bag limit for cabezon and greenling combined. California and Oregon are proposing slot limits for cabezon; cabezon must be within 15-22 inches in California and 15-19 inches in Oregon to be retained. There is no size limit in Washington and recreational fishers are limited to 15 bottom-type fishes daily.

Commercial landings of cabezon are monitored as part of a mixed group called "Other Fish". This group of species includes sharks, skates, rays, grenadiers and other groundfish. This group has been defined historically as groundfish species that do not have directed or economically important fisheries. The coastwise ABC for this entire group of species was 14,700mt during 1999-2002 (5,200mt for the Eureka, Monterey and Conception INPFC areas and 9,500mt for Columbia and Vancouver INPFC areas).

DATA SOURCES INVESTIGATED

The data sources that were considered for use in the population modeling of cabezon are explored in the next section. Data for species managed by the Pacific Fishery Management Council are collected by both federal (or quasi-federal) and state agencies. This can complicate matters because multiple agencies may collect the same types of data. Where this occurs, the analyses below are based on those data that are most likely to be informative regarding changes in population size.

Removals

Whenever possible, removals were characterized as landed catch plus fish released and presumed dead. Historical catches (prior to 1980) were inferred from state reports or backward projections of later catches. Although cabezon are caught using a variety of pot and line type gears, all catches are assumed taken using a single gear type for the purposes of this assessment.

Recreational Catches

Given the nearshore depth-distribution of cabezon, it is not surprising that much of removals are due to the recreational sector (Table 2; Figure 4). Information on the activities of recreational fishermen has been collected by both state (CDF&G, ODF&W, and WDF&W) and federal (MRFSS) programs. The MRFSS program obtains effort information from a random-digit dialing protocol and catch/trip from intercept interviews. State run recreational sampling programs differ from the MRFSS program because effort is based upon exit counts of boats leaving recreational harbors. This type of exit count works well in the northern states because the number of ports is low and it is relatively easy to monitor these ports.

The RecFIN statistical subcommittee compared the state (only in Washington and Oregon) and MRFSS sampling programs and found that the state programs are likely to provide more accurate estimates of total removals. Therefore, the estimates of removals for this assessment are based on state estimates to the extent possible. It should be noted, however, that even in those states with state-sponsored recreational sampling programs, certain recreational activities are not monitored by the states (e.g. shore fishing). Thus MRFSS data are still needed to determine total removals for those activities. In addition, recreational catch from the MRFSS sampling program were not estimated during the years 1990-1993, so the estimates of the recreational catch in California for those years were calculated by linear interpolating between the catch for 1989 and that for 1994. The removals by the recreational catches by state are determined as follows:

1. Oregon: a combination of ODF&W (Don Bodenmiller, per. commn) OBS survey estimates of ocean boat catch plus the MRFSS estimates of shore and

inland marine catch. OBS collects information on the number of cabezon taken by recreational fishers. Biological sample information is used to determine the average weight of the fish caught annually and hence to compute removals in metric tons.

2. Washington: the estimated removals (metric tones) from 1990-2002 were taken from the state-sponsored ocean sampling program and the nearshore catch was estimated by MRFSS, which could be taken directly from the RecFIN website ((http://www.psmfc.org/recfin/). For years prior to 1990, removals were determined by adding the catches from state sampling in the ocean areas to the landings by shore fishermen estimated by MRFSS.

3. California: based solely on MRFSS estimates taken from the RecFIN website ((http://www.psmfc.org/recfin/ for the years 1980 to current. The total historical recreational catch is uncertain. Substantial catches are known to have occurred prior to 1979, because the catch (in numbers) reported in the CPFV logbooks was generally larger in late 1940s than during the 1980s. However, total removals due to the recreational sector cannot be determined because the logbooks only report a fraction (~10%) of the recreational catch in the more recent period (when there are estimates of all modes of recreational catch). For the purpose of this assessment, the catch is assumed to increase over time from 1930 to 1979; sensitivity analyses examine the impact of changing this assumption.

Estimates from the state and federal programs can sometimes differ greatly. In the case of Washington, for example, the MFRSS estimates for the total removals for 1980-2002 were twice those based on the state program, although the state program not accounting for shore-based fisheries causes some of the discrepancy. Estimates of recreational removals are therefore uncertain.

Commercial Catches

Estimates of commercial landings are obtained from fish tickets that detail the landed catch. Landed catches of cabezon are recorded in a specific cabezon category but also in a mixed-species category. Furthermore, this system has changed over time. The entire landing was assumed to be cabezon when the landing receipt identified the catch as nominal. For those landings brought to the dock as a mix of species, the species composition proportions determined from port samples were applied to the landing to estimate cabezon weight. This is a standard procedure carried out within the PacFIN database.

There are marked differences in the magnitude as well as the temporal pattern of the commercial take of cabezon in each of the three states (Table 2; Figure 4). Washington has never had a commercial fishery for cabezon. Oregon had a small commercial (relative to the recreational) fishery until the late 1990s when commercial landings increased dramatically due to development of the live-fish fishery in that state. California has a record of commercial catch that goes back to the 1920s and has by far the largest commercial removals of the three states. Commercial landings of cabezon in California reached a peak of over 150mt in 1998 and averaged more than 80mt since the mid 1990's

(Table 2). The live-fish fishery, which was first introduced into the U.S. west coast in California, was a primary driver for this increase in catch.

Discards

Discard mortality is assumed to be negligible for the purposes of this assessment because of the shallow habitat of this fish, its physiology, and its hardiness. The lack of any appreciable cabezon discard in the West Coast Observer Program (Lin-Lai, NWFSC, pers, commn) supports this assumption.

Length Compositions

Cabezon otoliths are not collected routinely during port sampling. Therefore, the only information on the structure of the catch is from length measurements. Sex is not recorded when sampling for length, so all of the catch length distributions considered in this assessment are sex-aggregated. Catch length compositions (Table 3; Figure 5) were developed for each state and fishery sector (see Table 4 for the numbers of fish and trips sampled).

The catch length compositions for each state and year from the recreational fisheries were obtained from the RecFIN website (RecFIN expands the sampled length proportions by port, mode (fishing activity) and wave (bi-monthly period) to estimate the proportion at length for the entire year.

The commercial catch length distributions for Oregon (1998-2002) are based on fish sampled by state port biologists. The sample size in the first two years is low (Table 4) because the Oregon commercial fishery had started only recently. No weighting of the length-frequency data for Oregon is needed (i.e. the raw length-frequency data are simply added together) because each cabezon sample typically made up the entire catch. The commercial length compositions for California were extracted from the CALCOM database. Commercial length samples are expanded using the standard routine at the port-gear-month level and then aggregated for the state.

Indices of Abundance

There is no standardized survey designed to estimate the abundance of cabezon along the U.S. west coast. All surveys presently used to provide biomass indices for groundfish populations are conducted at depths that are largely outside the depth preference of cabezon. Cabezon are caught so infrequently in the standardized trawl surveys that those data sources are not considered further. Therefore, in common with the assessment of yelloweye rockfish (Methot et al. 2002), this assessment is based on recreational CPUE data, larval abundance indices from standardized egg/larvae surveys (as possible index of reproductive output), and impingement rates of juvenile cabezon (considered as a possible index of recruitment).

Seven potential indices of abundance (eight if the two CPFV indices are considered separate indices) were developed by fitting models to the proportion of non-zero records and the catch-rate (or whatever quantity is being measured such as number of larvae impinged) given that the catch was non-zero, and taking the product of the resultant estimates (delta method). Table 5 summarizes the details of the sampling programs, the years for which data are available, the number of data points and the number of non-zero records for each data source. The proportion of non-zero records was modeled as a binomial variable while the catch-rate for non-zero records was modeled as a lognormal variable. The models were fitted using GLM and only main factor effects were considered (i.e. no interaction terms). A variety of alternative models were developed and these were weighted using AIC. Table 6 lists the AIC-based weights for the models considered. Other distributional assumptions (e.g. negative binomial, delta-gamma) were considered but these provided very similar indices. The results of the analyses are illustrated by plots of the average annual catch rate (no stratification) and the corresponding GLM-base estimates. The CVs are based on a bootstrapping methodology (MacCall per. comm.) using only the factors from the best fitting model. Index values for each data source are given in Table 7.

Recreational CPUE indices

Commercial Passenger Fishing Vessels ("CPFV Observer" and "CPFV Logbook")

A recreational CPUE index was developed for California from the Commercial Passenger Fishing Vessel (CPFV) program (1988-98) operated by CDF&G. An observer was placed on some party fishing vessels and monitored location, depth and duration of fishing as well as the number of anglers and number of fish (by species) caught. Over 99% of all positive catches of cabezon were inside 30fm and for the analysis observations beyond 30fm were excluded. Factors available and considered for inclusion in the model include port complex (a proxy for latitude), and depth. AIC selected the full model (all factors; Table 6; Figure 6).

An alternative CPFV index (1960-2001) was constructed from data included the (self-reported) logbooks of the captains of the CPFV fleet (Figure 6). This data set included those trips with observers that were analyzed above, as well as many more trips. The data available were summarized by month and California block area; each record therefore contains at least one, but probably more than one, trip. The data were filtered to include only those trips (or collapsed trips) that caught nearshore species (but not necessarily cabezon). Factors considered in the models included season, latitude and depth.

Both CPFV CPUE indices include information from southern to northern California, although the majority of the data come from the central sections of the state. We chose to use the CPFV logbook series instead of the observer series in the assessment because: (a) some of the CPFV observer data series are included in the CPFV logbook data, and (b) the CPFV time series is longer. The two series indicated similar trends during the years they overlap (Figure 7a). Figure 7b depicts diagnostics for the CPFV logbook model.

California RecFIN

An alternative recreational CPUE index for California was developed using data collected by the MRFSS port samplers (Figure 8). These data were collected during the dockside intercepts used by the MRFSS program to estimate WAVE (bi-monthly period) and MODE (fishing type) specific CPUE that is later expanded by effort to get total recreational catch. Only shore and private boat fishing modes where fishing activities were targeting nearshore groundfish were included when developing CPUE indices to exclude the commercial party/charter vessels on which the CPFV Observer and CPFV

Logbook indices are based. Data were analyzed using factors such as MODE (private boat or shore) and season (spring, summer, fall and winter). A similar index was not developed for Oregon-Washington because shore-based angling is not as large a component of the recreational fisheries in the north compared to California.

Oregon Ocean Boat Survey

A recreational CPUE index was developed from data collected by ODF&W (1979-89 and 1999-2002; Figure 9). Similar to the RecFIN data, these data were obtained from angler interviews and intercepts. However, the data are not available at the individual trip level but rather grouped by trip-type (salmon, groundfish, etc.), port, and month. Factors considered were port and season (spring, summer, fall, and winter). Records that that did not involve trips targeted at groundfish were excluded when conducting the GLMs.

Washington Recreational Index

A recreational CPUE index was developed from data collected by WDF&W (1990-2002; Figure 10). The factors examined when fitting the GLMs were: port group (northern ports, middle coast ports, and Ilwaco), season (summer/winter), and vessel type (party/charter, private, Ilwaco). Records that that did not involve trips targeted at groundfish were excluded when conducting the GLMs.

Ichthyoplankton Indices

A spawning index was developed based on ichthyoplankton data. Cabezon larvae are initially neustonic and available (and readily identifiable) to planktonic sampling gears. The Southwest Fishery Science Center (SWFSC) and the Alaska Fisheries Science Center (AFSC) have conducted ichthyoplankton surveys off the west coast and developed databases with information on the abundance of cabezon larvae. Generally the size of fish collected during these studies is <15mm (pre-settlement) and therefore not thought to correlate well with recruitment to age-1. However, the abundance of this size group may relate (in a linearly proportional way) to the amount of reproductive output the year before the year of sampling. The possibility of developing an index using the Santa Cruz mid-water juvenile rockfish survey was investigated. However, cabezon are only a very small component of the catch in this survey (Steve Ralston, SWFSC, pers. comm.) so no attempt was made to develop an index of pre-settlement cabezon using these data.

CalCOFI

The SWFSC has conducted larval tows off California since 1950. Tows are generally made at stations from the Mexican border to roughly 36°N, so these data relate primarily to southern California. Surface and subsurface tows are made, but the subsurface tows catch few cabezon and are therefore excluded when developing the index. Surface tows made south of 31°N during June-September and west of 122°W are also excluded from the analyses due to few positive tows. The data for the years 1977, 1979, 1982 and 1983 were also excluded because of changes in survey methodology. The factors considered in the analyses where: day and night (day: between 6AM and 6PM), latitude (north and south of 34°N), longitude (east and west of 121°W) and month. The resultant index is shown in Figure 11.

AFSC Larval Index for Oregon and Washington.

The AFSC and the Soviet Pacific Research Institute conducted neustonic tows using a bongo-type net as part of a sampling program during 1980-87 (expect for 1986). This program operated from 39°N to 48°N, but the majority of tows (~85%) were north of 41°N so these data are assumed to pertain to the relative abundance of cabezon larvae for Oregon and Washington. Tows were conducted during all seasons and from 3-200 miles offshore. Larval cabezon were identified and counted whenever they were encountered. Factors that were measured at sea (or derived later by analysis) and evaluated for inclusion in the model were: time of day (day / night), latitude (south of 44°N / north of 44°N), longitude (west of 126°W / east of 126°W), distance from shore (<1000m from shore; >1000m from shore) and season (summer / winter). The resultant index is shown in Figure 12.

Power-plant Impingement

An index of recruitment was created using impingement data obtained from the Edison power plants in California (Figure 13). These data (catch in numbers per standardized flow volume) come from only the extreme southern California bight (33-34°N). The factors considered when developing the index were: station (some stations had multiple intake areas), and season (Dec-Feb, Mar-May, Jun-Aug, and Sept-Nov). This index is considered to pertain to recruitment rather than to reproductive output because the lengths of the fish impinged were primarily those of 0 and 1 year-old fish (Figure 14).

ASSESSMENT

Stock Structure

There is little direct information on the structure of cabezon stocks on the U.S. west coast. However, the indices of abundance for California and those for Washington exhibit substantially different trends (Figures 6-13), the growth curves developed for California and Washington differ markedly (Figure 3), and the fishing history for the 3 states is very different (Figure 4). Therefore, for the purposes of this assessment, cabezon are treated as two stocks divided at the Oregon-California border (Figure 1). This is consistent with assumptions made about stock structure in previous assessments where stock structure data were lacking (Williams et al. 1999; Crone et al. 1999; Jagielo et al. 2000). It also provides the states with the state-specific information needed to manage their fisheries.

Assessment Model

The present assessment is the first ever of the cabezon resource off the U.S. west coast, so there are no previous assessments of the resource against which to compare the assumptions that underlie the present assessment. The assessment framework is based on fitting an age- and sex-structured population dynamics model to the catch, abundance index and catch length-composition data.

The population dynamics model

The base-case variant of the population dynamics model (see Appendix B) is based on the following six key assumptions:

1. There are two fleets (commercial and recreational) that differ in terms of their (length-specific) selectivity patterns.

2. Selectivity is assumed to be asymptotic, constant over time, and related to length by a logistic function (domed-shaped selectivity is explored in a sensitivity analysis).
3. The catch is removed instantaneously in the middle of the year after half of natural mortality.
4. Recruitment is related to reproductive output by means of a Beverton-Holt stock-recruitment relationship with log-normally distributed process error.
5. Length-at-age is normally distributed about its expected value.
6. The estimates of catch-in-mass are known with negligible error (compared to that associated with the abundance index and the catch length-composition data)

As noted above, the assessment divides the cabezon resource at the Oregon-California border. The data for Oregon-Washington are very sparse so this assessment attempts to assess this area utilizing the results for California. In particular, the virgin reproductive output and the steepness of the stock-recruitment relationship for Oregon-Washington are assumed related to those for California. The constant of proportionality relating the virgin reproductive output for Oregon-Washington to that for California, c (see Equation B.3) is based on the ratio of the coast-wide nearshore rocky habitat in California to the total nearshore rocky habitat off the west coast. This approach to setting c assumes that cabezon density in a virgin state is proportional to the amount of rocky nearshore habitat.

Parameter estimation

The population dynamics model includes many parameters. However, the values for many of these are based on auxiliary information (Table 8). The base-case value for steepness (h) has been set equal to 0.7, as suggested by the STAR panel. The extent of variation in recruitment, σ_R^2, was arbitrarily set equal to 1.0. Similarly, the base-case value for the instantaneous rate of natural mortality was set to 0.25yr^{-1} and based on the life history of cabezon. Given the considerable uncertainty associated with the (assumed) base-case values for σ_R^2, and M, sensitivity tests examine the consequences of changing the values for these parameters.

The priors assigned to S_0, L_{50} and ΔL (Table 8) act as bounds for these quantities when conducting the analyses to find the values for the parameters that correspond to the maximum of the posterior density function (the MPD estimates). These priors were chosen to be "uninformative" over a relatively wide range.

The values for the parameters related to growth and fecundity are based on the results in Figures 2 and 3, and on the fit to the information on the relationship between length and mass. The values that determine the variability in length-at-age, σ^g, are computed by assuming the CV of length-at-age at age 1 is 0.14 and that at age 15 is 0.09. Although there are no studies aiming to estimate the variability of length-at-age for cabezon, there is an indication that the CV of length-at-age decreases linearly with age for many marine fishes (Erzini 1994). The only sample of length-at-age available for cabezon (Grebel 2003) indicated that the CV for age-0 females was 0.11 and for age-0 males was 0.14, and for age-10 was 0.01 for females and 0.09 for males. These values were based on small sample sizes (2 to 13 animals), therefore the upper limit for the CVs (0.14 and

0.09) were assumed and the value for age-10 was increased slightly and assumed to apply to age-15.

No attempt is made to estimate the recruitment residuals for the first year of the projection period (1930), nor those for some of the subsequent years. This is because the data are completely uninformative regarding the values for these parameters. The results of this assessment are based on estimating the recruitment residuals for 1975-2002. This selection is based on length composition and impingement data and its affect on the model is explored further in the sensitivity analyses.

The objective function minimized to find the MPD estimates for the model parameters includes contributions from the abundance index data (Table 7), the catch length-composition information (Table 3), and the priors (Appendix C).

The values for the constants of proportionality that relate the abundance indices to the model predictions (see Equations C.1, C.5, and C.8) are not included in the non-linear minimization search but are instead calculated analytically. The prior distributions for the logarithms of these parameters are assumed to be uniform because uniform on a log-scale is the uninformative prior for a scale parameter.

Two alternative approaches for dealing with the overall catchability variability scaling parameters were considered initially: (a) assuming them to be equal to 1 (i.e. assuming that the CVs computed for the abundance indices (Table 7) reflect the actual amount of variability of the indices about the true population trajectory), and (b) treating them as estimable parameters (with uniform priors; Equations C.2, C.6, and C.9). Neither of these two approaches is ideal because: (a) there are clear significant “runs” of residuals when these parameters are set equal to 1 which suggests that the CVs for the abundance indices from the bootstrapping exercise under-estimate the true extent of uncertainty, and (b) estimating the extent of additional variance is not ideal because it assumes that the discrepancy between the model and indices is due to the CVs being under-estimates whereas the actual reason is that the model of the population dynamics or that used to standardize the raw abundance index data excludes some key factors. All analyses were initially conducted for *both* approaches for dealing with the catchability variability scaling parameters. After consideration by the STAR panel, it was decided that the most appropriate base-case model included *estimation* of the catchability variability scaling parameters. All subsequent sensitivities presented refer to this base–case analysis.

The catch length-composition data were pooled into 44 length-classes, each of which has width 2cm (first length-class 6-7.9cm). The number of animals measured to construct the length-frequency distributions is substantial (Table 2). However, fits to length-frequency data usually exhibit substantial overdispersion relative to a multinomial distribution where the sample sizes are set to the number of animals measured. Therefore, for the purposes of the analyses of this document, the sample sizes are set to the “effective” number of animals measured (ω^d - see Equation C.12) using the approach developed by McAllister and Ianelli (1997). The results of preliminary analyses suggested setting the effective sample size to 60 for all years when fitting the California commercial lengths and 40 for all years when fitting the California recreational and Oregon length data sources. An effective sample size of 10 is more appropriate for the Washington recreational length-frequency information.

Evaluating convergence of the MCMC algorithm

The Metropolis-Hastings variant of the Markov-Chain Monte Carlo (MCMC) algorithm (Hastings 1970; Gilks *et al*. 1996; Gelman *et al.* 1995) with a multivariate normal jump function was used to sample 3,000 equally likely parameter vectors from the joint posterior density function. This sample implicitly accounts for correlation among the model parameters and considers uncertainty in all parameter dimensions simultaneously. Inference is based on samples generated by running 10,000,000 cycles of the MCMC algorithm, discarding the first 2,500,000 as a burn-in period and selecting every 2,500th parameter vector thereafter. The initial parameter vector was taken to be the vector of maximum posterior density (MPD) estimates. A potential problem with the MCMC algorithm is how to determine whether convergence to the actual posterior distribution has occurred; the selection of 10,000,000, 2,500,000 and 2,500 was based on generating a sample that showed no noteworthy signs of lack of convergence to the posterior distribution. We evaluated convergence by applying the diagnostic statistics developed by Geweke (1992), Heidelberger and Welch (1983), and Raftery and Lewis (1992) and by examining the extent of auto-correlation among the samples in the chain.

Model diagnostics

Figure 15 shows the fit to the base-case model (MPD estimates) for California only. Note that the model is fit to all California indices except the CPFV Observer and CalCOFI series. The former index is a not independent of the logbook series and is shorter (and hence less informative) and therefore was excluded. The latter index had too few positive tows and was deemed not to be useful by the STAR panel. The fit to the latter series in Figure 15 was therefore computed from the MPD estimates of population size and the maximum likelihood estimates for the catchability coefficient. Figures 16 and 17 show the fits of this model to the catch length-composition information and include the distributions for the annual effective sample sizes based on the approach of McAllister and Ianelli (1997).

The model tracks the changes in the CPFV Logbook index qualitatively but there are some notable systematic differences between the data and the model predictions (Figure 15). The wide confidence intervals for this series are indicative that the variability of this series as a measure of changes in biomass is high. Note that in the CPFV logbook data series the wide confidence intervals have expanded the y-axis causing the index to look flatter than it is (compare Figure 6).

The average values for the effective sample sizes in Figures 16 and 17 are close to the values assumed when fitting the population dynamics model (commercial: 60; recreational: 40).

Results

Base-case results: California

Figure 18 shows the MPD estimates of the time-trajectories of exploitation rate for the commercial and recreational sectors, reproductive output (in absolute terms and expressed relative to the virgin level), and recruitment. It also shows plots of recruitment against reproductive output.

The reproductive output of the cabezon resource off California is estimated to be 34.7% of its virgin level in 2003, and the current reproductive outputs is estimated to be 313 mt. Appendix D lists the MPD estimates of the numbers-at-age matrix. Results are not shown for all of the years between 1930 and 1965 in Appendix D because the lack of assessment data (abundance index and catch length-composition data) and the low catches over this period means that the age-structure only changes slowly from the pre-exploitation equilibrium age-structure.

Figure 19 shows the length- and age-specific selectivity ogives for the two fleets (commercial and recreational). Males are less selected than females for a given age because females are larger at age. Selectivity based on age and length suggests immature fish are not completely excluded from current and historical catch.

Figure 20 displays the changes over time in reproductive output and catch simultaneously. There appears to be a qualitative correlation between increased catches and downward changes in population size, particularly after catches greater than about 100 mt. This correlation is particularly apparent in the early 1980s when the catches by the recreational fishery are assumed to have increased and in the mid–to-late 90s when the commercial take increases.

Figure 21 illustrates the change in numbers at length in the starting (1930) and ending (2003) years of the assessment. Catch length composition data is used to fit the model, so it is important to assure the length information changes when the population goes from an unexploited to an exploited state. The biggest difference between the two years is the substantial loss of the larger and older size-classes in the exploited population.

A separate stock reduction analysis was performed in Stock Synthesis (Appendix E) using the same parameterization as the base case analyses. This less complex analysis was used to corroborate that the added complexity of the base-case model was justified. Results of the less complex stock reduction analysis were consistent with those from the base case assessment.

Base-case results: California and Oregon-Washington

Figure 22 shows the fits of the original two base-case models (MPD estimates) to the abundance index data for California and Oregon-Washington. Note that the model is fit only to the data for CPFV Logbook series and Oregon and Washington CPUE series. The two base–case models correspond to the fixing to 1 and estimating the catchability variability scaling parameters, respectively. The results for the remaining abundance series are computed from the MPD estimates of population size and the maximum likelihood estimates for the catchability coefficients. All of the catch length-composition information is included in the analysis. No recruitment residuals are estimated for the Oregon-Washington component of the population due to the sparseness of the data (i.e. the only additional parameters are those that define the selectivity curves for the commercial and recreational sectors).

The CPUE-based abundance indices for Oregon-Washington are essentially flat (or increasing) even though catches are increasing over time (Figure 22). Therefore, the model cannot fit these indices without implying biomass was not impacted by fishing. This leads to essentially infinite estimates of biomass for Oregon-Washington (and hence for California). The fits to the California data deteriorate markedly with the introduction of the data for Oregon-Washington.

Figure 23 presents model outputs for the component of the cabezon population off Oregon-Washington. The results in Figure 23 are based on setting S_0 for Oregon-Washington based on the estimate of S_0 for California and the value for c of 0.81. The only parameters specific to Oregon-Washington estimated to develop Figure 22 are the selectivity parameters for the commercial and recreational fisheries in this area. Note that recruitment is assumed to be constant for the calculations on which Figure 23 is based.

The results in Figure 23 suggest that the size of population in Oregon-Washington may be dropping rapidly. The quantitative results in Figure 23 are totally determined by the assumption c=0.81. However, the qualitative conclusions of this Figure are insensitive to changing the value of this parameter over a wide range. Furthermore, the only way to avoid the conclusion of rapidly declining population size is that c is much smaller than 0.81 (i.e. Oregon-Washington has an inherently higher density of cabezon given its habitat area).

The results in Figures 22 and 23 indicate therefore that it is premature at present to conduct an analytical assessment for cabezon off Oregon-Washington. The remaining results in this document pertain to the population off California only.

Comparison with Synthesis

A model of the dynamics of the California component of the population was constructed using length-based Stock Synthesis (Methot 2000) to compare outputs with the ADMB model. The specifications of the Synthesis assessment were based, to the extent possible, on those for the base-case analysis in which the catchability variability scaling parameters are set to 1. Figure 24(a) shows the MPD estimates of the time-trajectories of recruitment, fishing mortality for the commercial and recreational sectors, and reproductive output (in absolute terms and expressed relative to the virgin level), as well as recruitment plotted against reproductive output for an assessment of cabezon off California based on this application of Stock Synthesis. The results in Figure 24(a) are essentially identical to the corresponding ADMB-based outputs. The similarity of the model results validates the newer ADMB code, so all further analyses are conducted using the newer code.

Sensitivity analyses

The sensitivity analyses are based on the assessment for California only. Table 9 lists results (values for likelihood components, the current (2003) reproductive output and the ratio of the 2003 to the virgin reproductive output) for sensitivity tests for the assessment for California in which the weights assigned to the data sources included in the assessment are varied:

1 Drop the recreational catch length-composition data.

2 Double the weight assigned to the recreational catch length-composition data.
3 Drop the commercial catch length-composition data.
4 Double the weight assigned the commercial catch length-composition data.
5 Drop the Impingement index
6 Add the CalCOFI index
7 Drop the RecFIN index
8 Drop all indices (except CPFV Logbook data)
9 Drop all indices except the CPFV Observer data

Table 10 examines the sensitivity of the results to changing the values for M and σ_R^2. Table 11 explores the sensitivity of the results to changes in several model inputs including the first year for which a recruitment residual is estimated, the magnitude of historical (pre-1980) recreational catches, halving and doubling the effective sample size for the length-composition data, the assumed CVs for length-at-age, domed-shaped selectivity in the commercial fishery, and lowering the extremely high recreational catch (291 mt) in 1980 to 116 mt (calculated by averaging the catch from 1981 to 1983). In all cases, standard deviations for the depletion (taken from the normal approximation) are provided to characterize uncertainty.

Overall, the results indicate the model is not very sensitive to adding or removing the available data sources (Table 9). Only two cases are noteworthy: 1) the exclusion of the commercial catch length composition data, and 2) the use of the CPFV Observer data instead of the CPFV Logbook data. The CPFV Observer series was originally rejected as a potential index of abundance because it overlaps with the CPFV Logbook series and because it contains data for fewer years.

The results are sensitive to the value assumed for M (Table 10). Decreasing M from its base-case value of 0.25yr^{-1} to 0.2yr^{-1} leads to a more depleted resource and *vice versa*. Model results are less sensitive to changing the value assumed for σ_R^2, with a more depleted resource as σ_R^2 increases. The widest range of results occurs when σ_R^2 is held constant at the low value (0.36) and M is changed. Although estimated depletion fluctuates, the standard deviations do not greatly change.

Model outputs are generally weakly sensitive to most other parameter changes explored (Table 11). The sensitivity to the first year for which recruitment residuals are estimated is among the greatest; estimating recruitment starting in later years offers a less pessimistic view of resource depletion. The model is also sensitive to the assumption that length-at-age CVs change linearly with age, although this assumption seems biologically robust. Changes in historical catch, effective sample sizes for the catch length composition data, and domed-shaped rather than asymptotic selectivity in the commercial fishery (to mimic the live-fish fisheries choice of certain size classes) has little affect on the estimate of depletion, although there are some changes to the estimate of the absolute value of the reproductive output in 2003. Under all sensitivity runs, the standard deviations for depletions remained very similar, indicating no general increase in uncertainty with any of the parameter changes.

Figure 25 shows the likelihood profiles for steepness. The data are unable to distinguish between values for steepness from 0.4 to 1 although the data provide evidence against a low value for steepness. Figure 26 shows likelihood profiles for the logarithm of S_0. As expected, higher values for S_0 correspond to a less depleted resource and to a higher current reproductive output.

Bayesian analyses

Diagnostic statistics

Figure 27 summarizes the convergence statistics for three of the key model outputs (the objective function, the ratio of the reproductive output in 2003 to S_0, and the logarithm of S_0). The panels for each quantity show the trace, the posterior density function (estimated using a normal kernel density estimator), the correlation at different lags, the 50-point moving average against cycle number (dotted line in the rightmost panels), and the running mean and running 95% probability intervals (solid lines in the rightmost panels).

The convergence diagnostics in Figure 27 do not indicate any convergence problems. It is not feasible to produce figures summarizing the convergence statistics for all of the very many parameters of the model. However, examination of detailed results for the recruitment residuals and the estimates of reproductive output also do not provide evidence for convergence problems. Some of the recruitment residuals fail the Geweke test but none of estimates of reproductive output. The posterior median for current depletion (41.5%) is larger than the corresponding MPD estimate (34.7%) although the MPD estimate does lie well within the bulk of the posterior distribution for current depletion.

Bayesian results

Figure 28 shows the Bayesian posterior for the time-trajectory of reproductive output (1930-2003). The results shown are the posterior medians and the posterior 95% intervals as well as the MPD estimates. The posterior medians are virtually identical to the MPD estimates for the last years of the assessment period but are notably larger for the early (pre-data) years. The posterior 95% intervals for reproductive output are wide for all years of the assessment period confirming that the data are not highly informative about the absolute size of the biomass.

Projections and decision analysis

The forward projections are restricted to the assessment for California only given the poor fit of the model when it is fitted simultaneously to the data for California and Oregon-Washington (Figure 22). The forward projections were conducted using the software developed to implement the SSC Terms of Reference for rebuilding analyses (Version 2.7d - Punt, 2003) and were used to compute harvest levels for the next 20 years (2004-23). Results (e.g. Table 12) are shown for four alternative control rules. Two of the control rules are based on the Groundfish FMP (ABCs based on the “other groundfish” F_{MSY} proxy of $F_{45\%}$ and OYs based on the 40-10 adjustment for stocks below $0.4S_0$) and the other two control rules are based on California’s Nearshore Fishery Management Plan (ABCs based on a F_{MSY} proxy of $F_{50\%}$ and OYs based on a 60-20 adjustment for stocks below $0.6S_0$).

The cabezon STAR panel (see STAR Panel Report: Cabezon) recommended that projections be based on the posterior distributions from the Bayesian analysis. They noted that the base-case Bayesian analysis (e.g. Figure 28) ignores uncertainty in natural mortality, M, and stock-recruitment steepness, h, and consequently recommended that the projections be based on the results of nine Bayesian analyses (combinations of values for M of 0.2yr^{-1}, 0.25yr^{-1} and 0.3yr^{-1} and values for h of 0.5, 0.7 and 0.9). Furthermore, the STAR panel recommended that the six cases with M values of 0.2yr^{-1} and 0.3yr^{-1} be given half the weight assigned to the cases with M=0.25yr^{-1}.

Figure 29 shows diagnostic statistics for current depletion for each of the nine cases. There is no evidence in Figure 29 or in the detailed diagnostic statistics for convergence problems for any of the nine analyses. Figure 30 shows the implications of the nine analyses in terms of the posterior for current depletion. As expected from Table 10, current depletion gets larger (the assessment becomes more optimistic) when M and steepness are larger. Figure 31 shows the posterior for current depletion when the posteriors for the nine cases are pooled assigning weights of 0.5 for cases with M=0.2yr^{-1} and M=0.3yr^{-1} and 1 for cases with M=0.25yr^{-1}. As expected, the distribution for current depletion in Figure 31 is wider than any of the single distributions for current depletion on which it is based (Figure 30).

The technical specifications for the projections (see Appendix F for an example of an input file to the projection software) are as follows:

a) The virgin reproductive output for a simulation is set equal to the model-estimate of S_0 for that simulation.
b) Future recruitment is generated by sampling recruits / reproductive output ratios with replacement from those for 1975-2001. The more recent recruits/reproductive output ratios are ignored because they are likely to be very imprecise. Recruitment is generated by sampling recruits/reproductive output ratios rather than recruits because the latter exhibit a slight declining trend with time for the base-case analysis (Figure 32)[1].
c) The catch for 2003 is assumed to be 90t.
d) The split of the exploitation rate between the commercial and recreational sectors is assumed to be 50:50. This assumption is based on the exploitation rates in recent years, the base-case MPD estimates of which are 0.09 and 0.1 respectively for 2001.
e) The projections for the analyses based on the MPD estimates used 1,000 simulations while those for based on the posterior distribution used 1,000 alternative parameter vectors (the upper limit for version 2.7d of the projections software) and 5,000 simulations[2].

[1] It should be noted that the harvest levels for the first few years of the projection period will not be impacted markedly by this selection because recruitments not already included in the assessment only constitute a small fraction of the harvest for these years.

[2] Actually, the projections for nine-case analysis used 996 sets of parameters and 4,980 simulations to ensure that the weights assigned to each of the cases was maintained in the projections.

The results of the projections are shown in Figure 33 and Table 12. Results are shown for three scenarios concerning the estimates on which the projections are based: (a) the MPD estimates (this is the basis for the bulk of projections presented to the Council in the past), (b) the posterior distribution for the base-case analysis, and (c) the posterior distribution for all nine cases combined. Table 12 lists the median harvests for the four control rules and the three scenarios. Table 12 also indicates the harvest rates corresponding to $F_{45\%spr}$ and $F_{50\%spr}$ for the MPD estimates. Figure 33 shows the same information as Table 12, but also includes the 5^{th}, 25^{th}, 75^{th} and 95^{th} intervals for the harvest based on the 40-10 and 60-20 control rules to highlight the uncertainty associated with making projections of harvest for cabezon.

The projections for the 40-10 and 60-20 control rules based on the base-case posterior are the most optimistic in terms of medians (Table 12) while the projections for F_{ABC} are essentially identical for the two scenarios based on the results of the Bayesian analyses. The differences in harvest for the 40-10 and 60-20 rules between the two Bayesian scenarios occurs because the posterior for current depletion for the nine analyses scenario assigns higher probability to low depletion than the posterior for the base-case analysis (Figures 30 and 31). The projection results corresponding to the MPD estimates are less optimistic than those based on the posterior distributions primarily because of the differences in the estimates of current depletion.

The widths of the 95% intervals in Figure 33 generally increase with time (because unknown recruitment makes up an increasingly large proportion of the population with time) and as more uncertainty is added. For example, the harvest for 2004 based on the MPD estimates is estimated to have essentially no uncertainty (e.g. Figure 33, left panels) but the 95% intervals associated with the harvest for 2004 based on the nine analyses is 10-256*t* (40-10 rule) and 1-201*t* (60-20 rule).

The time-trajectories of harvest decline with time when F_{MSY} is assumed to be $F_{45\%}$. This occurs because the replacement fishing mortality is closer to $F_{55\%}$ rather than to $F_{45\%}$ (Figure 34), suggesting that $F_{45\%}$ may be a too aggressive fishing mortality for cabezon.

RESEARCH RECOMMENDATIONS

1 Accurate accounting of removals, especially from recreational and live-fish fisheries: Fisheries primarily exploited by recreational and live-fish commercial fisheries are traditionally hard to monitor. More effort to monitor these fishery sectors may be necessary to accurately monitor fishing mortality.

2 A fishery-independent survey of cabezon population abundance: Cabezon primarily inhabit depths less 50m. Nearshore fishes, at this time, are not surveyed using fishery-independent methods. As fishing pressure builds in nearshore areas, a standardized and statistically-designed survey will be needed to adequately monitor population trends.

3 A study of the stock structure of cabezon: Cabezon along the west coast of the U.S were assumed to consist of two distinct biological populations (split at the California-

Oregon border), but this assumption is based on very limited information. More work needs to be done to understand the stock structure of this and most other groundfish species.

4 Age validation/ age determination: Catch age-composition data were not available for this assessment. Accurate ageing is crucial to understand the population dynamics of a species, especially those for which there is limited survey information. Information on the age-structure of the catches for each fishery sector should substantially improve some aspects of the assessment.

5 A better understanding of the relationship between CPUE and population biomass: Changes in recreational CPUE are assumed to reflect changes in population biomass in a linearly proportional way. The results of the assessment would be severely in error if this assumption were substantially violated. Therefore, if future assessments depend on CPUE data, it is vital that the relationship between CPUE and population biomass be quantified. In principle, guidelines for dealing with this problem generically could be advanced through a workshop on methods and modeling approaches for the use of recreational data when developing indices of abundance.

6 A more standardized method of computing recreational CPUE. Recreational CPUE is becoming increasingly important as fishing effort moves into areas that have not been surveyed. Many decisions are necessary to use recreational information to develop CPUE indices. A more standardized method of developing these data would assist the development and review of assessments for those species that depend substantially on indices based on catch and effort information.

7 Effect of climate on cabezon: Several source of information in this assessment (e.g. the power-plant impingement index, the CalCOFI index and some length composition information) indicated that there was potentially good recruitment after 1999 (and before 1977 for the impingement data) whereas these same sources indicated that recruitment was very poor prior to 1999. This suggests that cabezon may be influenced by climatic/oceanic regimes. A better understanding of the relationship between cabezon population dynamics and climate would reduce the uncertainty of future assessments.

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Table 1. Biological parameters for cabezon. Values in parenthesis are the standard errors of the estimates.

A. Age and growth (VBGF) parameters

	Parameter L_∞	95% C.I.	k	95% C.I.	t_0	95% C.I.
North						
Male	690.25	NA	0.241	NA	-1.23	NA
Female	740.87	NA	0.354	NA	0.84	NA
South						
Male	46.85 (2.50)	41.93 to 51.77	0.28 (0.07)	0.14 to 0.43	-1.19 (0.74)	-2.53 to 0.26
Female	62.12 (3.53)	55.18 to 69.07	0.18 (0.03)	0.12 to 0.24	-1.06 (0.39)	-1.82 to -0.29
Combined	56.78 (2.57)	51.73 to 61.83	0.20 (0.03)	0.14 to 0.26	-1.23 (0.38)	-1.98 to -0.49

B. Age and length maturity function parameters (combined sex and area)

	a	b
age (years)	-1.5754	4.0968
length (cm)	-0.7433	25.7021

Table 2. Removals in mt for each fishery and state.

Year	California Commercial	California Recreational	California[a] Inferred Rec	Oregon Commercial	Oregon Recreational	Washington Recreational	California total	Ore-Wash total
1930	0		25				25	0
1931	1		25				26	0
1932	2		25				27	0
1933	2		25				27	0
1934	2		25				27	0
1935	5		25				30	0
1936	8		25				33	0
1937	4		25				29	0
1938	2		25				27	0
1939	2		25				27	0
1940	2		25				27	0
1941	6		25				31	0
1942	1		25				26	0
1943	3		25				28	0
1944	2		25				27	0
1945	2		25				27	0
1946	4		25				29	0
1947	2		25				27	0
1948	4		25				29	0
1949	7		25				32	0
1950	10		25				35	0
1951	11		25				36	0
1952	16		25				41	0
1953	6		25				31	0
1954	3		25				28	0
1955	3		25				28	0
1956	6		25				31	0
1957	6		25				31	0
1958	9		25				34	0
1959	4		25				29	0
1960	1		50				51	0
1961	2		50				52	0
1962	1		50				51	0
1963	1		50				51	0
1964	2		50				52	0
1965	3		50				53	0
1966	6		50				56	0
1967	6		50				56	0
1968	9		50				59	0
1969	12		50				62	0
1970	5		50				55	0
1971	2		50				52	0
1972	3		50				53	0
1973	2		50				52	0
1974	7		50				57	0
1975	3		100	0	0	2	103	2
1976	9		100	0	0	2	109	2
1977	6		100	0	0	2	106	2
1978	13		100	0	0	3	113	3
1979	23		100	0	13	2	123	15
1980	27	291		0	9	4	318	14
1981	29	121		0	28	3	150	30
1982	29	122		0	19	16	151	35

1983	11	104	0	19	4	115	24
1984	8	113	1	17	4	121	22
1985	11	77	3	14	3	88	20
1986	7	145	5	22	5	152	32
1987	4	117	6	13	8	121	27
1988	6	96	11	21	8	102	40
1989	11	101	7	22	14	112	43
1990	12	99[b]	5	19	11	111	35
1991	7	94[b]	8	19	9	102	36
1992	17	89[b]	7	19	14	105	40
1993	3	79	2	30	12	82	44
1994	41	55	7	23	9	96	38
1995	90	69	6	16	9	159	31
1996	114	85	6	17	8	199	31
1997	133	60	21	25	11	193	57
1998	169	73	27	16	6	242	50
1999	126	43	27	18	10	169	54
2000	117	41	31	17	7	158	55
2001	73	57	46	19	8	130	73
2002	51	39	44	18	12	90	74

[a] This catch has been assumed
[b] Catch was estimated by linear interpolation between the values for 1989 and 1993.

Table 3 Catch length composition by state and fishery sector.

California

by Commercial

cm	1995	1996	1997	1998	1999	2000	2001	2002
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00
28	0.05	0.04	0.00	0.01	0.00	0.00	0.00	0.00
30	0.08	0.11	0.01	0.03	0.00	0.00	0.00	0.00
32	0.15	0.16	0.03	0.09	0.00	0.00	0.00	0.00
34	0.08	0.14	0.06	0.12	0.01	0.02	0.01	0.00
36	0.12	0.13	0.16	0.17	0.15	0.18	0.05	0.00
38	0.06	0.10	0.14	0.20	0.22	0.19	0.18	0.17
40	0.07	0.06	0.12	0.12	0.18	0.17	0.22	0.21
42	0.10	0.04	0.15	0.10	0.13	0.12	0.18	0.09
44	0.05	0.05	0.07	0.06	0.10	0.09	0.15	0.13
46	0.10	0.04	0.06	0.03	0.07	0.08	0.10	0.08
48	0.02	0.04	0.07	0.03	0.04	0.04	0.05	0.11
50	0.04	0.03	0.02	0.02	0.03	0.03	0.02	0.06
52	0.01	0.02	0.04	0.01	0.02	0.02	0.02	0.05
54	0.02	0.01	0.01	0.00	0.01	0.02	0.01	0.04
56	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.02
58	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.02
60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
62	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

by Recreational

cm	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.06	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
20	0.06	0.00	0.00	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.03
24	0.08	0.01	0.01	0.04	0.02	0.02	0.00	0.02	0.04	0.03	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.03	0.00	0.01	0.03
28	0.16	0.00	0.03	0.02	0.01	0.04	0.06	0.00	0.02	0.01	0.00	0.02	0.02	0.01	0.01	0.01	0.03	0.00	0.01	0.00
30	0.11	0.06	0.16	0.06	0.02	0.04	0.04	0.04	0.00	0.06	0.03	0.01	0.02	0.02	0.02	0.01	0.05	0.00	0.02	0.00
32	0.05	0.06	0.03	0.07	0.03	0.04	0.10	0.02	0.00	0.04	0.01	0.04	0.04	0.04	0.06	0.02	0.08	0.03	0.02	0.01
34	0.03	0.06	0.08	0.05	0.05	0.05	0.06	0.00	0.00	0.04	0.05	0.03	0.13	0.07	0.08	0.04	0.08	0.00	0.01	0.01
36	0.10	0.08	0.08	0.08	0.03	0.06	0.07	0.09	0.06	0.07	0.09	0.07	0.11	0.13	0.11	0.25	0.13	0.04	0.02	0.12
38	0.03	0.05	0.08	0.09	0.08	0.08	0.09	0.03	0.05	0.04	0.09	0.07	0.09	0.15	0.13	0.05	0.10	0.07	0.01	0.00
40	0.06	0.11	0.10	0.13	0.19	0.09	0.04	0.09	0.07	0.20	0.12	0.11	0.06	0.10	0.13	0.17	0.10	0.05	0.03	0.17
42	0.03	0.06	0.09	0.06	0.04	0.06	0.05	0.09	0.05	0.04	0.14	0.16	0.13	0.12	0.15	0.17	0.12	0.08	0.09	0.20
44	0.04	0.06	0.04	0.10	0.11	0.11	0.06	0.14	0.10	0.11	0.13	0.09	0.07	0.10	0.10	0.06	0.07	0.10	0.08	0.06
46	0.06	0.08	0.10	0.08	0.03	0.05	0.10	0.11	0.12	0.04	0.11	0.07	0.11	0.06	0.04	0.14	0.09	0.06	0.11	0.12
48	0.04	0.08	0.06	0.06	0.17	0.06	0.06	0.05	0.15	0.05	0.03	0.05	0.07	0.03	0.06	0.02	0.01	0.07	0.13	0.08
50	0.02	0.06	0.02	0.02	0.06	0.03	0.07	0.04	0.08	0.01	0.04	0.03	0.01	0.05	0.05	0.02	0.04	0.09	0.15	0.00
52	0.03	0.06	0.02	0.03	0.07	0.06	0.04	0.08	0.02	0.05	0.04	0.03	0.04	0.03	0.02	0.02	0.03	0.10	0.09	0.06
54	0.02	0.03	0.03	0.03	0.03	0.05	0.05	0.07	0.07	0.03	0.01	0.01	0.02	0.04	0.02	0.01	0.00	0.09	0.12	0.04
56	0.04	0.06	0.02	0.02	0.03	0.02	0.01	0.08	0.07	0.08	0.03	0.03	0.02	0.01	0.00	0.01	0.01	0.01	0.04	0.01
58	0.02	0.04	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.01	0.05	0.00	0.01	0.02	0.00	0.00	0.04	0.03	0.00
60	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.03	0.03	0.02	0.00	0.01	0.01	0.01	0.00	0.01
62	0.02	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.05	0.01	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01
64	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
66+	0.01	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.03

Table 3 continued. Catch length composition by state and fishery sector.

Oregon

	by Commercial					by Recreational																			
cm	1998	1999	2000	2001	2002	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	8	1	1	0	0	6	0	0	0	0	1	2	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0
22	0	0	0	0	0	0	1	1	2	0	4	0	3	2	0	3	1	0	1	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	6	2	0	0	0	0	0
26	0	0	0	0	0	20	3	0	1	0	1	0	0	2	0	1	3	0	0	2	0	0	0	0	0
28	0	0	0	0	0	12	1	1	3	0	0	0	0	1	0	4	2	0	0	0	0	0	0	0	0
30	0	0	0	0	0	8	2	0	3	0	1	1	2	1	0	2	1	0	1	1	1	0	1	2	0
32	0	0	0	0	0	8	2	17	6	0	2	0	0	3	3	3	1	0	1	0	1	1	0	0	1
34	0	0	1	0	0	4	7	0	4	7	2	3	0	6	1	9	6	0	0	5	5	2	3	3	1
36	0	0	5	5	5	8	2	0	0	1	2	0	5	7	2	5	5	13	0	3	4	5	1	2	2
38	0	10	7	7	9	8	1	17	0	7	10	5	4	5	4	3	3	5	9	3	4	4	2	12	6
40	2	8	9	9	13	0	0	1	4	9	3	3	0	1	10	4	2	6	4	5	7	2	4	11	12
42	12	3	8	8	14	0	1	3	9	10	3	4	7	7	3	4	3	5	9	6	7	8	10	5	6
44	14	15	10	8	12	5	13	1	4	7	9	0	2	9	16	10	9	9	10	4	9	9	8	12	5
46	9	8	11	11	11	0	0	3	0	10	9	5	12	14	9	5	6	8	9	6	11	5	7	9	8
48	11	13	10	9	9	0	4	0	21	7	6	19	4	12	5	4	11	17	0	10	8	11	11	13	16
50	9	15	10	9	7	0	8	2	11	8	12	24	27	5	16	6	4	0	6	16	6	12	8	4	8
52	16	18	7	7	7	5	2	2	6	10	7	14	8	1	7	8	10	10	13	5	14	8	12	5	7
54	5	8	8	7	4	0	11	17	0	6	7	7	10	15	18	4	11	4	12	12	9	8	8	4	7
56	5	3	6	6	4	5	19	17	18	4	8	8	5	5	1	5	7	4	7	11	7	5	14	7	7
58	9	0	3	4	2	5	0	1	0	6	3	4	2	1	0	1	4	2	3	3	3	5	2	8	5
60	4	0	2	3	2	5	13	0	6	6	2	1	5	2	4	1	5	3	6	3	3	3	3	3	3
62	0	3	2	2	1	0	8	0	0	2	0	1	2	0	0	2	1	2	0	1	1	5	2	1	3
64	2	0	1	1	1	0	2	0	3	0	0	0	0	1	0	2	1	7	0	1	1	4	4	1	1
66	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	1	1	0	1
68	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	1	1	0	1
70	2	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
72	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
76+	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0

Table 3 continued. Catch length composition by state and fishery sector.

Washington

By Recreational

cm	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	8	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	7	9	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	5	0	0	20	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	2	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0
32	5	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0
34	5	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	2	0	4	0	0	0	0	0	0	0	4	0	0	0	14
38	5	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	4	12	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	5	0	0	0	6	6	0	5	0	14	0	0	0	0	17	4	0	14	0	14
44	7	24	8	0	6	6	0	5	0	0	0	0	0	14	17	25	0	0	0	0
46	4	24	10	20	6	3	0	8	9	0	0	0	0	0	0	4	10	7	33	0
48	2	12	0	0	19	3	0	0	0	0	0	0	0	0	0	11	10	0	0	0
50	5	3	28	0	0	6	0	12	9	0	0	0	0	0	0	0	0	14	17	0
52	2	0	13	40	0	6	0	0	0	0	0	0	0	29	17	0	20	0	0	0
54	1	0	5	0	25	12	0	14	16	14	0	0	0	0	0	12	10	0	0	0
56	6	0	10	0	0	3	0	5	3	0	0	0	0	0	0	10	10	14	17	0
58	3	12	0	0	12	0	0	9	3	0	0	0	0	14	0	10	10	0	0	14
60	4	0	2	0	0	0	0	8	13	14	0	0	0	14	17	6	10	21	17	29
62	9	0	2	0	6	6	0	5	10	14	0	0	0	0	0	10	10	0	17	14
64	6	0	8	20	6	6	0	23	0	14	0	0	0	0	17	0	0	7	0	0
66	0	0	0	0	6	0	0	4	3	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	6	0	0	4	3	0	0	0	0	0	0	0	0	0	0	0
70	0	0	5	0	0	3	0	0	0	0	0	0	0	0	0	0	0	7	0	0
72	0	0	0	0	0	3	0	0	0	14	0	0	0	14	0	0	0	7	0	0
74	0	0	0	0	0	3	0	0	0	0	0	0	0	14	17	0	0	0	0	14
76+	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Biological (length) sample size information

state	California		California		Oregon		Oregon		Washington	
sector	Commercial		Recreational		Commercial		Recreational		Recreational	
type	lengths		lengths		lengths		lengths		lengths	
	# samples	# trips	# samples	# trips	# samples	# trips	# samples	# trips	# samples	# trips
1980			483	468			104	101	119	117
1981			231	221			90	89	50	50
1982			303	292			135	133	50	50
1983			313	276			74.5	74	51	51
1984			242	228			106	106	53	53
1985			213	206			156	156	70	68
1986			284	284			150	150	31	31
1987			168	168			171	171	60	60
1988			136	136			202	202	43	43
1989			166	166			156	156	18	18
1990										
1991										
1992										
1993	30	15	317	306			221	221		
1994	9	7	184	178			244	244		
1995	206	84	194	186			100	100		
1996	1696	241	327	323			99	99	28	28
1997	904	131	162	159			375	375	14	14
1998	1345	148	235	226	5	57	217	217	43	43
1999	1479	191	208	207	6	40	220	220	42	42
2000	2500	340	122	121	116	866	185	185	24	24
2001	1080	163	197	197	132	1228	126	126	20	20
2002	251	35	122	124	172	1295	162	161	23	23

Table 5. Summary statistics for the data sources on which the indices are based.

Data source	Years	# obs	# positive
CA CPFV Observer CPUE	1988-98	4546	236
CA CPFV Logbook CPUE	1960-2001 except 1979	42577	16558
CA RecFIN CPUE	1980-2001 Except 1990-93	29849	2488
Oregon recreational CPUE	1979-87 &99-02	636	508
Washington Rec CPUE	1990-2001	44505	5712
AFSC larval survey	1980-1985 &1987	1170	174
CalCOFI Survey	1978-2002	2380	344
CA Power-Plant Impingement	1972-2002	6834	962

Table 6. AIC weights for the different models that were considered when developing the potential indices of abundance

model	% ZERO AIC	positive CPUE AIC	% ZERO AIC weights	positive CPUE AIC weights
CPFV OBSERVER				
year	1516.76	653.86	0.00	0.01
year port	1453.96	650.55	0.00	0.04
year port depth	1410.55	649.95	0.00	0.06
yr depth	1298.19	647.30	0.00	0.23
yr depth port	1271.96	645.16	1.00	0.66
CPFV LOGBOOK				
year	55835.82	64219.04	0.00	0.00
year season	55083.92	64000.57	0.00	0.00
year latitude	55641.67	61823.62	0.00	0.00
year depth	55290.08	64204.31	0.00	0.00
yr lat season	54767.92	61443.22	0.00	0.00
yr dep season	54572.67	63987.44	0.00	0.00
yr dep season latitude	53764.34	61204.37	1.00	1.00
RECFIN SHORE & PRIVATE BOAT				
year	17108.83	6745.07	0.00	0.00
year mode	17079.84	6680.41	0.65	0.06
year season	17107.71	6731.52	0.00	0.00
year mode season	17081.05	6674.85	0.35	0.94
CALCOFI LARVAL				
year 2	1929.86	1078.24	0.00	0.00
year day/night	1838.51	1069.41	0.00	0.00
year month	1905.78	1077.10	0.00	0.00
year longitude	1931.07	1080.08	0.00	0.00
year latitude	1868.80	1071.46	0.00	0.00
year day/night lat	1769.81	1057.76	1.00	1.00
CALIFORNIA POWER_PLANT				
year	5494.07	2904.42	0.00	0.00
year month	5607.46	3016.11	0.00	0.00
year season	4993.35	2682.41	0.00	0.00
year station	5380.96	2841.29	0.00	0.00
year season station	4881.64	2620.23	1.00	1.00
OREGON OCEAN BOAT SAMPLING (Recreational)				
year	652.38	1259.27	0.00	0.00
year port	619.23	1204.73	0.53	0.71
year season	653.60	1261.23	0.00	0.00
all	619.46	1206.57	0.47	0.29

AFSC OREGON WASHINGTON LARVAL				
year	984.87	452.49	0.00	0.00
year time	939.27	442.82	0.00	0.11
year season	984.42	451.99	0.00	0.00
year latitude	964.06	452.66	0.00	0.00
year longitude	902.53	453.25	0.00	0.00
yr long time	857.40	444.15	1.00	0.06
yr lat time	917.43	441.61	0.00	0.20
yr dist	919.26	447.70	0.00	0.01
year dist time	873.59	439.36	0.00	0.62
WASHINGTON OCEAN RECREATIONAL SAMPLING				
year	34050.96	14849.19	0.00	0.00
year port	30456.79	10269.39	0.72	0.65
year season	34038.07	14754.85	0.00	0.00
year port season	30458.66	10270.61	0.28	0.35
year vessel	33718.97	11899.46	0.00	0.00

Table 7. Estimated cabezon CPUE indices for each fishery in each area. The CV is the bootstrapped standard error CV associated with each years estimate

	CALIFORNIA					
	CPFV (Observer)		RecFIN		CPFV (logbook)	
Year	CPUE	CV	CPUE	CV	CPUE	CV
1960					4.07	0.12
1961					5.19	0.10
1962					8.17	0.10
1963					12.59	0.09
1964					14.10	0.08
1965					13.34	0.08
1966					14.19	0.08
1967					10.18	0.09
1968					5.71	0.09
1969					5.06	0.10
1970					6.64	0.09
1971					6.33	0.09
1972					10.33	0.08
1973					7.65	0.09
1974					8.17	0.08
1975					7.33	0.09
1976					6.72	0.08
1977					5.84	0.09
1978					8.91	0.09
1979						
1980			1.06	0.08	11.02	0.09
1981			0.94	0.11	5.49	0.10
1982			0.75	0.11	3.93	0.10
1983			0.95	0.10	4.41	0.10
1984			1.01	0.12	1.75	0.12
1985			0.85	0.12	2.16	0.12
1986			1.08	0.10	5.74	0.09
1987	4.92	0.69	1.06	0.13	7.71	0.09
1988	2.05	0.24	0.75	0.14	7.61	0.10
1989	1.73	0.26	1.44	0.15	10.00	0.08
1990	6.81	0.41			10.40	0.08
1991	1.76	0.40			8.06	0.09
1992	2.46	0.30			6.47	0.10
1993	1.02	0.36	0.90	0.08	3.51	0.11
1994	0.96	0.35	0.74	0.12	2.16	0.12
1995	1.25	0.29	1.05	0.13	2.88	0.11
1996	2.10	0.22	1.18	0.09	5.98	0.09
1997	1.37	0.28	0.82	0.14	5.01	0.08
1998	0.89	0.38	0.92	0.13	2.94	0.11
1999			0.74	0.12	2.76	0.10
2000			0.62	0.18	3.55	0.10
2001			0.86	0.17	5.34	0.10
2002						

Table 7 (continued)

	OREGON		WASHINGTON	
	Recreational		Recreational	
Year	CPUE	CV	CPUE	CV
1960.00				
1961.00				
1962.00				
1963.00				
1964.00				
1965.00				
1966.00				
1967.00				
1968.00				
1969.00				
1970.00				
1971.00				
1972.00				
1973.00				
1974.00				
1975.00				
1976.00				
1977.00				
1978.00				
1979.00	25.55	0.19		
1980.00	19.76	0.19		
1981.00	51.47	0.16		
1982.00	43.56	0.16		
1983.00	48.97	0.17		
1984.00	59.65	0.15		
1985.00	55.14	0.20		
1986.00	60.59	0.19		
1987.00	35.25	0.19		
1988.00				
1989.00				
1990.00			35.42	0.06
1991.00			38.04	0.06
1992.00			34.70	0.06
1993.00			32.68	0.06
1994.00			34.05	0.04
1995.00			35.17	0.05
1996.00			37.27	0.05
1997.00			42.20	0.05
1998.00			30.73	0.06
1999.00	67.44	0.13	33.79	0.07
2000.00	62.12	0.09	36.12	0.06
2001.00	56.63	0.10	52.41	0.06
2002.00	75.37	0.12		

Table 7 (continued)

	CalCOFI larval index (CA)		AFSC larval index (north)		S. CA Edison impingement index	
Year	CPUE	CV	CPUE	CV	CPUE	CV
1972					13.57	0.22
1973					17.22	0.20
1974					6.52	0.18
1975					9.38	0.15
1976					7.12	0.16
1977					4.39	0.23
1978	63.18	0.70			3.31	0.21
1979					1.48	0.22
1980	100.16	0.48	23.63	0.23	1.70	0.20
1981	43.57	0.30	9.16	0.26	2.76	0.24
1982			4.25	0.41	2.30	0.26
1983			18.33	0.25	2.36	0.24
1984	39.44	0.28	12.29	0.36	2.46	0.22
1985	74.52	0.31	6.81	0.36	2.36	0.21
1986	29.46	0.34			1.58	0.24
1987	32.96	0.46	23.13	0.34	2.65	0.20
1988	31.43	0.30			1.04	0.34
1989	87.16	0.21			2.59	0.24
1990	44.32	0.50			1.73	0.26
1991	85.75	0.32			2.39	0.23
1992	16.66	0.67			1.51	0.24
1993	16.82	0.50			0.56	0.34
1994	16.66	0.58			0.80	0.36
1995	30.34	0.38			0.84	0.44
1996	33.24	0.35			0.76	0.43
1997	46.69	0.37			1.32	0.39
1998	3.16	0.29			0.77	0.41
1999	52.95	0.29			5.87	0.22
2000	40.23	0.36			4.26	0.32
2001	29.37	0.37			6.02	0.49
2002	112.91	0.34			8.27	0.29

Table 8. The parameters of the population dynamics model. The base-case values are given for those parameters that are pre-specified while the prior distributions are specified for the parameters that are estimated by fitting the model to the catch, abundance index, and catch length-composition data.

Parameter	Description	Prior distribution / Base-case value
$\ell n S_0$	Logarithm of the virgin reproductive output (both stocks)	Uniform [6, 31]
c	Proportion of S_0 in the southern area	Pre-specified; 0.81
h	Steepness of the stock-recruitment function	Pre-specified; 0.7
ε_t^p	Recruitment residuals	$N(0;\sigma_R^2)$
L_{50}	Length-at-50%-selectivity	Uniform [19cm, 70cm]
ΔL	Difference between length-at-50% and 95% selectivity	Uniform [1cm, 60cm]
x	Maximum age-class	Pre-specified; 15 yr
M	Instantaneous rate of natural mortality	Pre-specified; 0.25 yr^{-1}
f_a	Fecundity-at-age	Pre-specified; Figures 2 and 3
$w_a^{g,p}$	Weight-at-age	Pre-specified; Figure 3
$\phi_{l,a}^{g,p}$	The age-to-length transition matrix	Pre-specified; Figure 3
σ_R^2	Extent of variation in the deviations about the stock-recruitment relationship	Pre-specified; 1
$\bar{L}_a^{g,p}$	Mean length of a fish of sex g, age a, and population p	Pre-specified; Figure 3
σ_a^g	CV of the length of a fish of sex g and age a	Pre-specified; see text
y_1	First year considered in the analysis	1930
y_{rec}	First year for which a recruitment residual is estimated	1975
Δl	Width of each length-class	2cm
l_{min}	Midpoint of the first length-class	6cm
l_{max}	Midpoint of the last length-class	92cm
CV_{min}	CV of length-at-age for an animal of age 1	0.14
CV_{max}	CV of length-at-age for an animal of age x-1	0.09
m_1	Slope of the logistic maturity function	Pre-specified; -1.58
m_2	Intercept of the logistic maturity function	Pre-specified; 4.1

Table 9. Values for the likelihood components for the base-case analysis and the sensitivity tests that involve changing the data sources included in the assessment (- data source is ignored).

Trial	Base Case	1	2	3	4	5	6	7	8	9
Likelihood Components										
CPFV logbook CPUE	83.43	78.23	84.44	84.28	83.71	83.78	83.17	83.11	83.38	-
RecFIN CPUE `	17.44	19.96	17.94	14.18	19.40	17.22	18.00	-	-	-
CalCOFI larval tows	-	-	-	-	-	-	29.44	-	-	-
Impingement	58.78	56.27	59.20	56.86	59.94	-	58.71	58.14	-	-
Length Freq Comm.	64.22	59.27	68.99	-	114.38	62.88	63.94	61.61	60.37	59.78
Length Freq Rec.	182.59	-	355.67	177.15	187.14	182.35	182.74	183.37	182.64	181.92
CPFV observer CPUE	-	-	-	-	-	-	-	-	-	10.23
Penalties	7.60	8.91	7.64	5.66	9.57	8.24	7.57	7.75	8.43	8.42
TOTAL LIKELIHOOD	414.06	222.56	593.89	338.13	474.15	354.48	443.58	393.99	334.83	260.35
2003 reproductive output	313	295	376	583	272	282	324	339	309	435
%Depletion	34.7%	35.4%	39.5%	46.6%	33.4%	32.8%	35.6%	36.9%	35.4%	47.5%
(Std. Dev.)	(7.21)	(9.84)	(7.40)	(8.91)	(7.62)	(7.32)	(7.27)	(10.49)	(11.98)	(19.34)

Table 10. Results for sensitivity tests in which the (pre-specified) values for M and σ_R are varied.

σ_R^2	M	ℓnS_0	S (2003)	%Depletion (Std Dev.)	Likelihood
0.36	0.2	14.57	334	31.5% (6.10)	406.81
0.36	0.25	14.48	364	37.4% (6.98)	403.30
0.36	0.3	14.44	403	43.4% (7.97)	402.82
1	0.2	14.48	283	29.2% (6.28)	415.93
1	0.25	14.41	313	34.7% (7.21)	414.06
1	0.3	14.36	348	40.2% (8.26)	414.40
2.25	0.2	14.43	260	28.2 (6.39)	428.35
2.25	0.25	14.36	289	33.4% (7.32)	427.25
2.25	0.3	14.33	323	38.8% (8.38)	427.96

Table 11. Results for sensitivity tests in which changes are made to the first year for which a recruitment residual is estimated, the historical (pre-1980) recreational catches, the effective sample size of the recreational length frequencies, CVs assumed for length-at-age, and the form of the selectivity ogive.

	ℓnS_0	S (2003)	%Depletion (Std. Dev.)	Likelihood
Base Case	14.41	313	34.7% (7.21)	414.06
y_{rec}				
1965	14.37	295	33.9% (7.22)	414.30
1985	14.64	543	47.9% (8.16)	423.25
1995	14.64	482	42.2% (5.86)	439.96
Recreational catch series (pre-1980)				
Halved	14.33	309	37.2% (7.77)	415.21
Doubled	14.60	394	35.9%(7.58)	417.40
1980 Catch = 116mt (not 291 mt)	14.33	267	32.0% (7.22)	413.62
Effective sample size				
Halved	14.36	320	37.2% (7.49)	658.26
Doubled	14.48	338	34.8% (7.23)	288.97
Length at age CV (both sexes)				
0.05 (all ages)	14.70	603	49.6% (7.91)	411.39
0.2 (all ages)	14.12	141	20.5% (6.34)	434.93
0.2/0.05 (ages 1 and 15)	14.35	292	34.0% (7.62)	419.93
0.09/0.14 (ages 1 and 15)	14.39	276	31.1% (6.39)	410.18
Domed-shaped Commercial Selectivity	14.43	332	36.0% (7.43)	412.76

Table 12. Median harvest levels corresponding to four control rules for each of three scenarios.

Year	Point estimates (Base-case)				Posterior distribution (Base-case)				Posterior distribution (Nine analyses)			
	40-10 rule	$F_{45\%}$ [a]	60-20 rule	$F_{50\%}$ [b]	40-10 rule	$F_{45\%}$ [c]	60-20 rule	$F_{50\%}$ [c]	40-10 rule	$F_{45\%}$ [c]	60-20 rule	$F_{50\%}$ [c]
2004	61	85	20	71	93	97	39	81	85	96	35	80
2005	65	83	29	71	94	97	50	82	88	96	46	82
2006	73	84	40	73	97	98	63	85	91	96	58	84
2007	75	83	47	74	98	98	70	87	90	95	64	85
2008	74	82	52	74	96	96	74	87	84	92	65	84
2009	72	79	55	73	94	95	77	87	80	89	66	82
2010	71	78	59	72	92	93	80	87	76	86	66	81
2011	71	76	64	72	91	92	84	87	74	82	68	79
2012	70	75	68	72	90	90	88	87	72	80	68	77
2013	70	73	71	72	89	89	91	87	71	77	70	75
2014	69	71	74	71	88	87	93	87	71	76	72	74
2015	68	69	77	70	86	85	95	86	71	74	74	73
2016	68	68	80	70	85	84	98	87	72	74	76	72
2017	68	66	83	70	85	83	101	87	72	72	78	72
2018	68	64	85	69	84	81	104	87	72	71	80	71
2019	67	63	87	68	83	80	106	87	72	70	81	71
2020	67	61	89	67	83	78	108	87	73	70	85	72
2021	66	59	92	67	83	77	110	86	74	69	87	72
2022	67	58	94	66	82	75	112	86	74	68	90	72
2023	67	56	97	65	82	74	114	86	75	67	92	72

[a] $F_{45\%spr}$=0.239
[b] $F_{50\%spr}$=0.197
[c] Not given

Figure 1. A map of the assessment area that shows both state and INPFC boundaries.

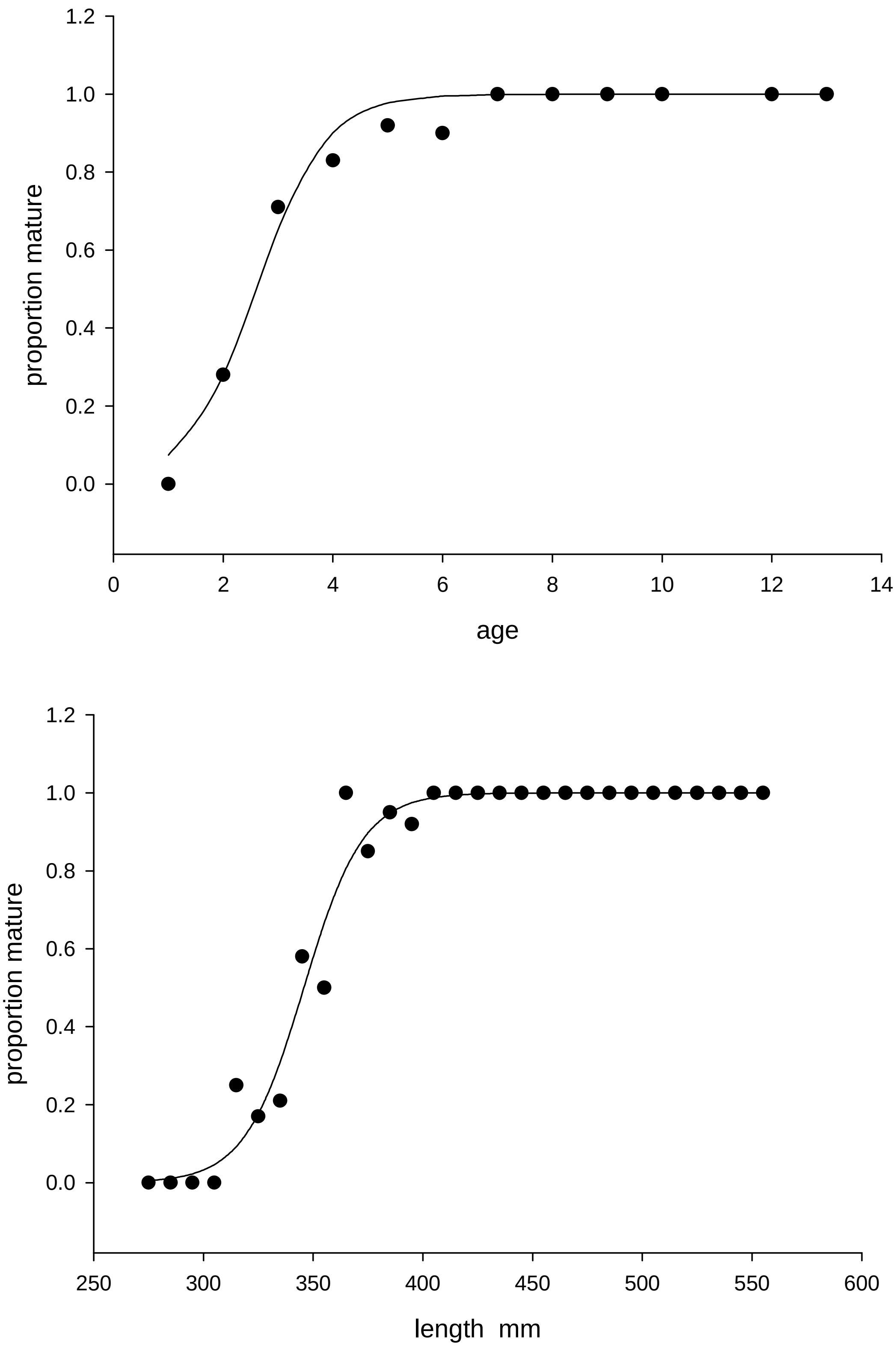


Figure 2. The maturity ogives of female cabezon by age and length.

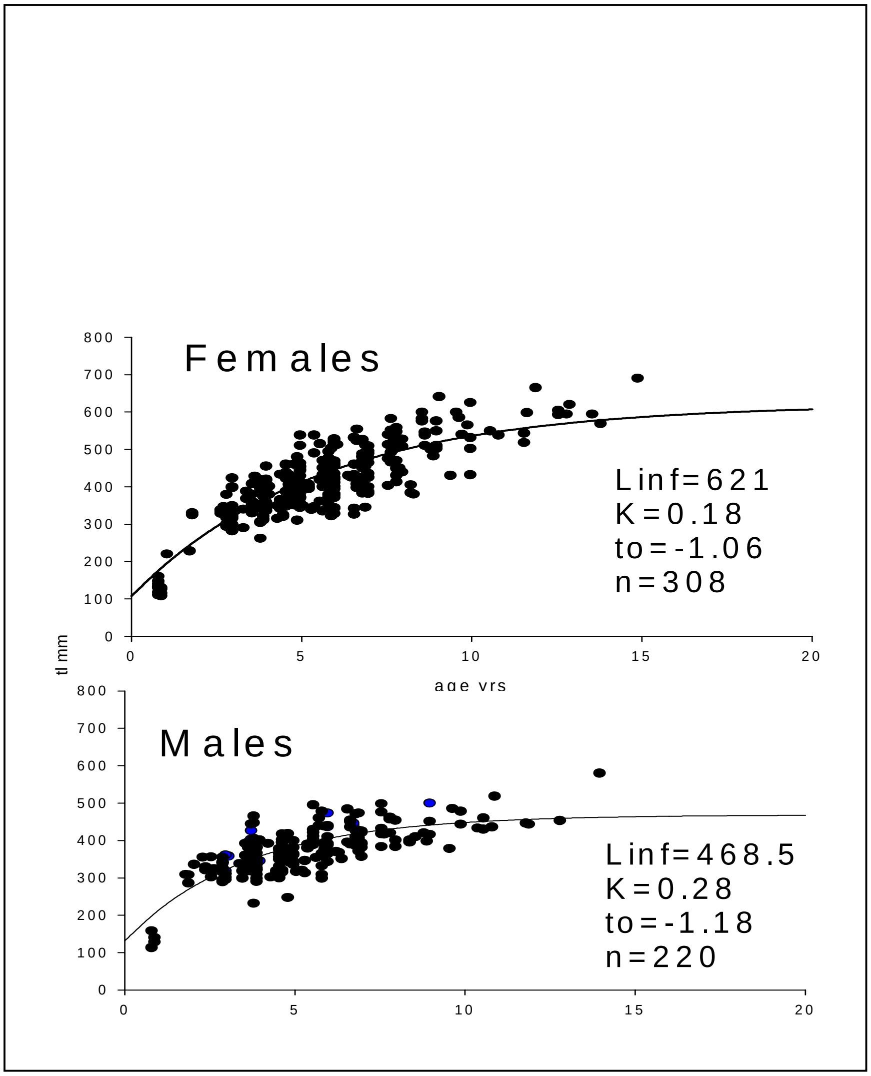


Figure 3a

Figure 3a. Von Bertalanffy growth curves for male and female cabezon from California (Grebel 2003).

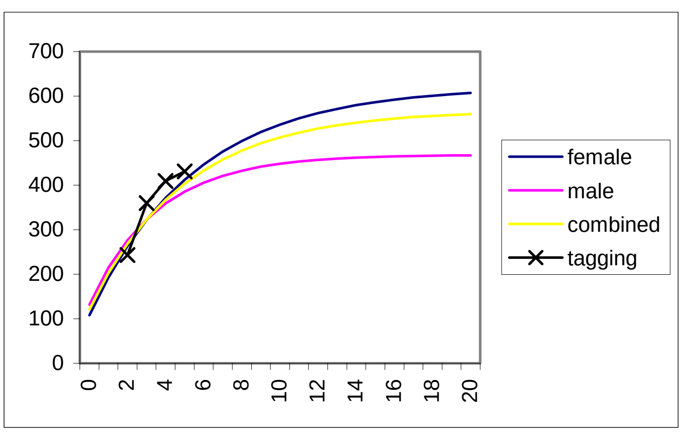
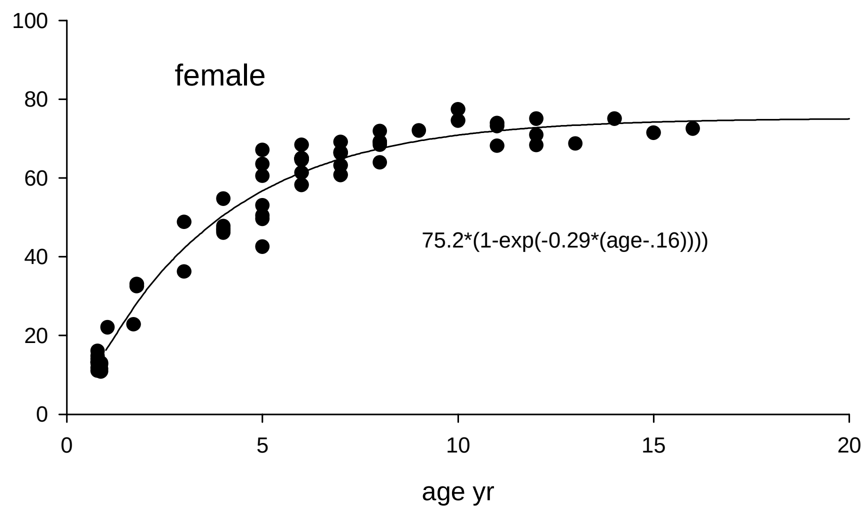


Figure 3b. Von Bertalanffy growth curves from California cabezon and that estimated from tag recapture information. Results are only shown for the tag-recapture based growth curve for lengths for which tag-recapture data are available.



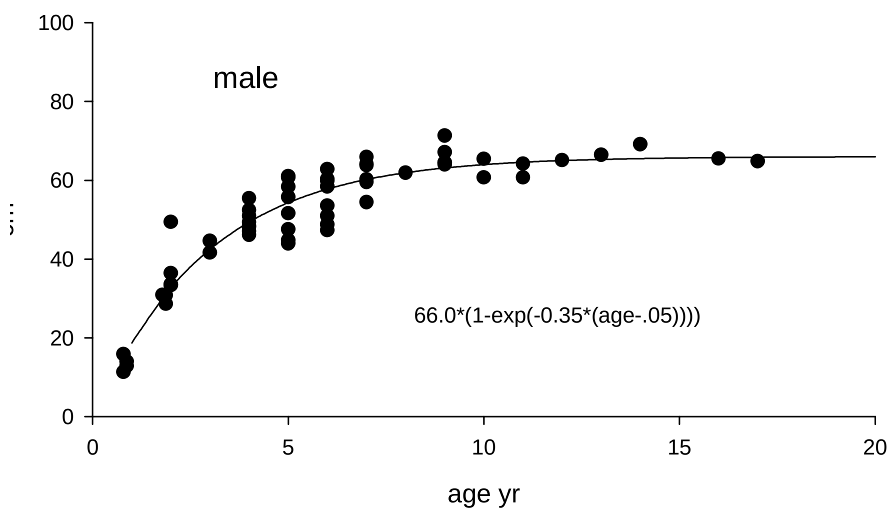
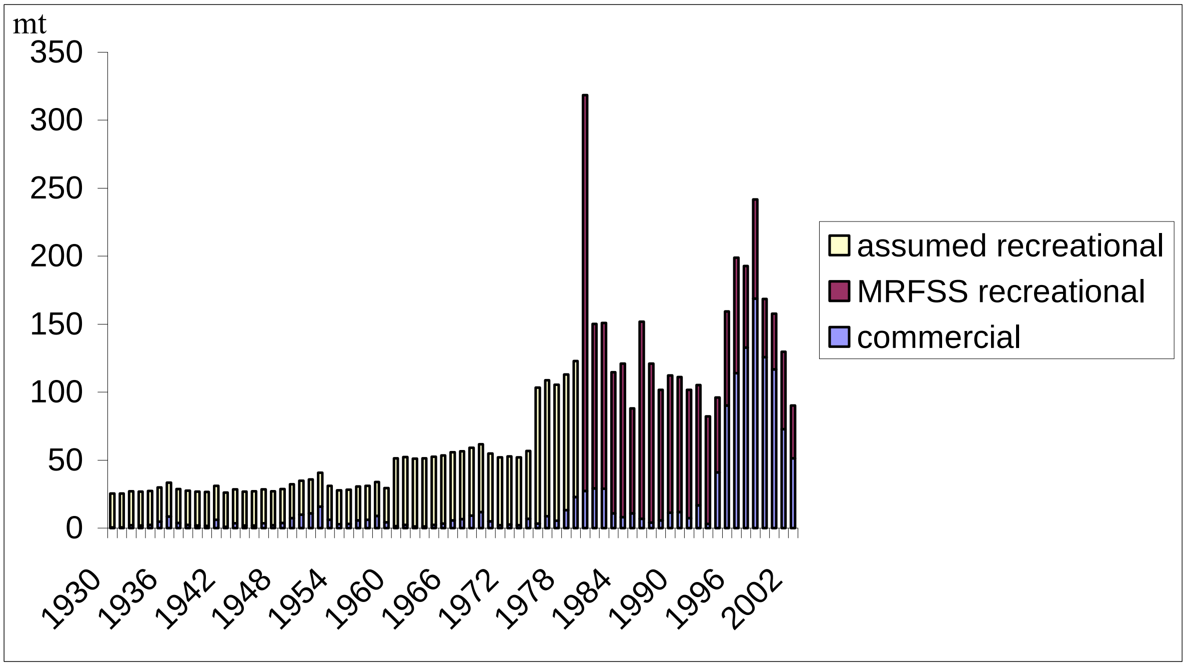


Figure 3c. Length-at-age relationships for cabezon in Puget Sound (Lauth 1987). All fish <2yrs are from California (Grebel 2003).



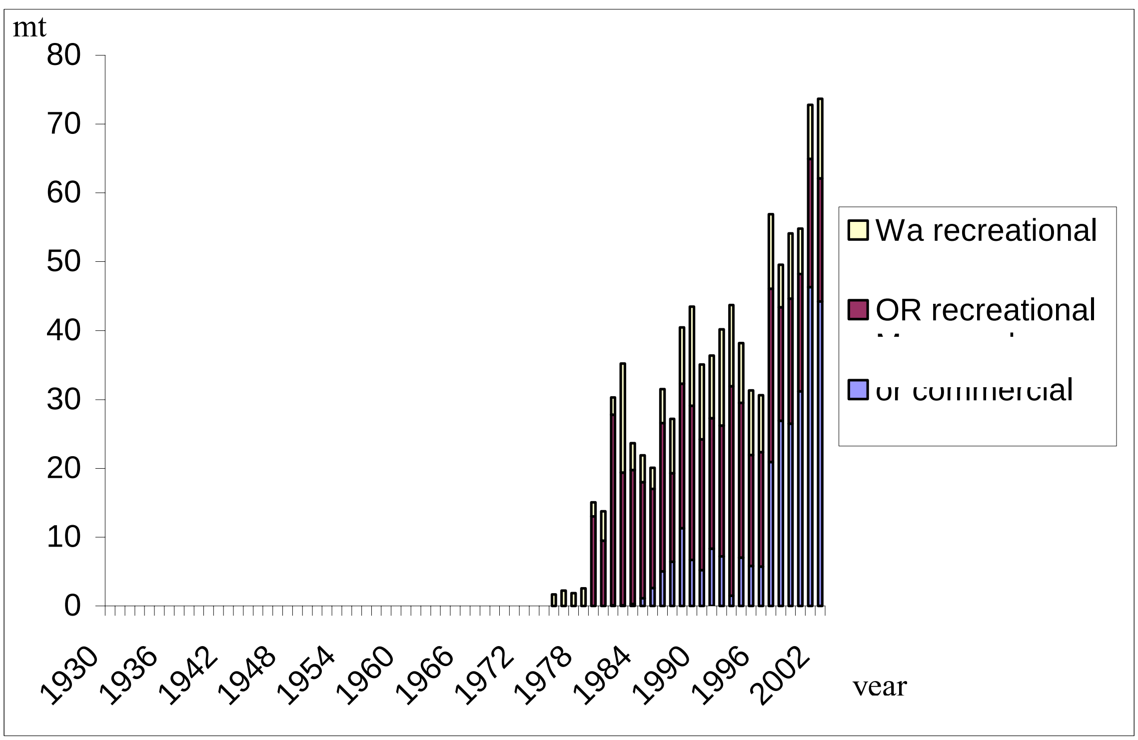


Figure 4. The cabezon removals by state and fishery sector used in the modeling. The removals for the recreational sector in California for the years prior to 1980 were inferred as outlined in the text.

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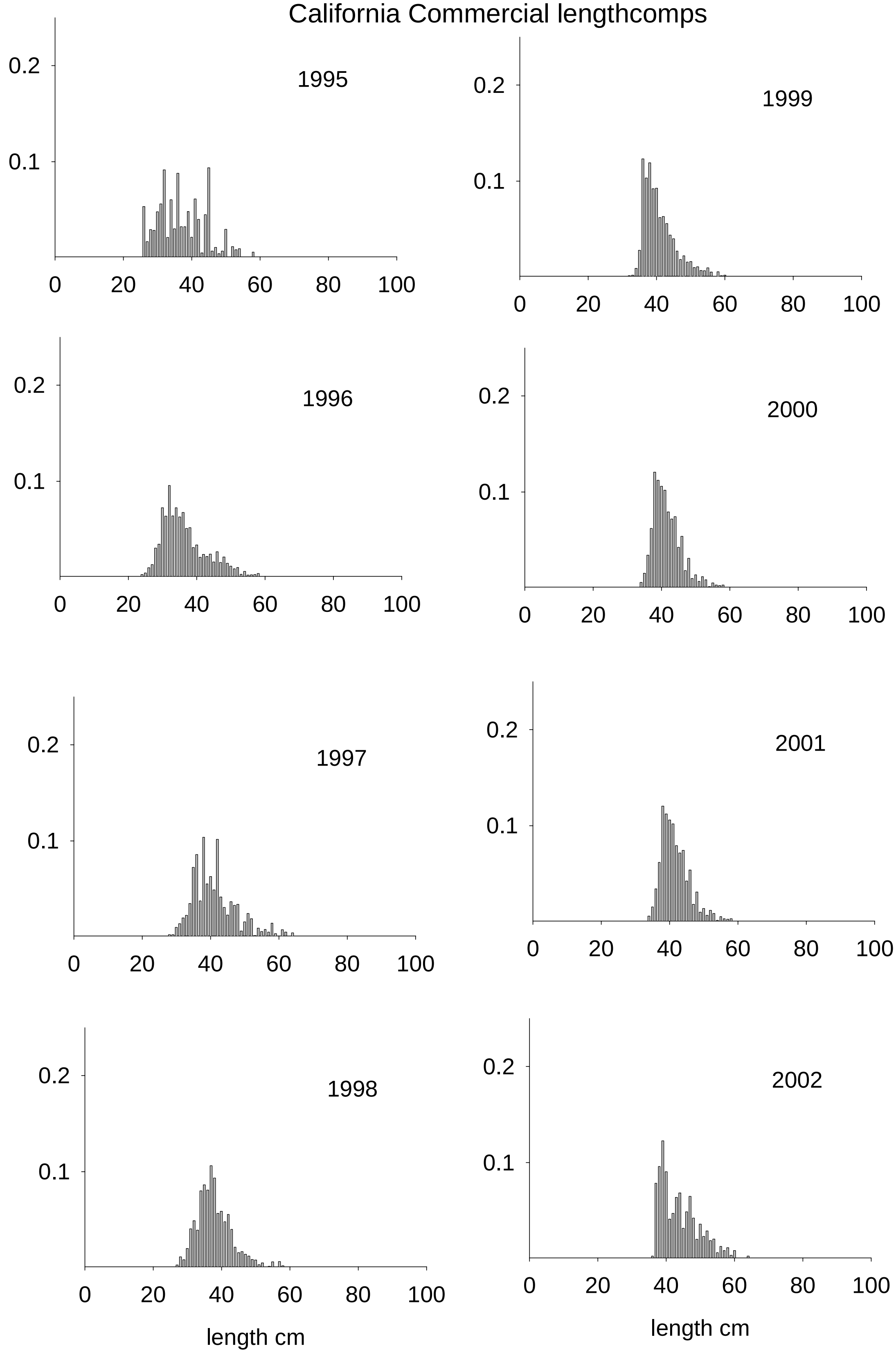
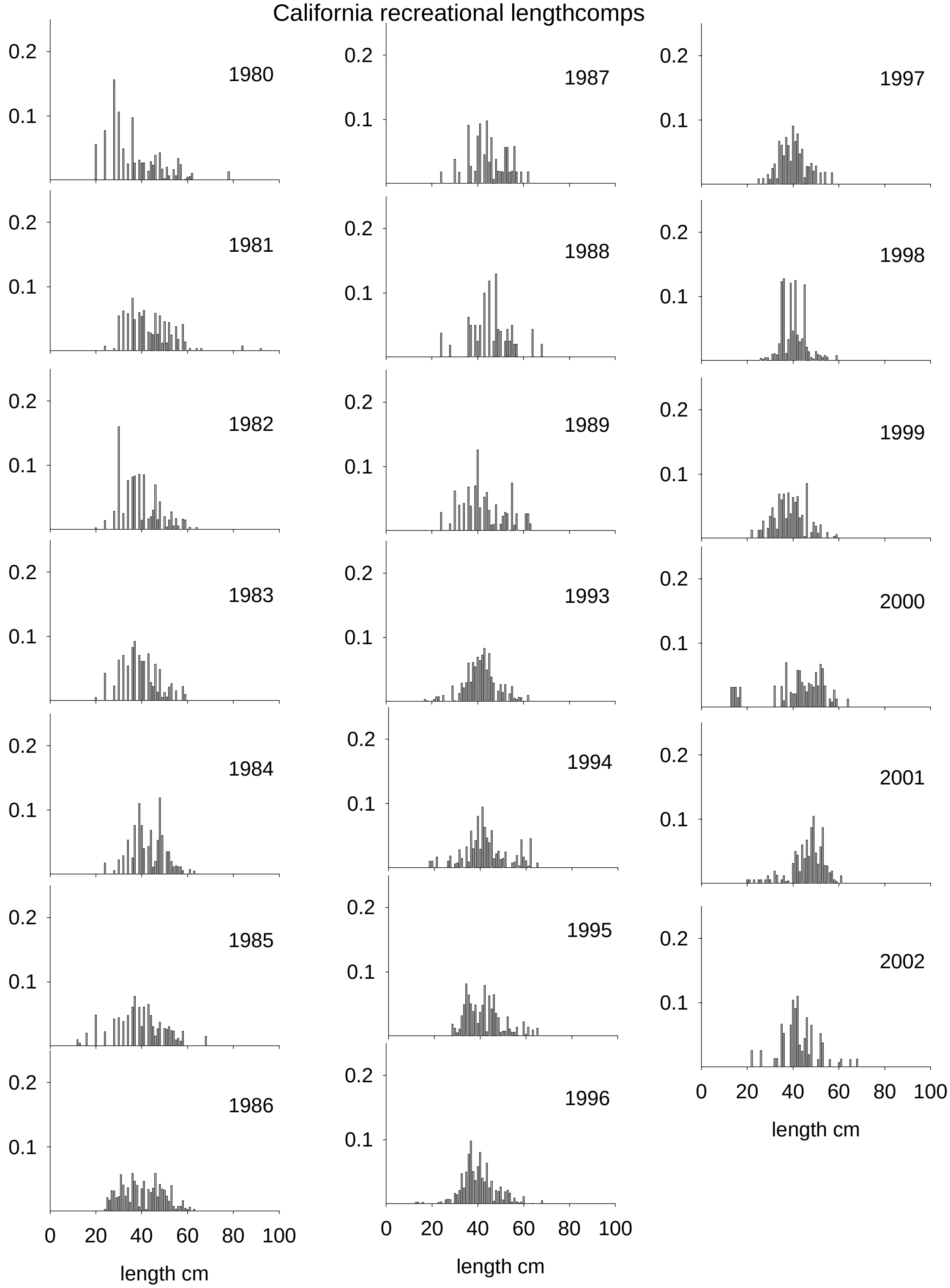
Figure 5. The following figures show the raw (i.e. un-binned) catch length frequency information by state and fishery sector. The order of information is commercial then recreational for California, Oregon and Washington.

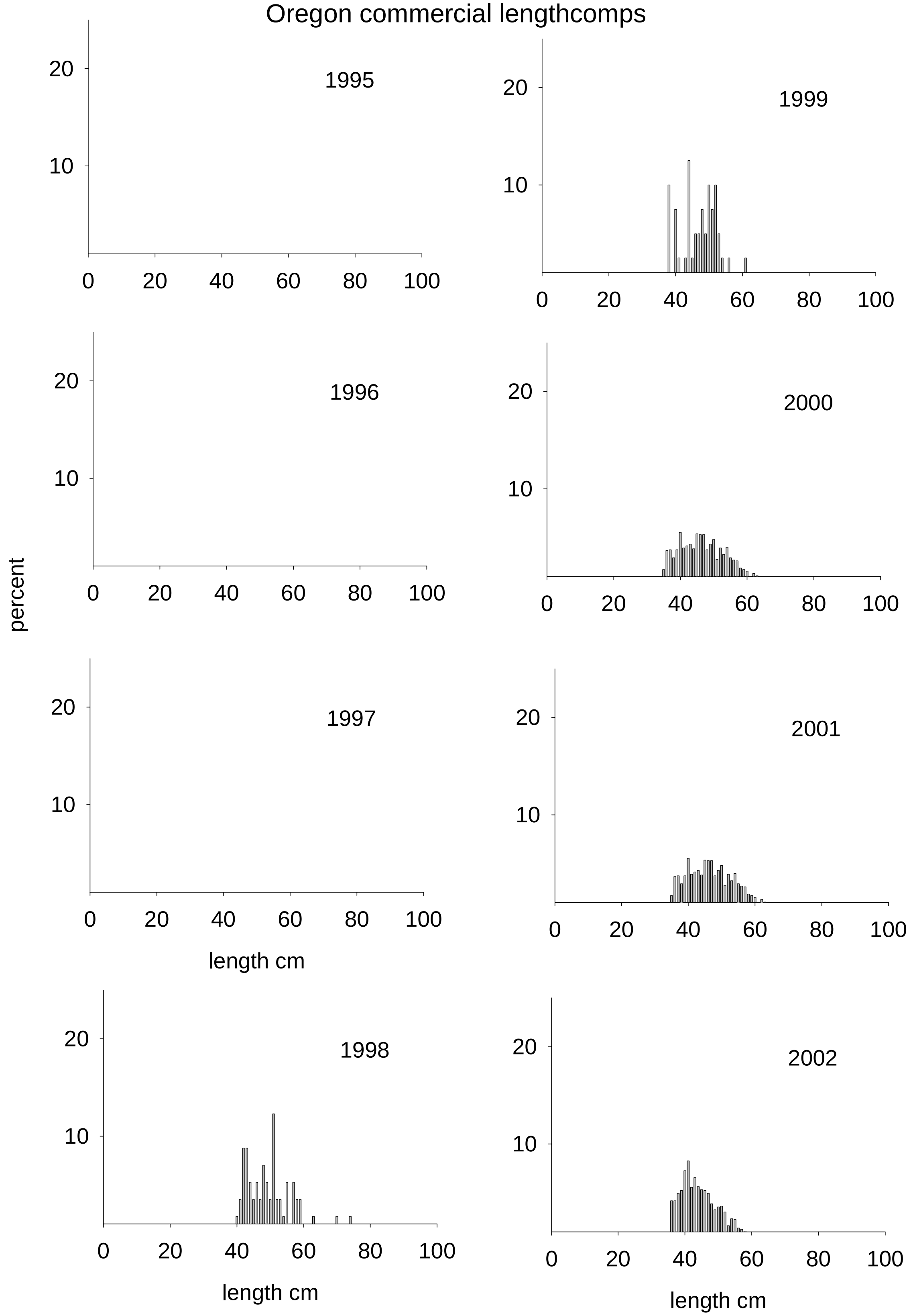
California Commercial lengthcomps



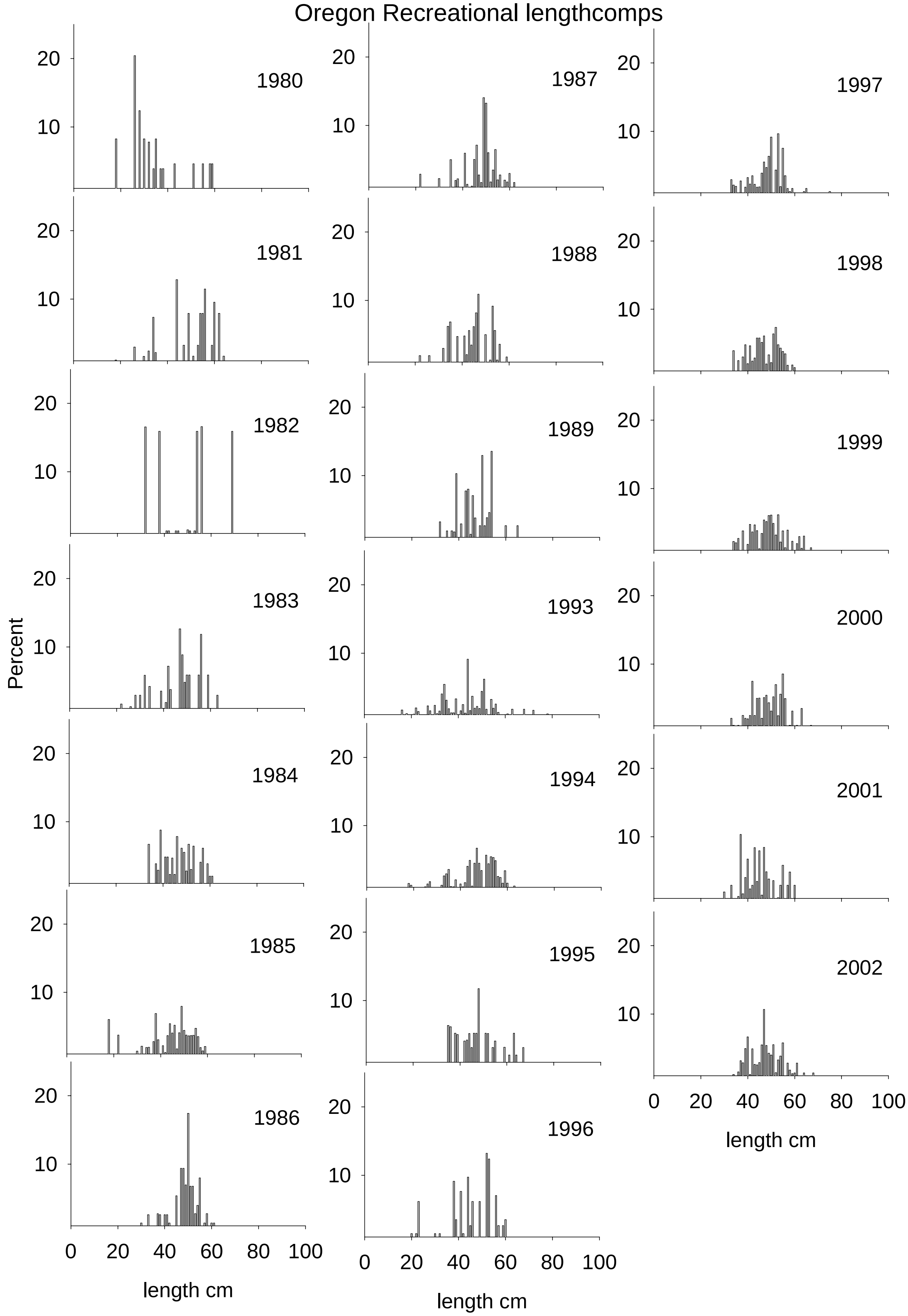
California recreational lengthcomps



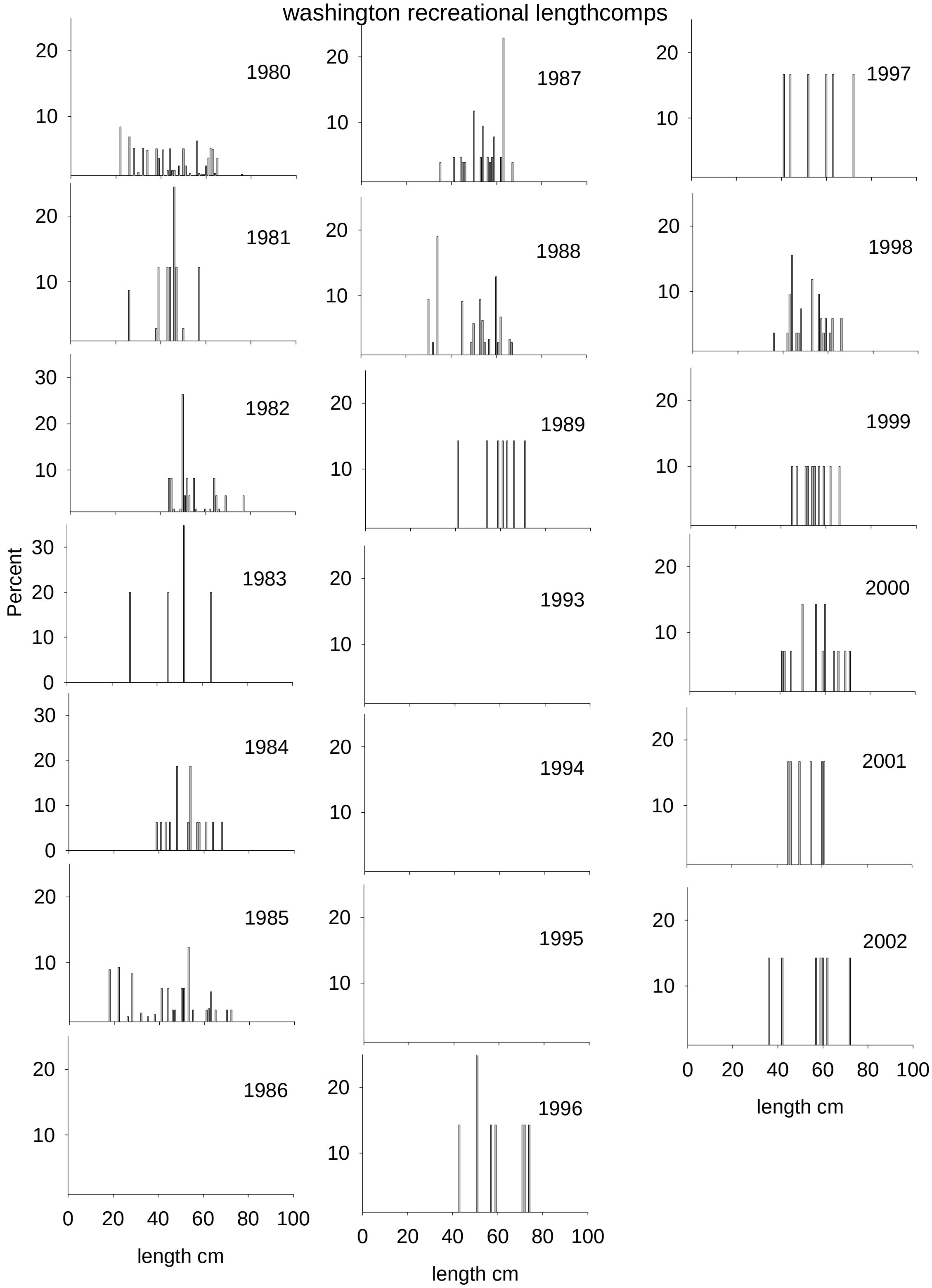
Oregon commercial lengthcomps

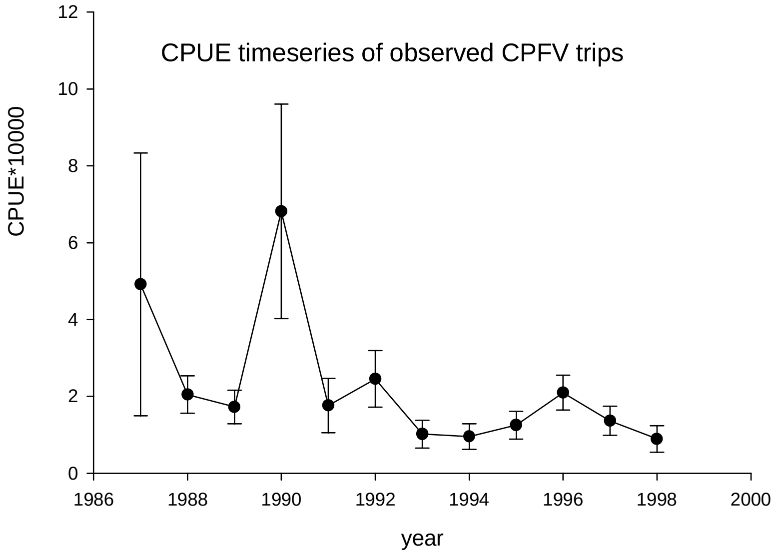


Oregon Recreational lengthcomps



washington recreational lengthcomps





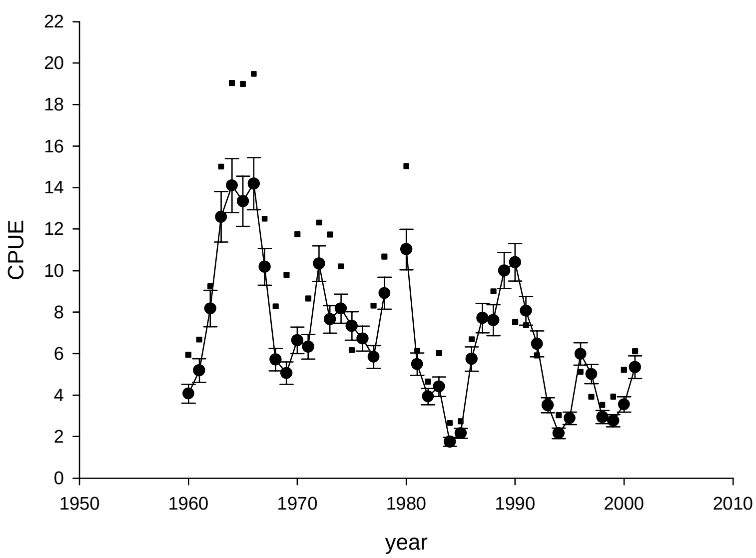


Figure 6. Recreational CPUE indices for the California CPFV fleet (CPFV Observer – upper panel; CPFV Logbook – lower panel). The GLM-based CPUE estimates are represented by connected circles; raw averages by the unconnected squares.

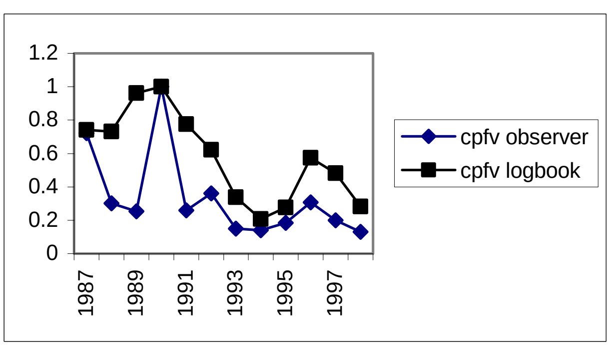
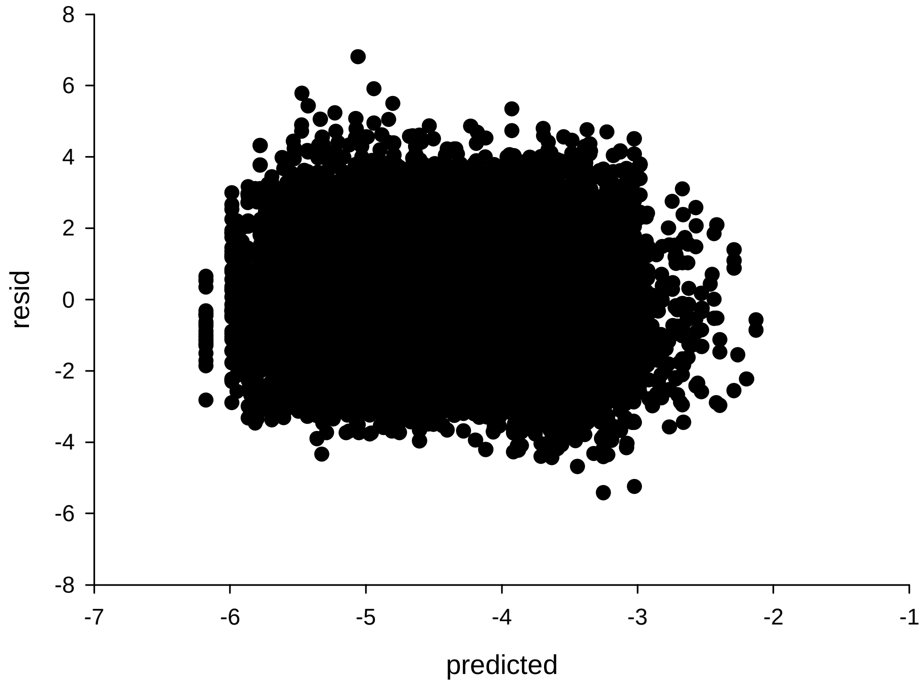


Figure 7a. Comparison of the CPFV observer and CPFV logbook indices.



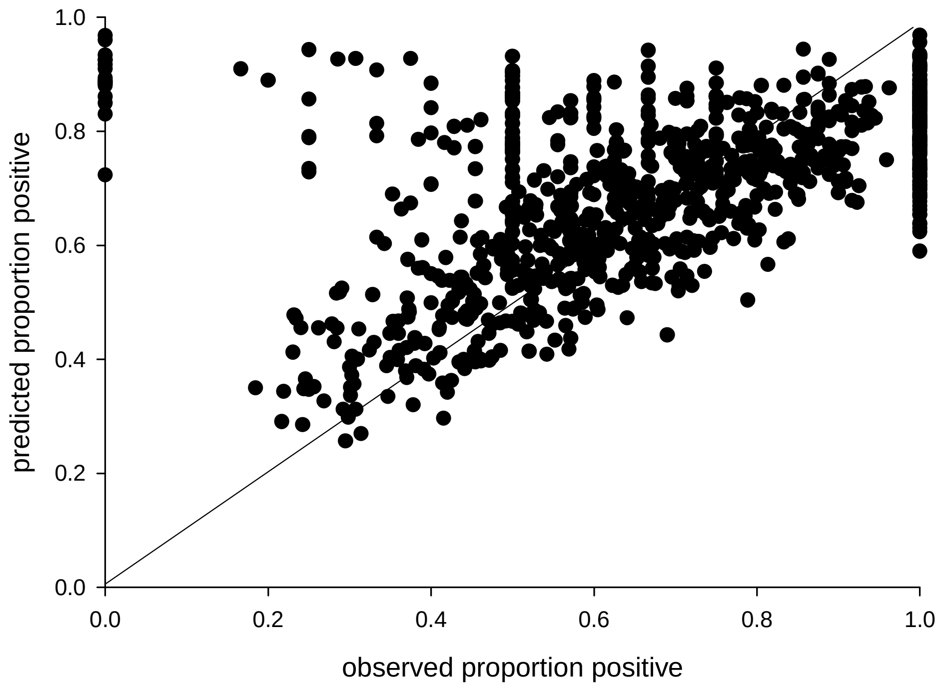


Figure 7b. Upper graph: Residuals plots of model estimates of the CPFV logbook positive tow CPUE; lower graph: observed and predicted percent of positive tows for each year-season-latitude combination.

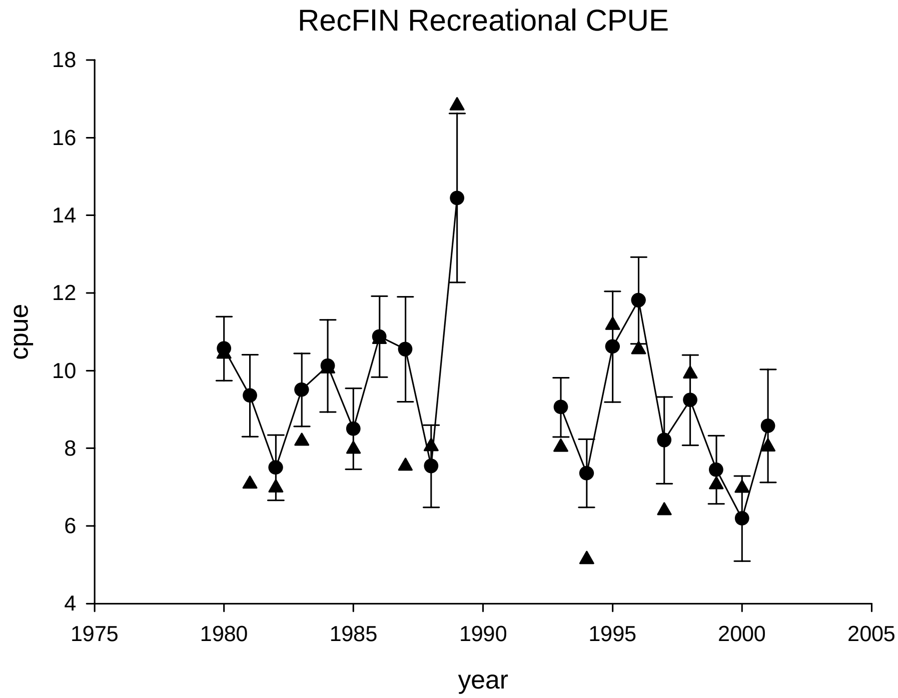


Figure 8. Recreational CPUE indices based on data for California shore and private boat anglers. The GLM-based CPUE estimates are represented by connected circles; raw averages by unconnected squares.

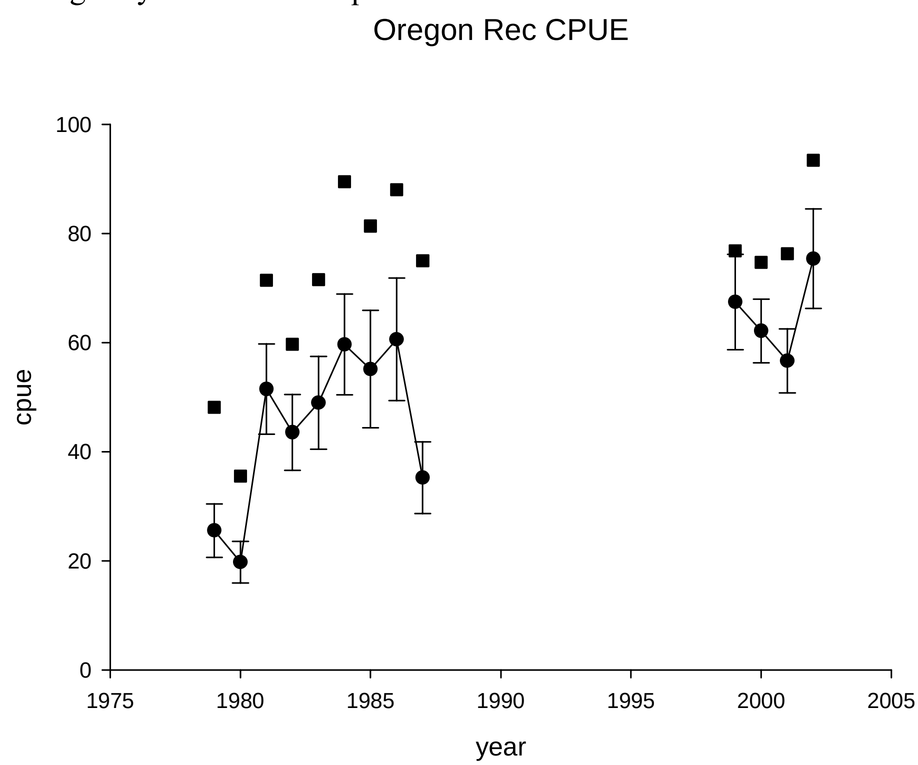


Figure 9. Recreational CPUE indices based on data from the Oregon ocean boat sampling program. The GLM-based CPUE estimates are represented by connected circles; raw averages by unconnected squares.

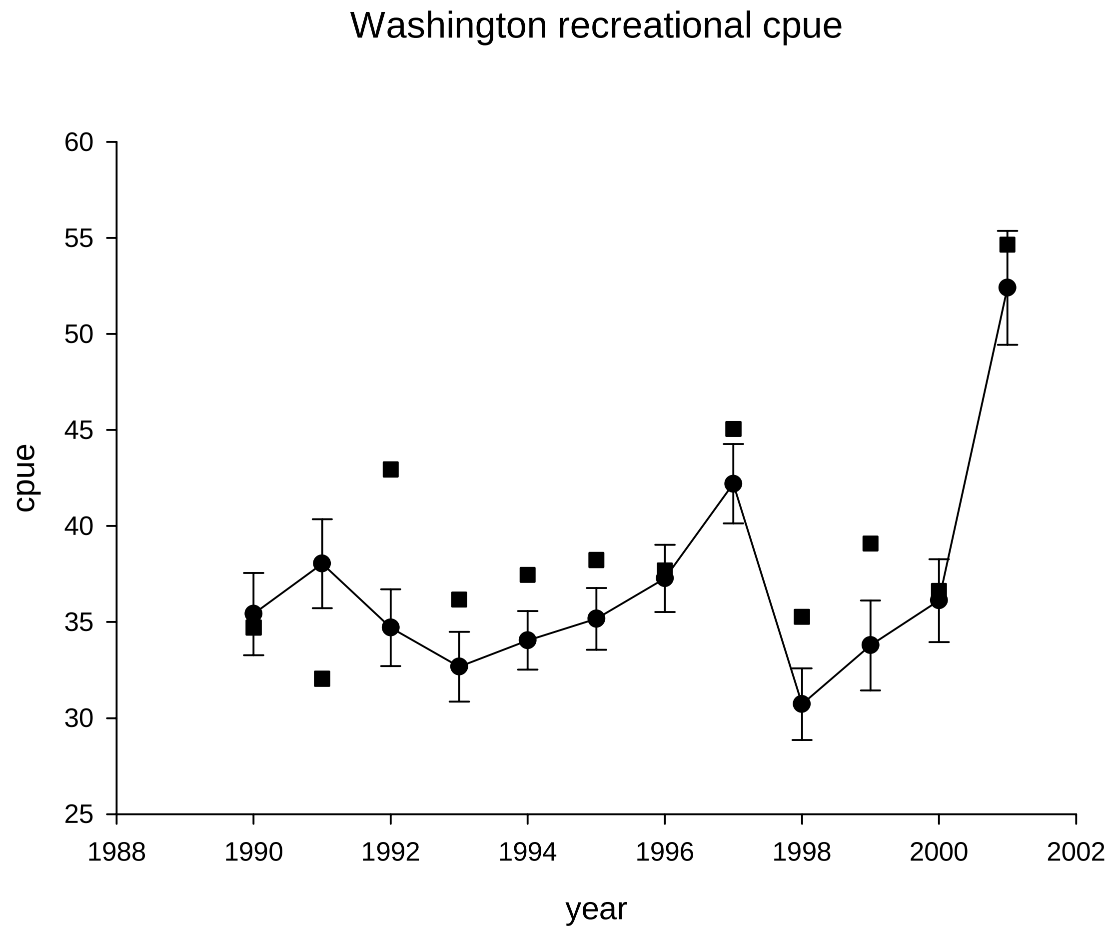


Figure 10. Recreational CPUE indices based on data for Washington state. The GLM-based CPUE estimates are represented by connected circles; raw averages by unconnected squares.

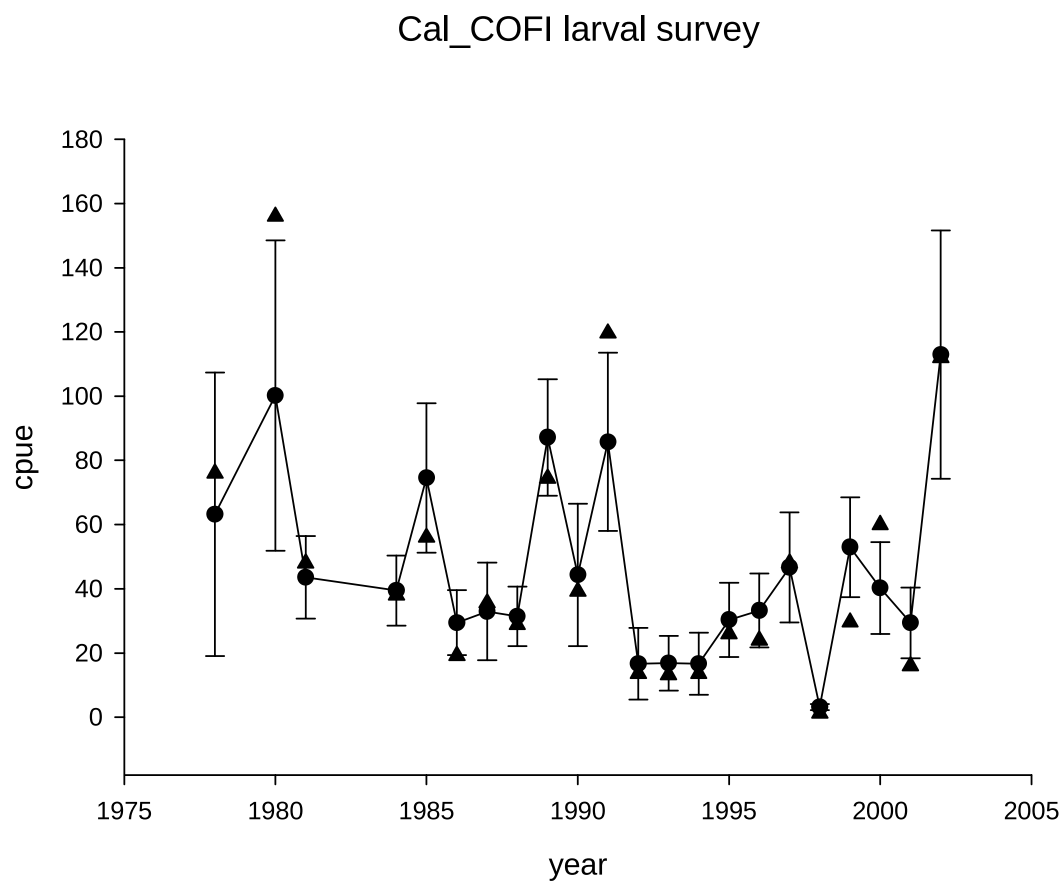


Figure 11. Index of reproductive output for southern California based on data from CalCOFI larval survey. The GLM-based CPUE estimates are represented by connected circles; raw averages by unconnected squares.

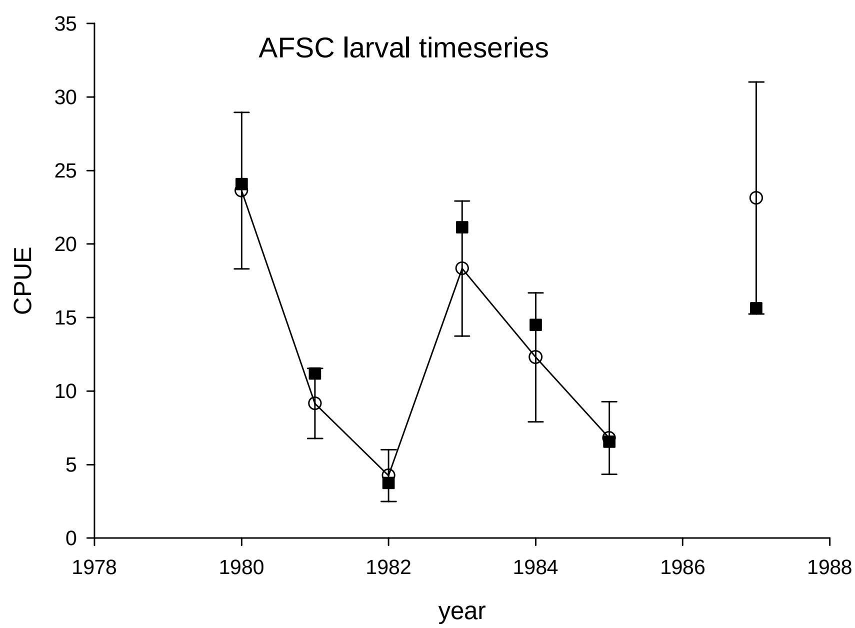


Figure 12. Index of reproductive output for Oregon and Washington based on data from the AFSC larval survey. The GLM-based CPUE estimates are represented by connected circles; raw averages by unconnected squares.

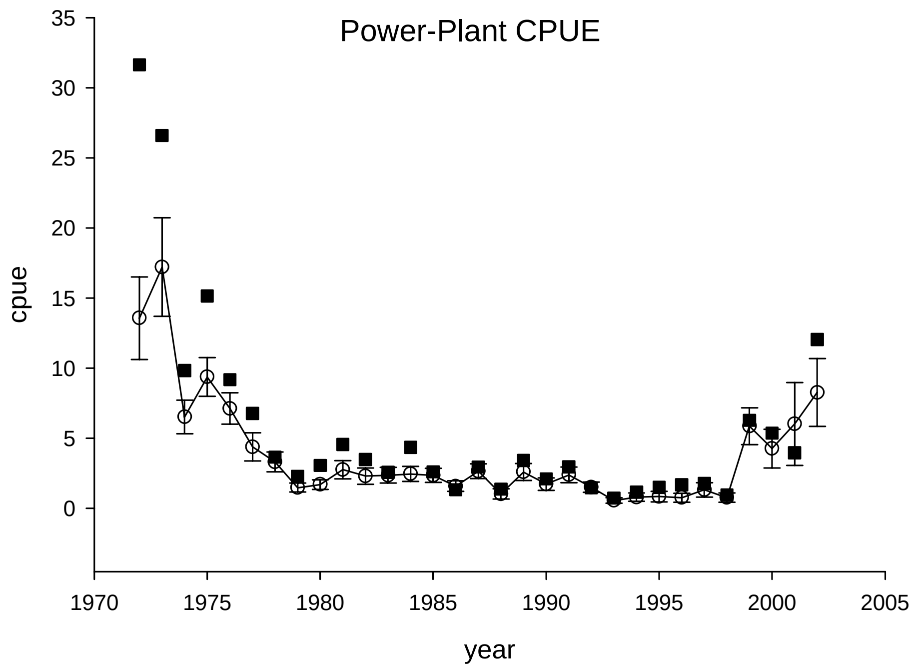


Figure 13. The timeseries of estimated CPUE from power-plant impingement data. The GLM-based CPUE estimates are represented by connected circles; raw averages by unconnected squares.

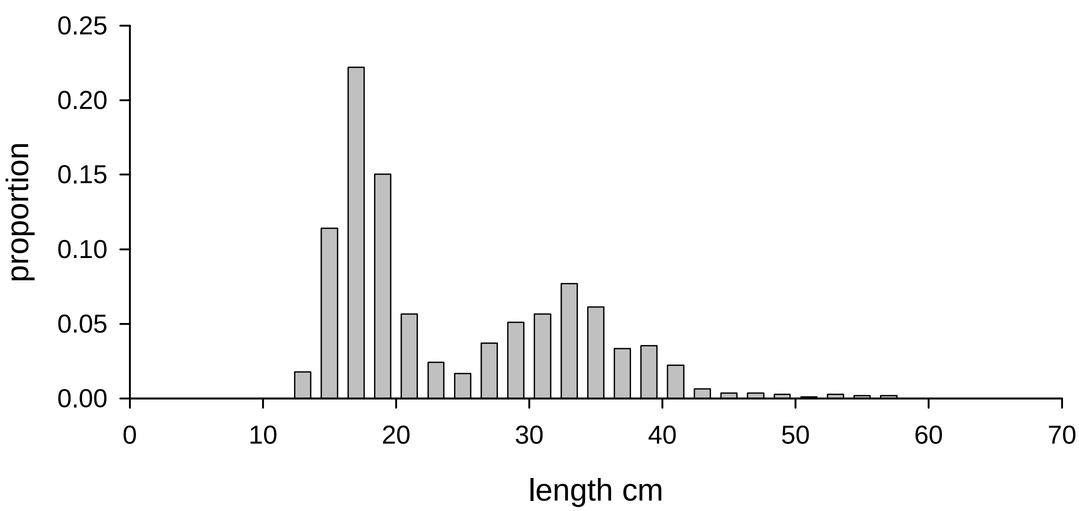


Figure 14. The raw length frequency of cabezon sampled in the power plants used to create the impingement time series depicted above.

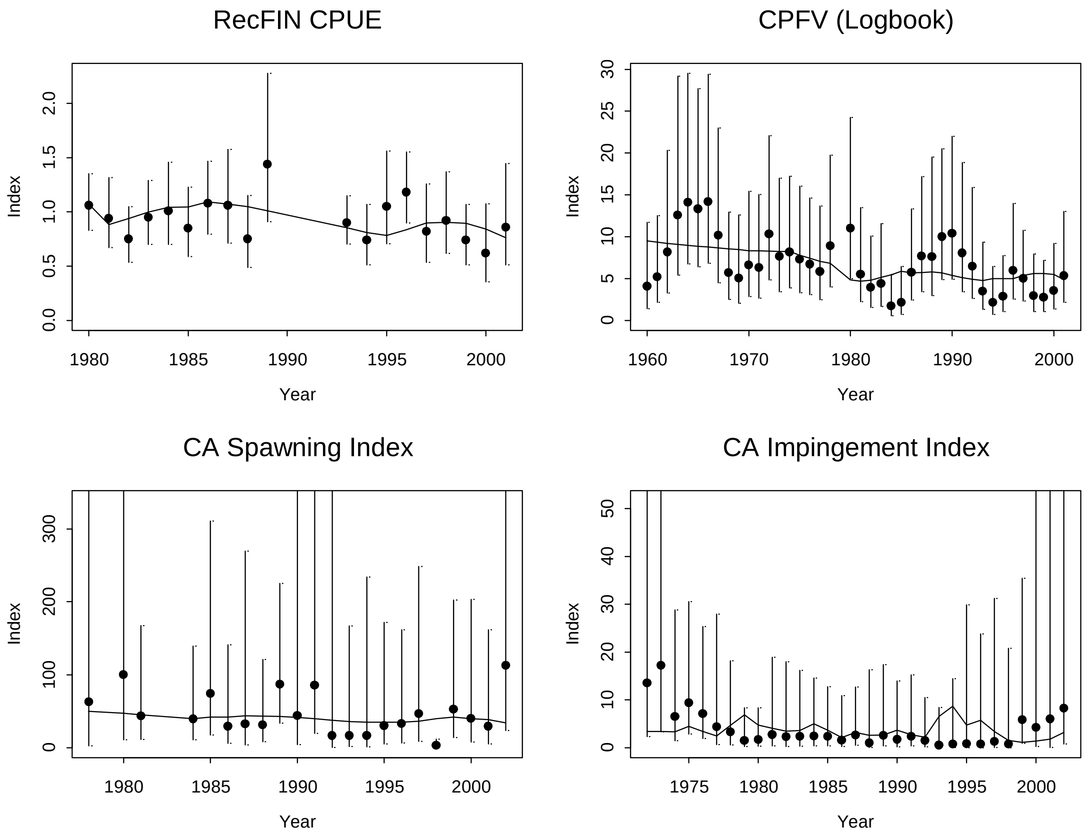


Figure 15. Observed (solid dots) and model-predicted (solid lines) abundance indices for cabezon off California.

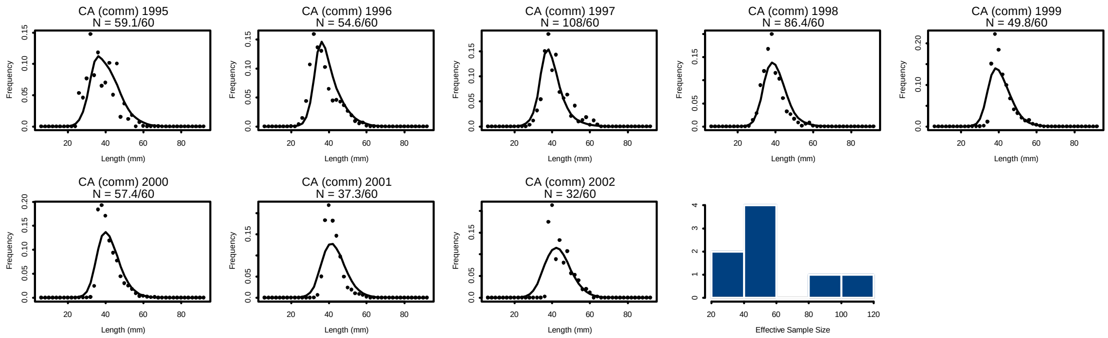


Figure 16. Observed (solid dots) and model-predicted (solid lines) commercial catch length-compositions for California. The annual effective sample sizes are shown in the form of histograms.

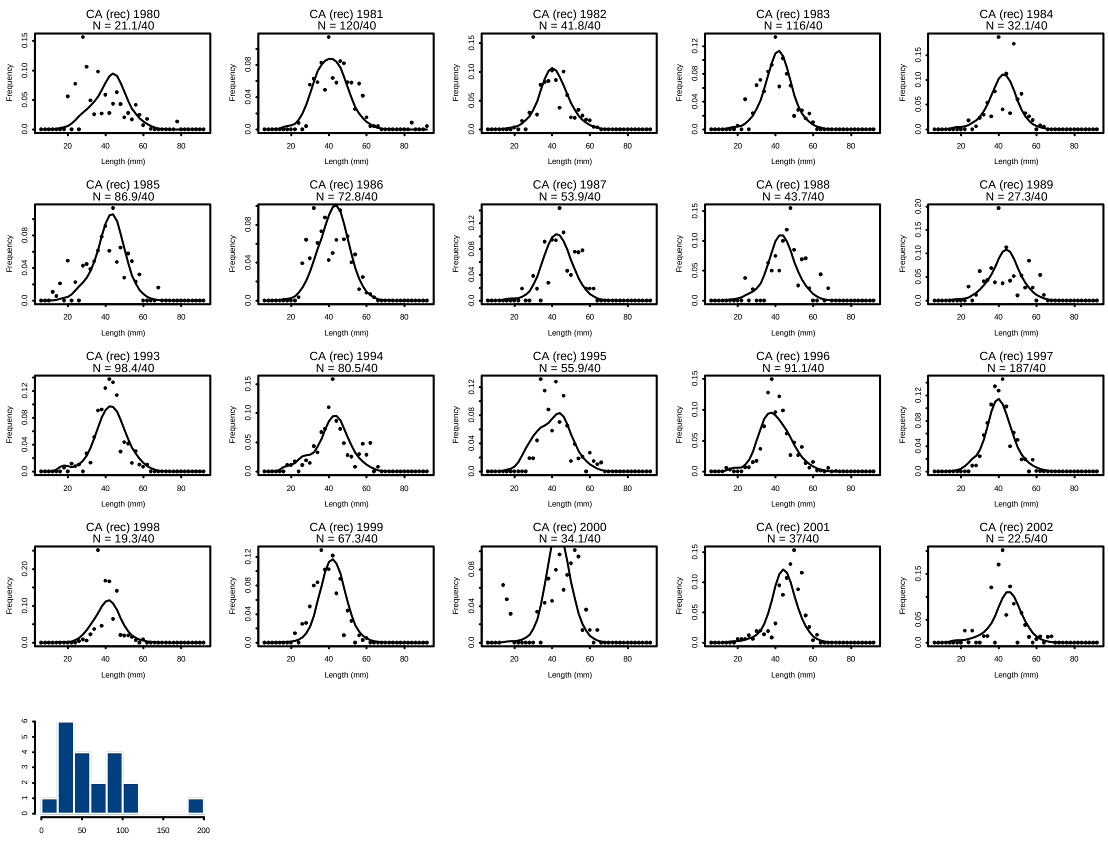


Figure 17. Observed (solid dots) and model-predicted (solid lines) recreational catch length-compositions for California. The annual effective sample sizes are shown in the form of histograms.

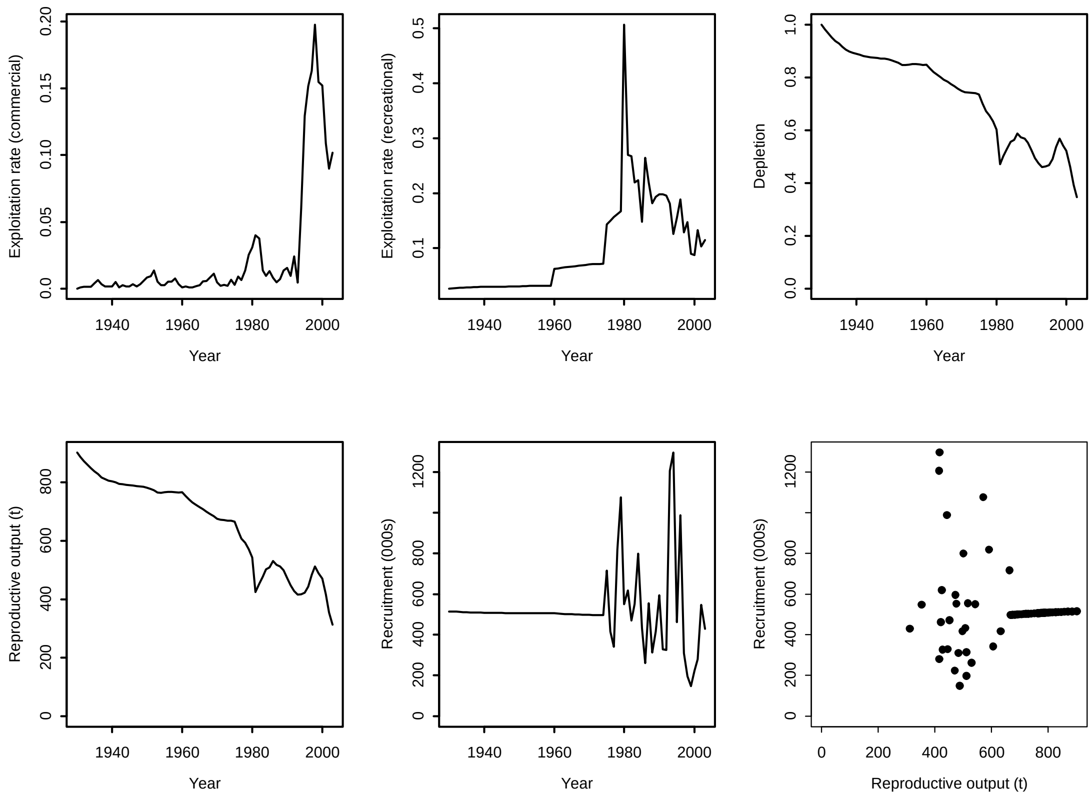


Figure 18. MPD time-trajectories of reproductive output and fishing mortality for cabezon off California.

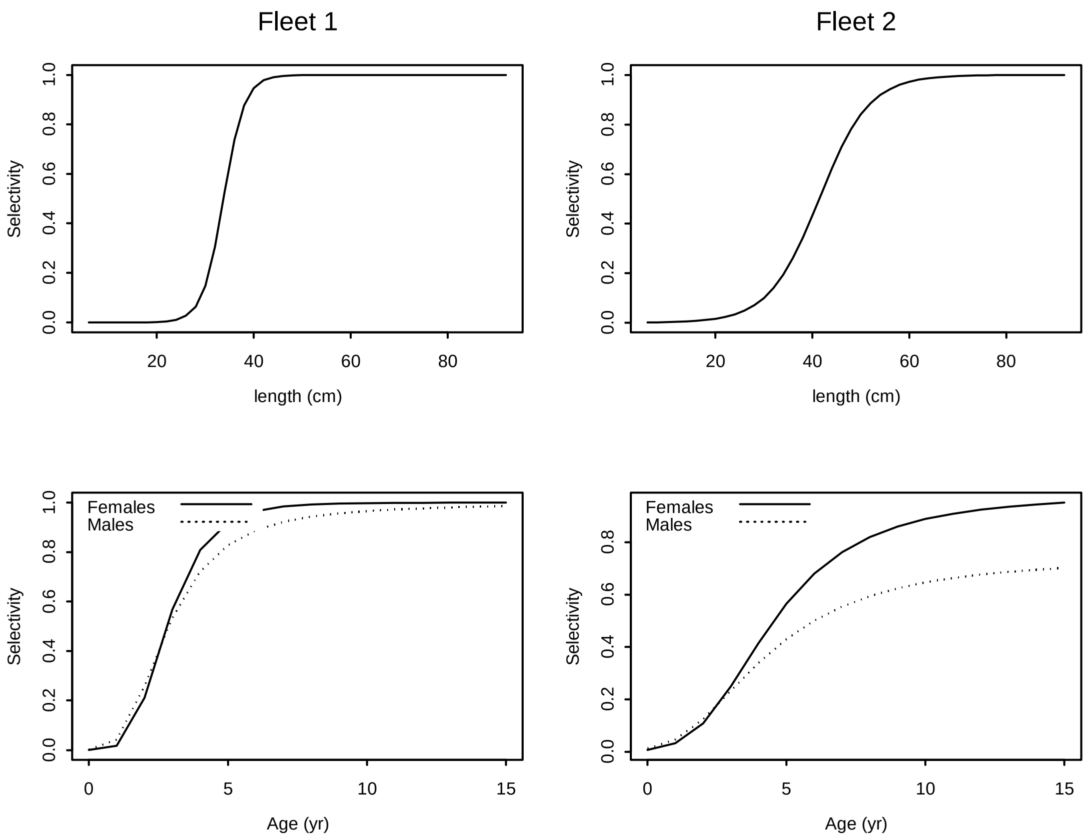


Figure 19. Cabezon length- and age-specific selectivity ogives for two fleets off California.

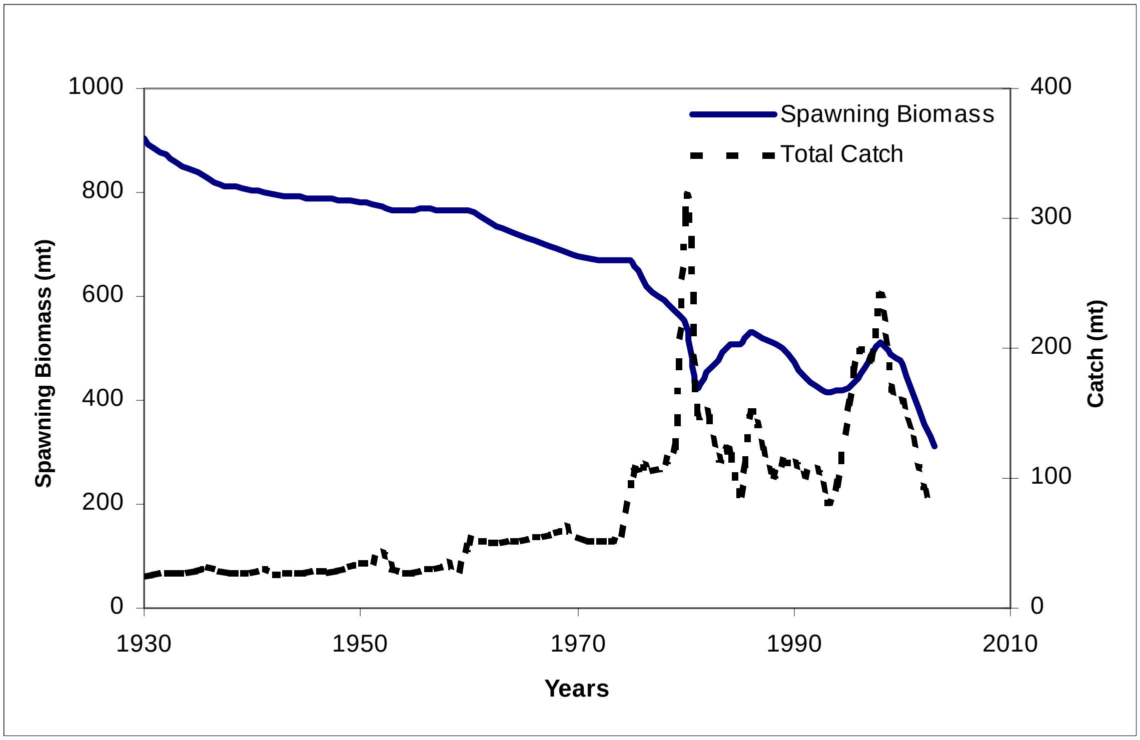


Figure 20. MPD time-trajectories of reproductive output and catch for the California population of cabezon.

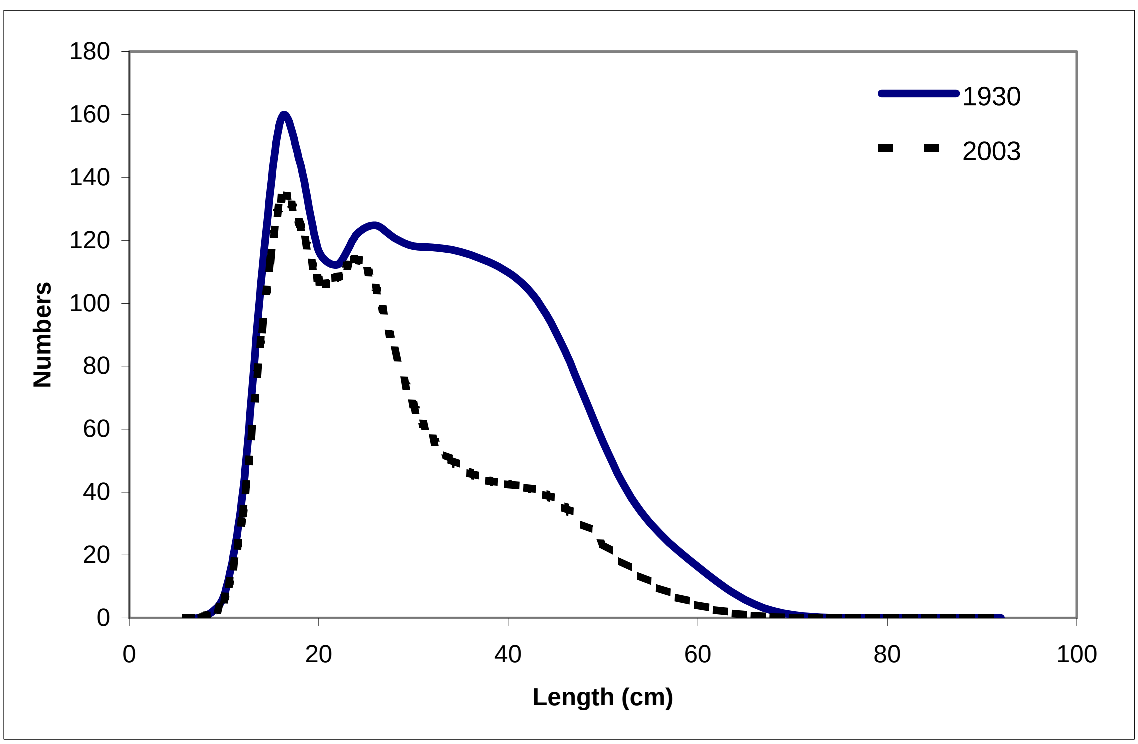
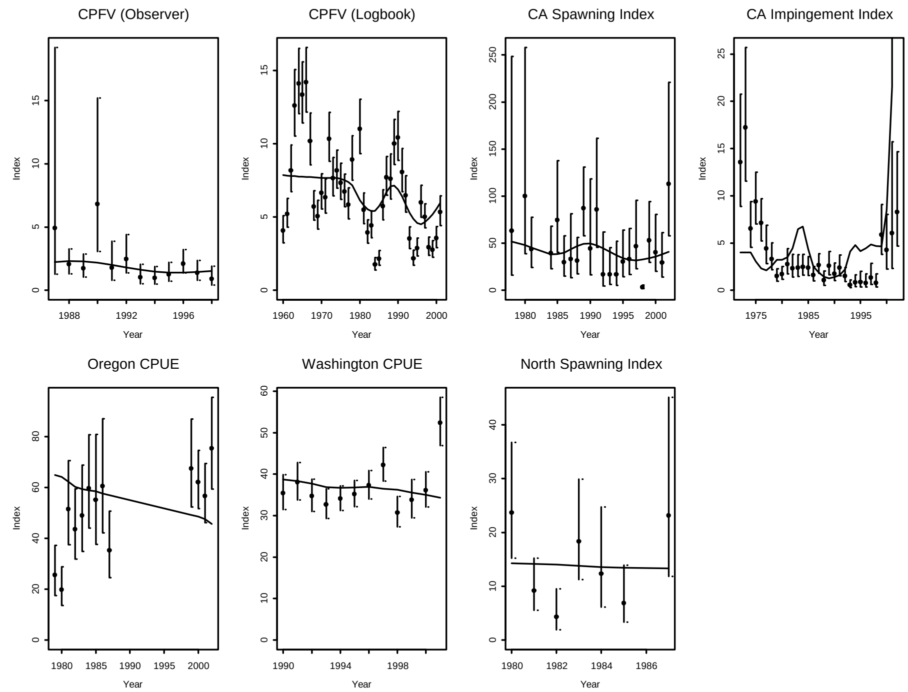


Figure 21. Numbers at length for two years for the California population of cabezon. Year 1930 represents an unexploited state whereas year 2003 represents the current exploited state.

(a) Catchability variability scaling parameters set equal to 1



(b) Catchability variability scaling parameters estimated

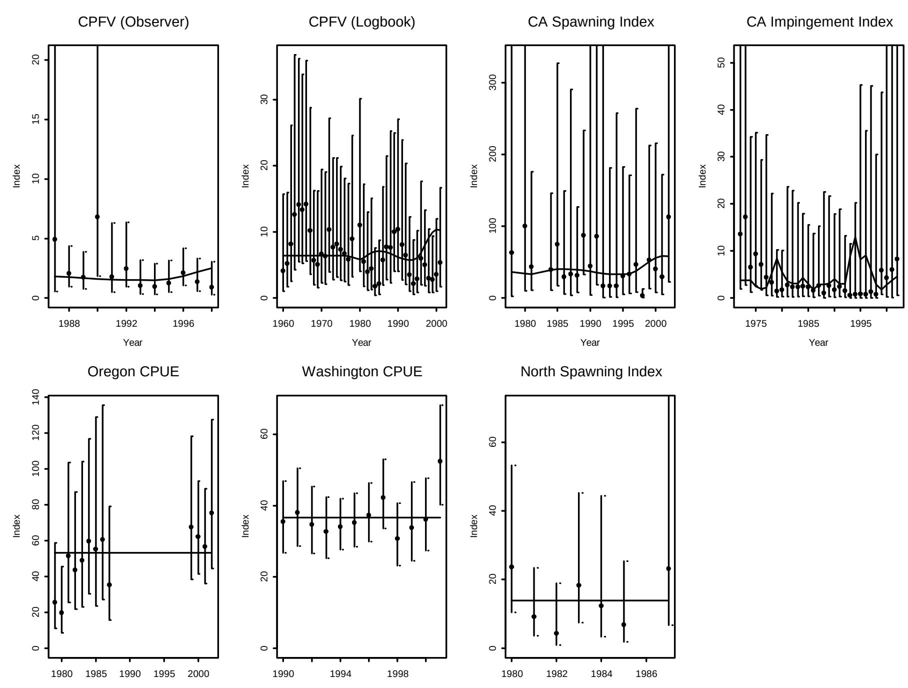
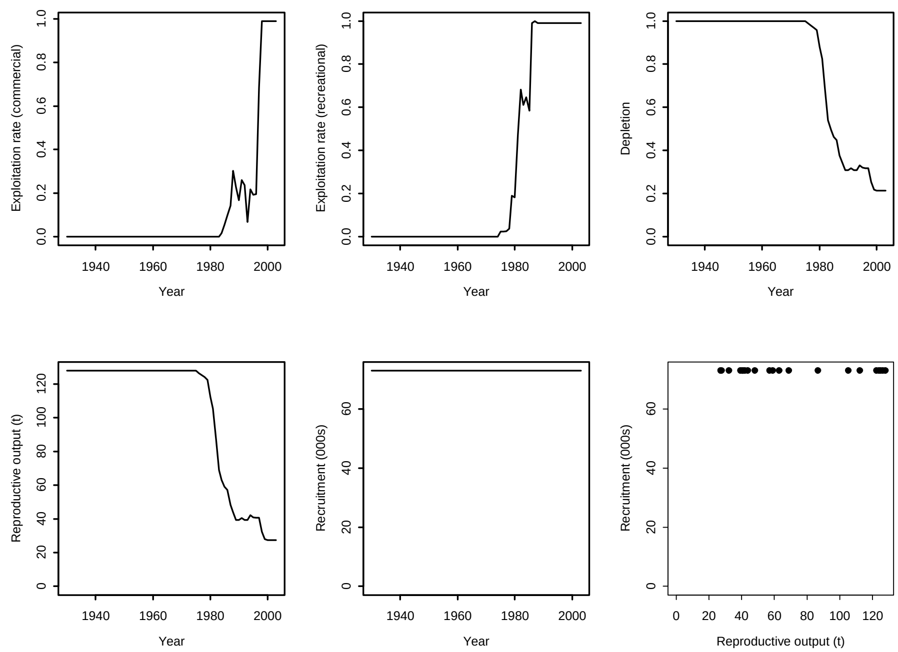


Figure 22. Observed (solid dots) and model-predicted (solid lines) abundance indices for cabezon off California and Oregon-Washington. Results are shown for the two base-case analyses. The confidence intervals in the lower panels include the impact of the estimates of the catchability variability scaling parameter factors.

(a) Catchability scaling parameters set equal to 1



(b) Catchability scaling parameters estimated

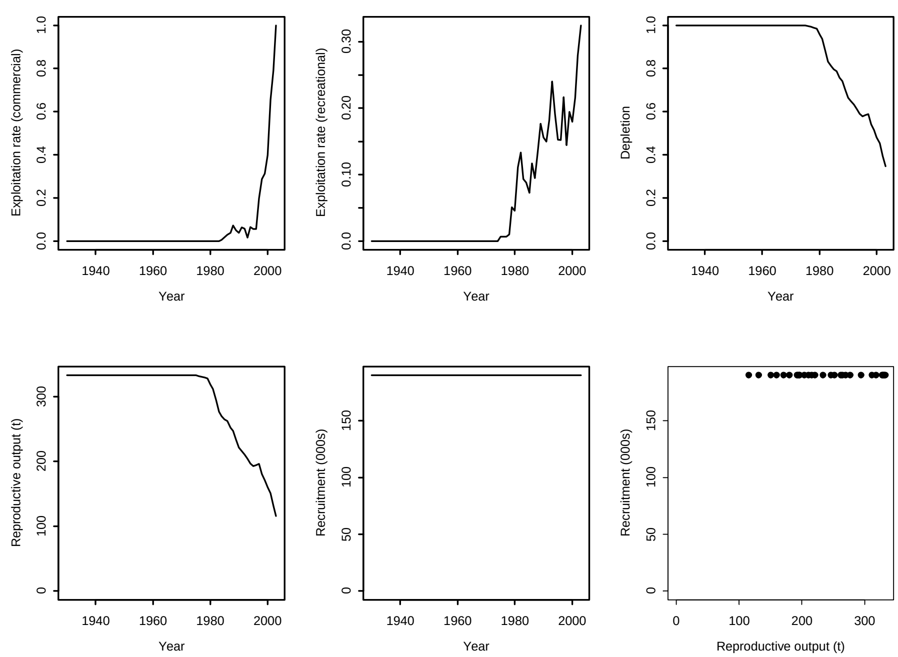


Figure 23. MPD time-trajectories of reproductive output and fishing mortality for the two base-case analyses of cabezon off Oregon-Washington.

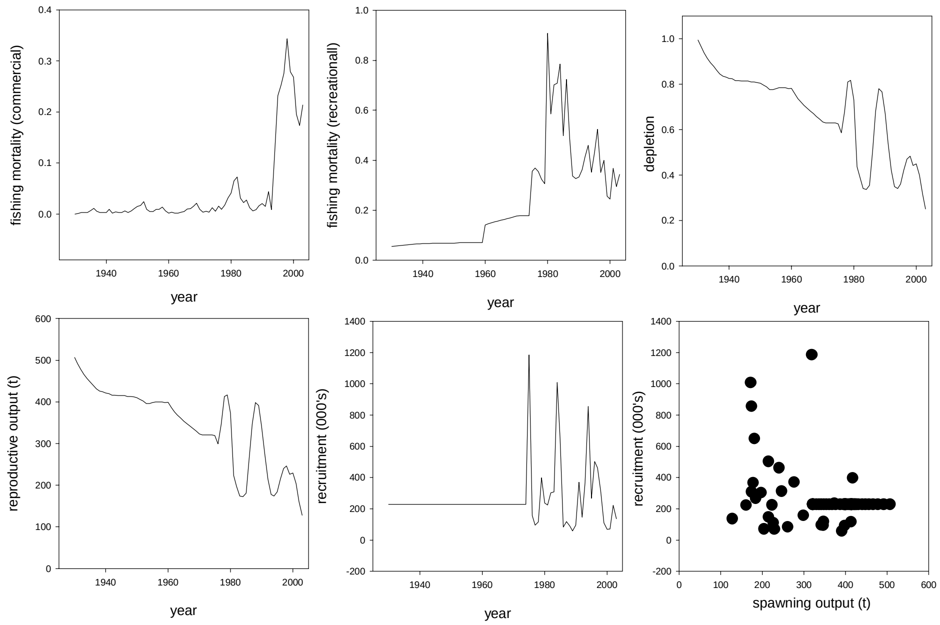


Figure 24a. MPD time-trajectories of reproductive output and fishing mortality for cabezon off California based on Stock Synthesis.

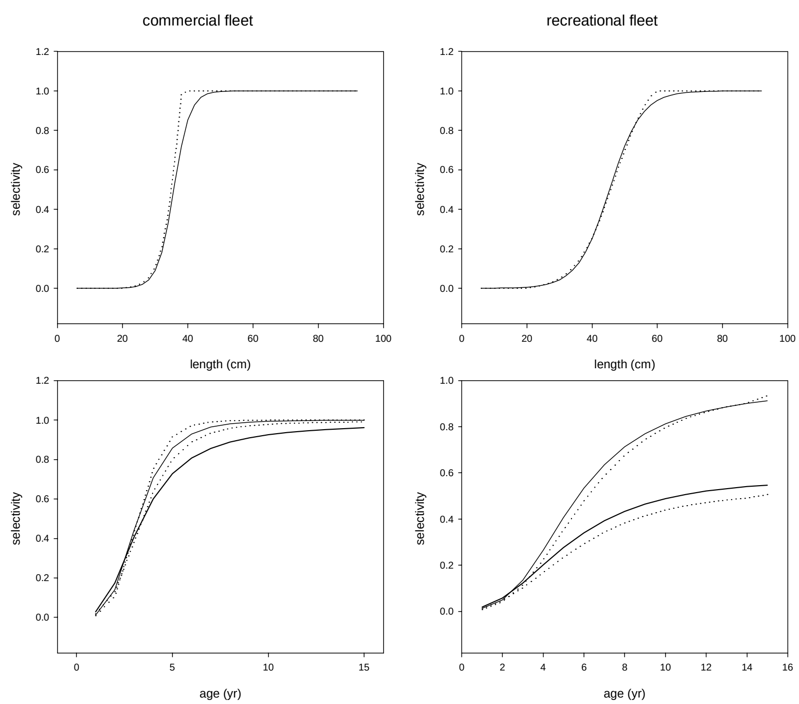


Figure 24b. Cabezon length- and age-specific selectivity ogives for two fleets off California. The base-case results from the ADMB model are shown by solid line; results from Synthesis are dotted lines.

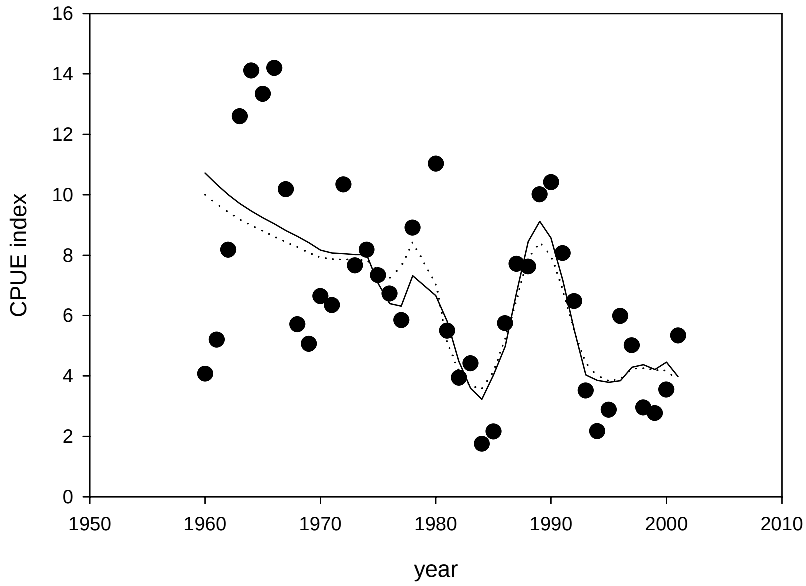


Figure 24c. Fits to the CPFV Logbook series. The base-case results are shown by the solid line; results from Synthesis by the dashed lines.

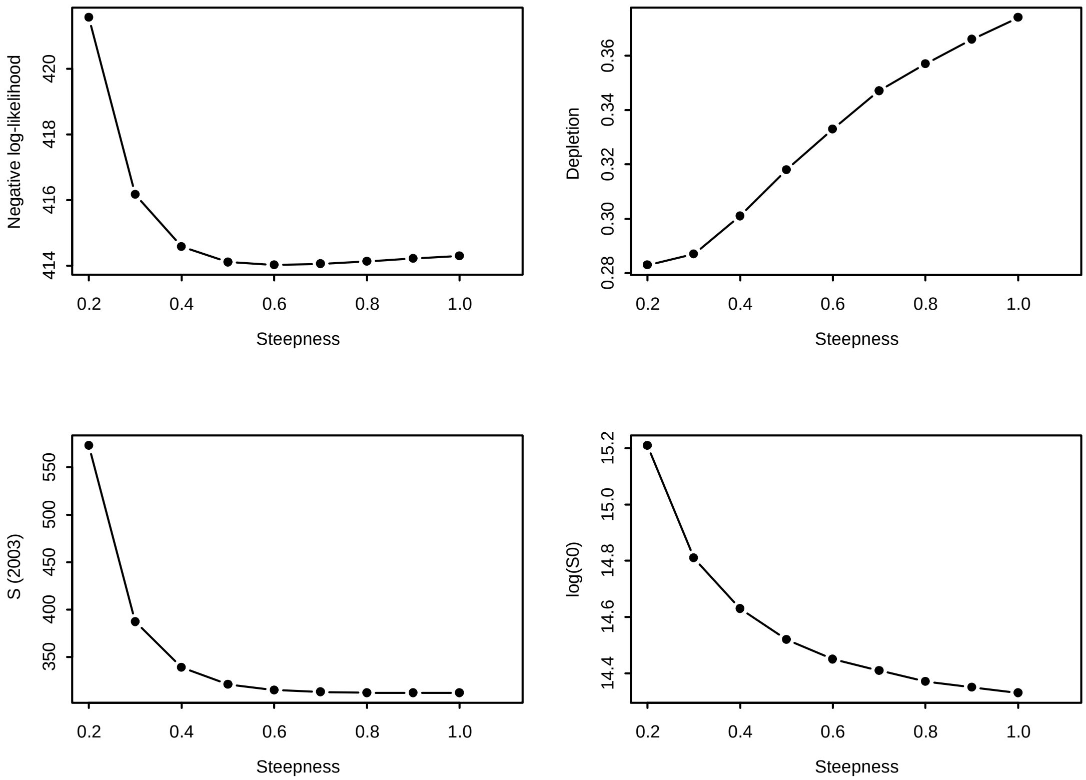


Figure 25. Results of likelihood profiles for steepness (h).

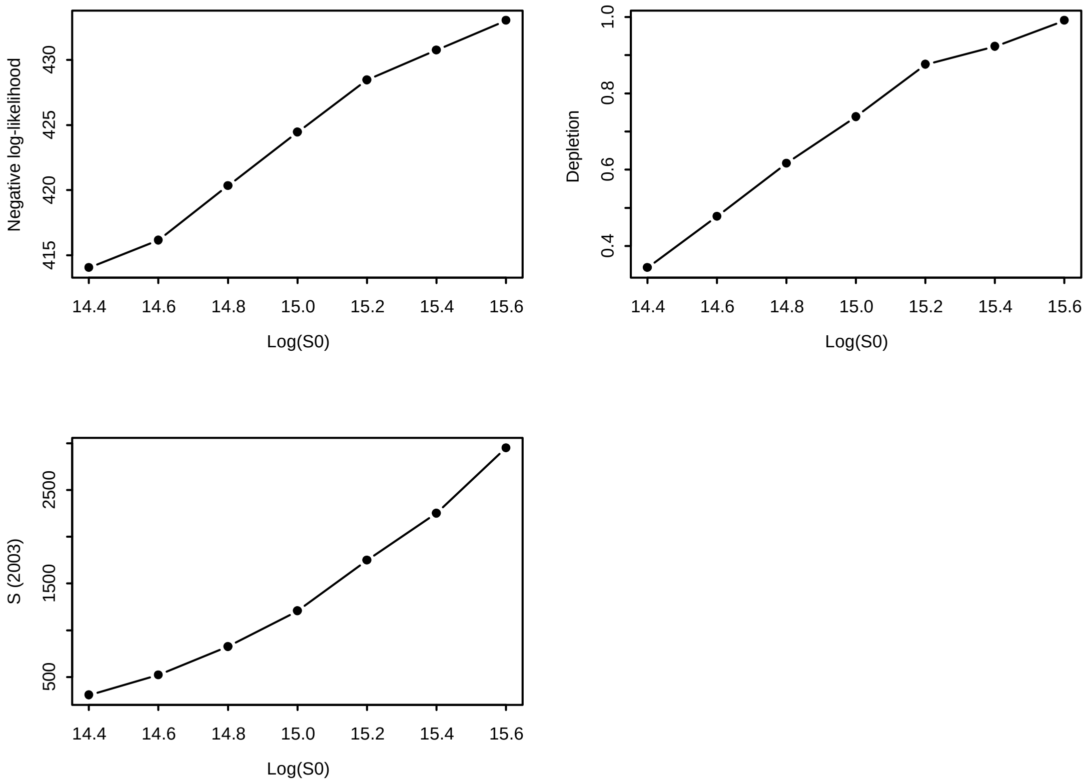


Figure 26. Results of likelihood profiles for $\ell n S_0$.

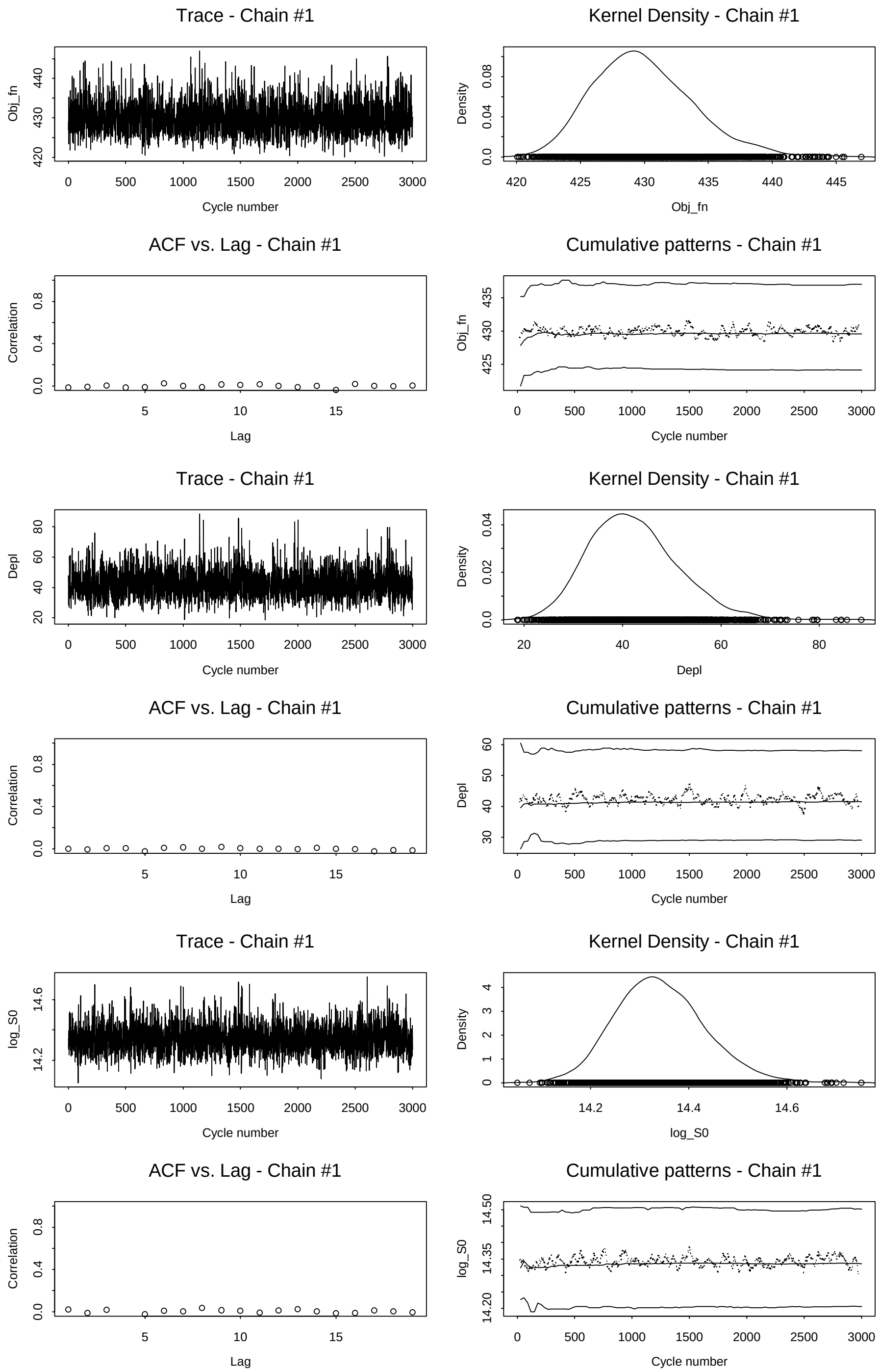


Figure 27. MCMC diagnostics for the objective function, current depletion and $\ell n S_0$.

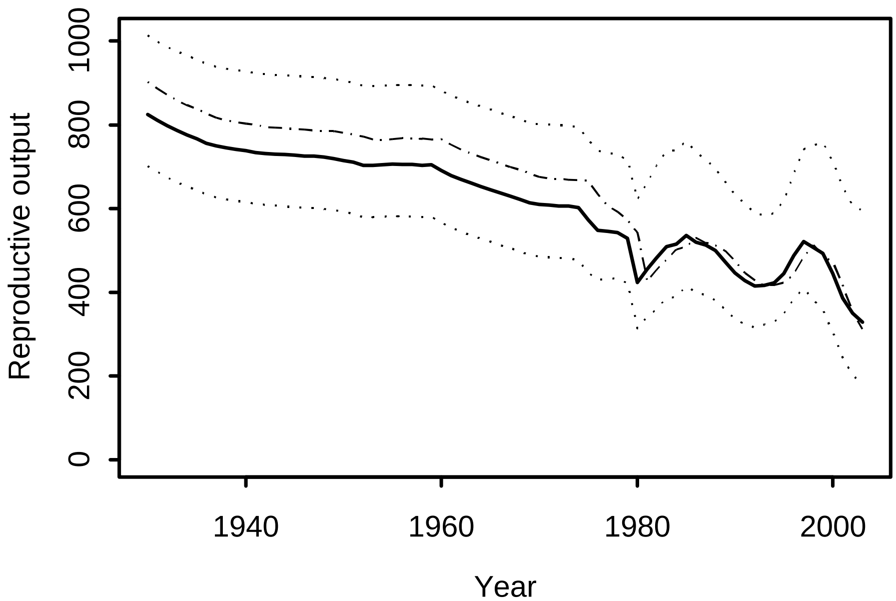
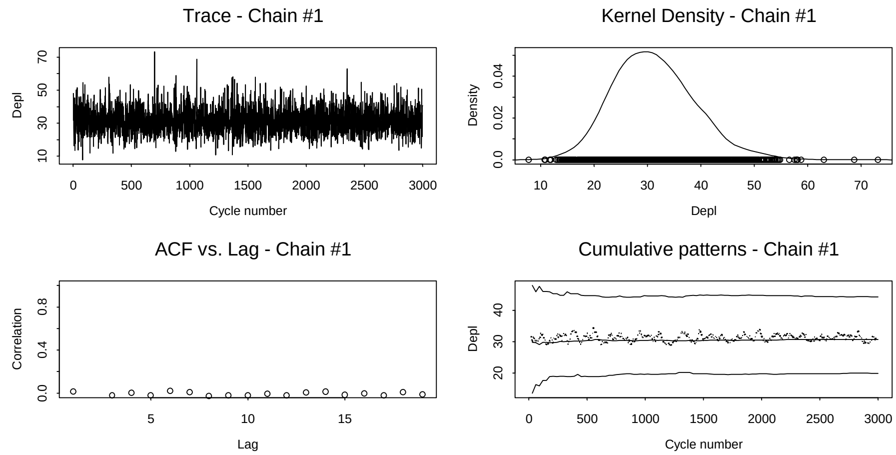
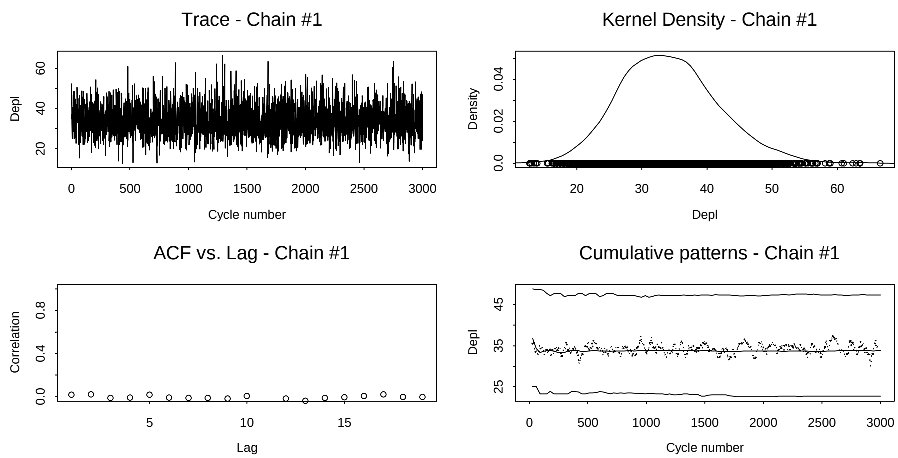


Figure 28. Posterior distributions (posterior medians and posterior 95% confidence intervals) for the time-trajectory of reproductive output (1930-2003). The dashed lines are the MPD estimates of annual reproductive output.

(a) M=0.2yr^{-1}; h=0.5



(b) M=0.2yr^{-1}; h=0.7



(c) M=0.2yr^{-1}; h=0.9

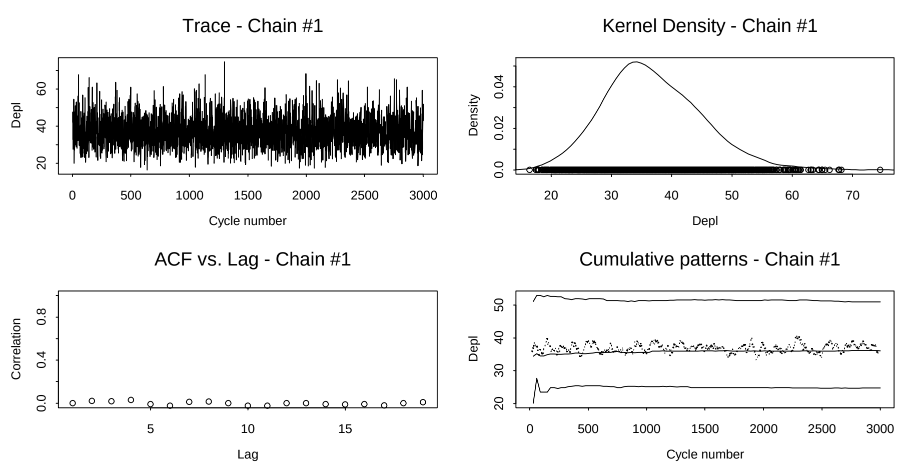
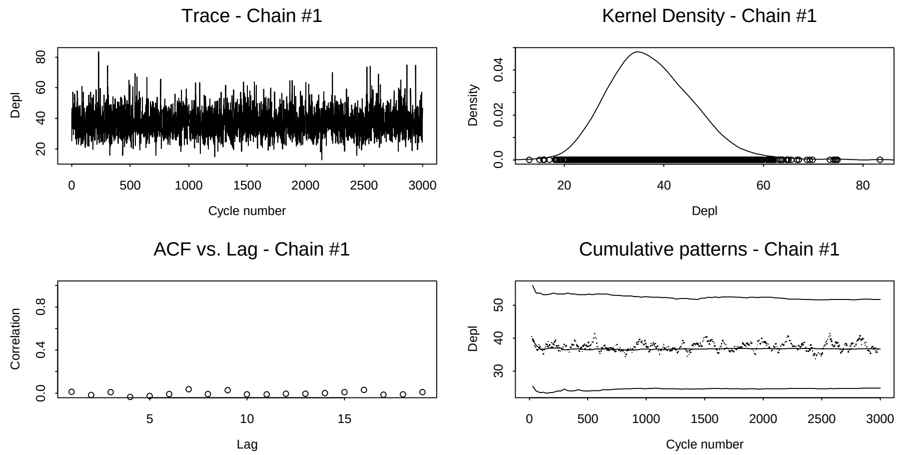


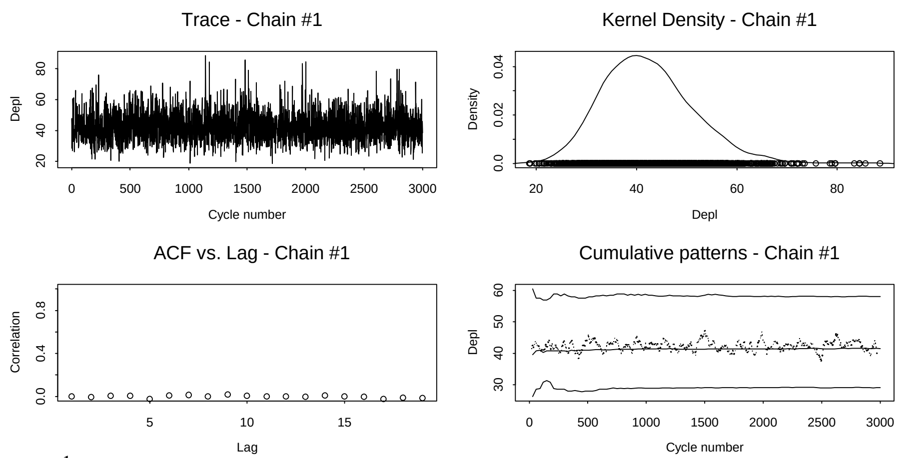
Figure 29: MCMC diagnostics for current depletion for each of the nine cases.

(Figure 29 Continued)

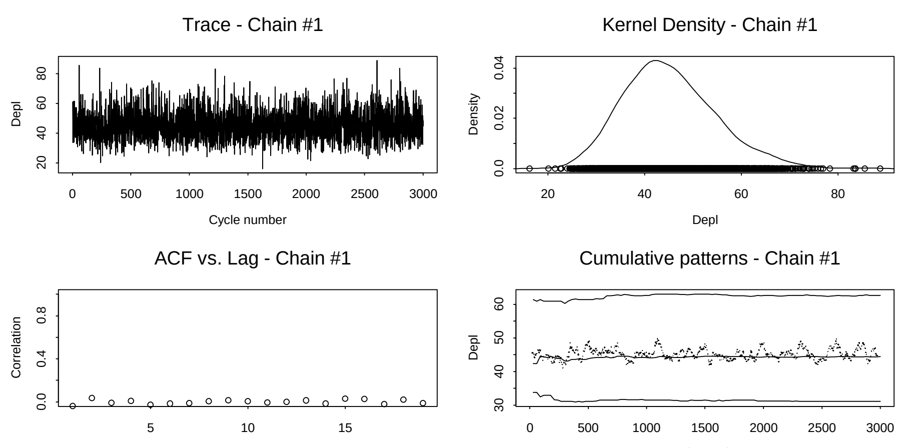
(d) M=0.25yr^{-1}; h=0.5



(e) M=0.25yr^{-1}; h=0.7 (Base-case)

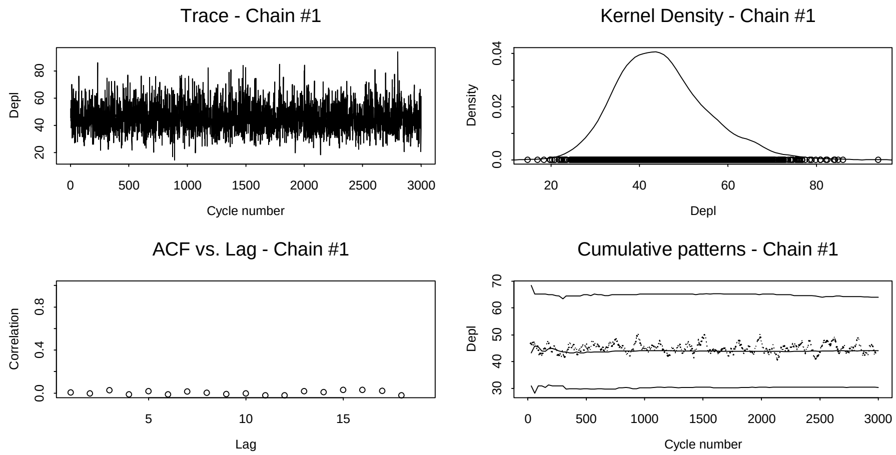


(f) M=0.25yr^{-1}; h=0.9

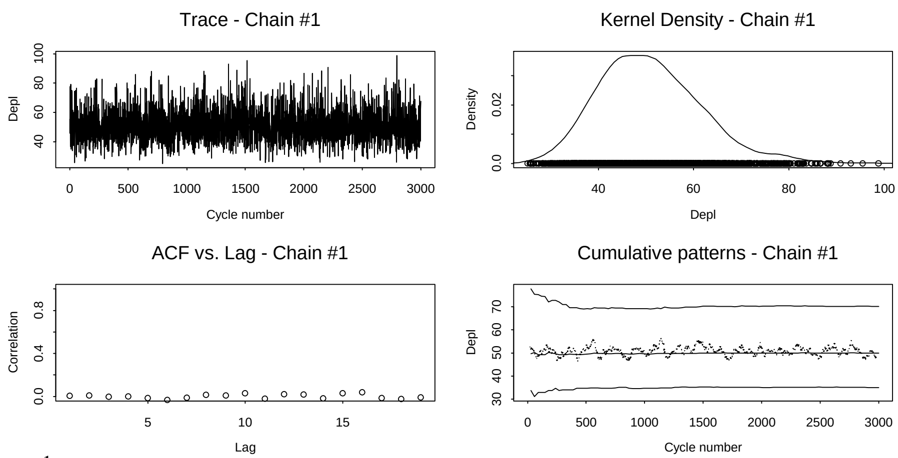


(Figure 29 Continued)

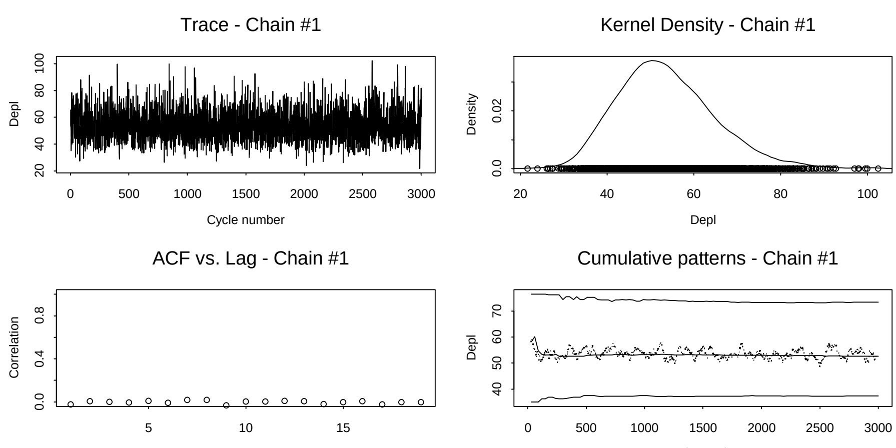
(g) M=0.3yr^{-1}; h=0.5



(h) M=0.3yr^{-1}; h=0.7



(i) M=0.3yr^{-1}; h=0.9



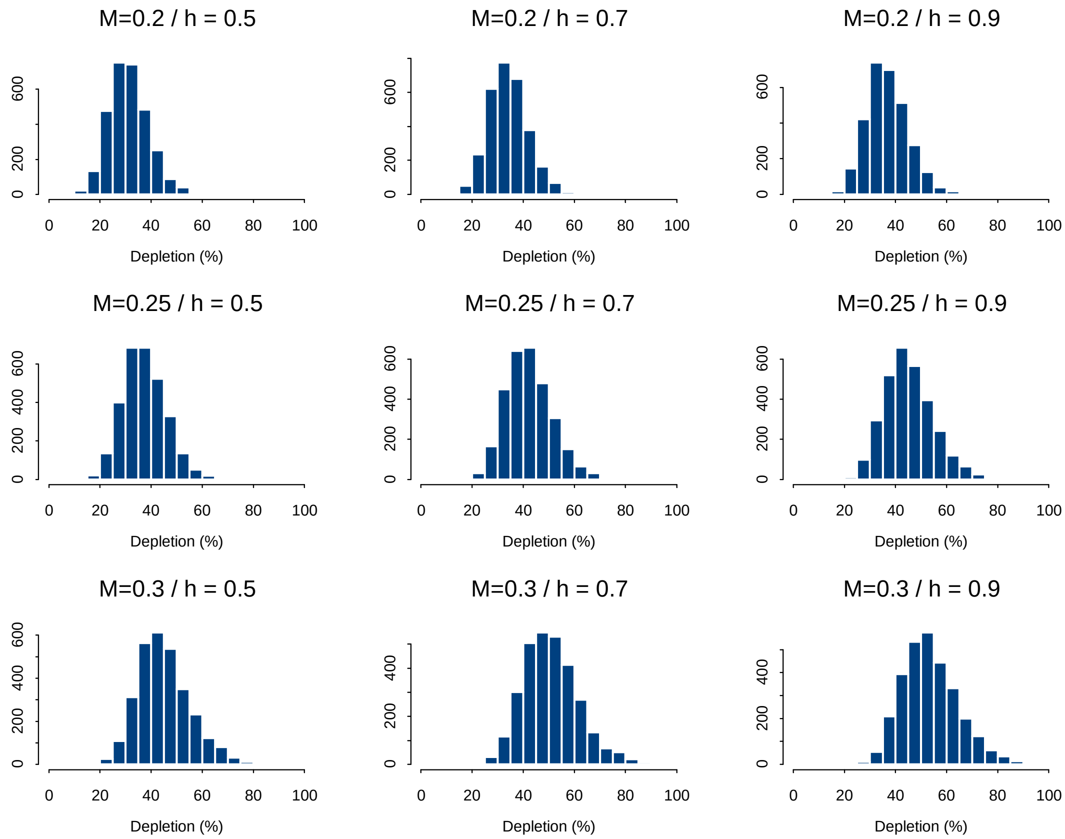


Figure 30: Posterior distributions for current depletion (i.e. S_{2003} / S_0) for each of the nine cases considered when conducting the projections.

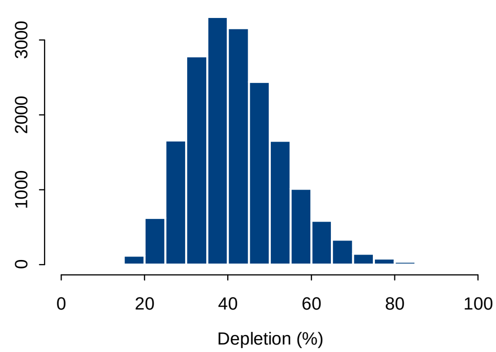


Figure 31: Posterior distribution for current depletion (i.e. S_{2003} / S_0) obtained by pooling the posterior distributions for the nine cases giving a weight of 1 to cases for which M=0.25yr^{-1} and 0.5 to cases for which M=0.2 yr^{-1} and M=0.3yr^{-1}.

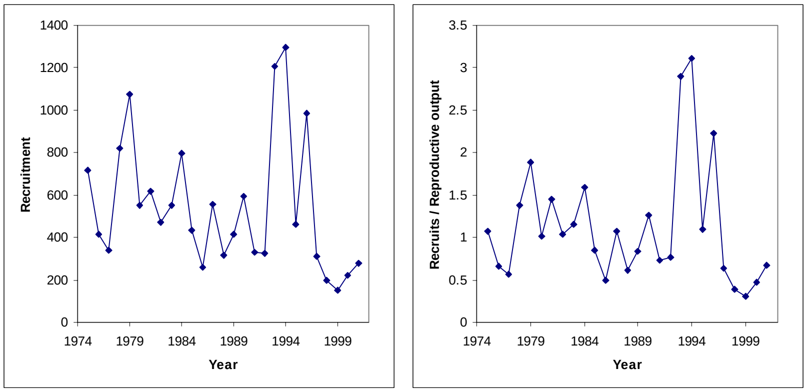


Figure 32. MPD time-trajectories of recruitment and recruits / reproductive output ratios for the base-case analysis.

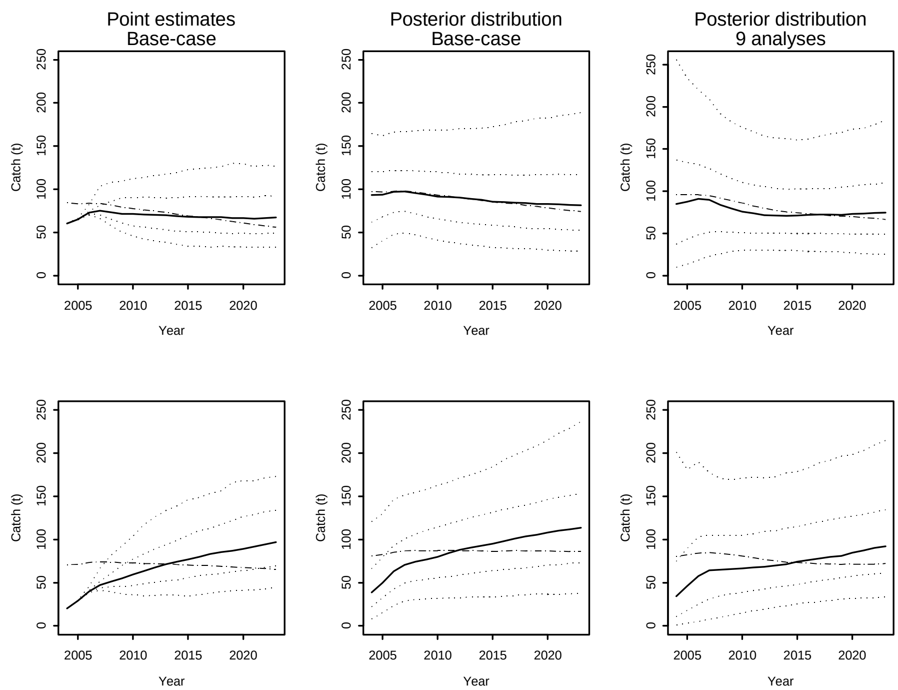


Figure 33 : Time-trajectories of yield. The solid lines are the median time-trajectories of 40-10 (upper panels) and 60-20 (lower panels) harvest, the dashed lines are F_{ABC} median time-trajectories of harvest, and the dotted lines and the 5th, 25th, 75th and 95th percentiles of 40-10 and 60-20 harvest. Results are shown for three scenarios (see text for details).

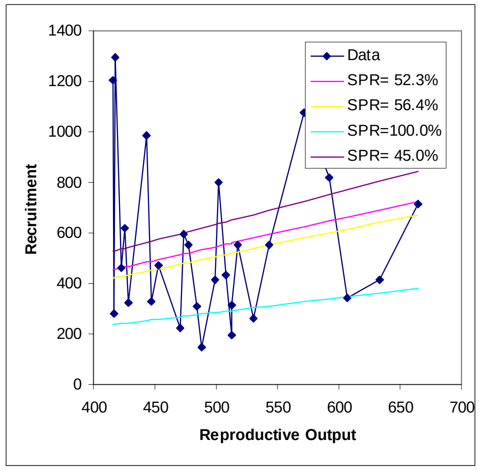


Figure 34. Recruitment versus reproductive output indicating various replacement lines.

Appendix A. Summary of California Nearshore Management Measures Affecting Cabezon

Year	Description	Effective Date
1999	Implement recreational and commercial size limit 14" total length	1/1/1999
Pre & 2000	Recreational Bag Limit of 10 fish w/in 20 fish aggregate	3/1/1984
2000	FGC fixes cabezon OY at 63,608 (40.3%) recreational; 94,398 (59.7%) commercial; Total = 158,006 pounds	12/30/1999
2001	Weekday closures - Commercial take prohibited Thursday thru Sunday	Jan-01
2001	Central and Southern Management Areas; recreational bag limit 10 fish; Recreational Fishery open year round; no depth restrictions, except no take in Cowcod Closure area in southern management area	1/1/2001
2001	Increase in size limit to 15" Total length recreational and commercial	Mar-01
2001	FGC fixes cabezon OY at 63,608 recreational; 94,398 commercial; Total OY = 178,728 pounds in emergency regulations	Sep-01
2002	Finfish traps required to have rigid five inch rings in entrance	1/8/2002
2002	FGC fixes cabezon OY at 84,330 (47.2%) recreational; 94,398 (52.8%) commercial; Total OY = 178,728 pounds reaffirming emergency action	2/4/2002
2003	Northern Rockfish and Lingcod Management Area; recreational bag limit remains at 10 fish; Open year round; No depth Restriction	1/3/2003
2003	FGC fixes cabezon OY at 118,300 (61%) recreational; 75,600 (39%) commercial; Total OY = 193,900 pounds	adopted by FGC 8/2/03; filed with OAL effective date pending

Appendix B: The Population Dynamics Model

Basic Dynamics

The population dynamics are assumed governed by:

$$N_{t+1,a}^{g,p} = \begin{cases} N_{t+1,0}^{g,p} & a=0 \\ (N_{t,a-1}^{g,p}\, e^{-M/2} - C_{t,a-1}^{g,p})e^{-M/2} & 1 \le a < x \\ N_{t,x-1}^{g,p}\, e^{-M} - C_{t,x-1}^{g,p}\, e^{-M/2} + N_{t,x}^{g,p}\, e^{-M} - C_{t,x}^{g,p}\, e^{-M/2} & a = x \end{cases} \qquad \text{(B.1)}$$

where $N_{t,a}^{g,p}$ is the number of fish of age a and sex g (g=1 for females; g=2 for males) in population p (p=1 for south; p=2 for north) at the start of year t,

M is the instantaneous rate of natural mortality (assumed to be independent of sex, age, time, and population),

$C_{t,a}^{g,p}$ is the catch (in number) during year t of fish of age a, sex g and population p:

$$C_{t,a}^{g,p} = \sum_f C_{t,a}^{g,p,f}$$

$C_{t,a}^{g,p,f}$ is the catch (in number) by fleet f (commercial or recreational) during year t of fish of age a, sex g and population p, and

x is the maximum age considered (treated as a plus group, and assumed to be independent of sex, age, time, and population).

Births

The number of zero-year-olds in a given year depends on the reproductive output and an assumed stock-recruitment relationship. The total number of zero-year-olds in population p of sex g at the start of year t+1 is given by a stochastic Beverton-Holt model, reparameterized as in Francis (1992):

$$N_{t+1,0}^{g,p} = \frac{4\,h\,R_0^p\, S_{t+1}^p}{S_0^p(1-h)/2 + (5h-1)S_{t+1}^p}\, e^{\varepsilon_{t+1}^p} \qquad \text{(B.2)}$$

where h is the steepness of the (Beverton-Holt) stock-recruitment relationship (assumed to be independent of population),

S_0^p is the reproductive output at pre-exploitation equilibrium for population p:

$$S_0^1 = cS_0\,;\; S_0^2 = (1-c)S_0 \qquad \text{(B.3)}$$

S_0 is the reproductive output at pre-exploitation equilibrium (both populations),

c is the fraction of the total unfished reproductive output that was in the southern area,

S_t^p is the reproductive output at the start of year t for population p:

$$S_t^p = \sum_{a=1}^{x} f_a \, N_{t,a}^{1,p} \tag{B.4}$$

f_a is a measure of the relative fecundity of an animal of age a (assumed to be independent of population),

$$f_a = w_a^{1,p} \frac{1}{1+\exp(m_2 + m_1 a)}$$

R_0^p is the number of zero-year-olds at pre-exploitation equilibrium in population p:

$$R_0^p = S_0^p \left\{ \sum_{a=1}^{x-1} f_a \, e^{-aM} + \frac{f_x \, e^{-xM}}{1-e^{-M}} \right\}^{-1} \tag{B.5}$$

ε_t^p is the logarithm of the ratio of the expected and actual number of zero-year-olds for year t and population p:

$$\varepsilon_t^p \sim N(0;\sigma_R^2)$$

σ_R is the standard deviation of ε_t^p.

Catches

The annual catches are assumed to be taken in a pulse in the middle of the year (after 50% of the natural mortality). The catch (in number) during year t of fish of age a, sex g and population p taken by fleet f is calculated from the total catch (in mass) for population p and fleet f during year t, $\tilde{C}_t^{p,f}$:

$$C_{t,a}^{g,p,f} = \frac{\tilde{C}_t^{p,f} \, N_{t,a}^{g,p} \, s_{a+0.5}^{g,p,f} \, e^{-M/2}}{\sum_g \sum_{a'=0}^{x} w_{a'+0.5}^{g,p} \, N_{t,a'}^{g,p} \, s_{a'+0.5}^{g,p,f} e^{-M/2}} \tag{B.6}$$

where $s_a^{g,p,f}$ is the selectivity of the gear of fleet f on fish of age a and sex g in population p (assumed to be independent of time):

$$s_{a+0.5}^{g,p,f} = \sum_{l=l_{\min}}^{l_{\max}} s_l^{g,p,f} \, \phi_{l,a+0.5}^{g,p} \tag{B.7}$$

$s_l^{g,p,f}$ is the selectivity of the gear of fleet f on fish of sex g in length-class l and population p (assumed to be independent of time), assumed to be of the logistic form:

$$s_l^{p,g,f} = \left\{1+\exp\left(-\ell n19\frac{L_l - L_{50}^{p,f}}{\Delta L^{p,f}}\right)\right\}^{-1} \tag{B.8}$$

L_l is the mid-point of length-class l,

$L_{50}^{p,f}$ is the length-at-50%-selectivity for fleet f and population p,

$\Delta L^{p,f}$ is the difference between length-at-95%-selectivity and the length-at-50%-selectivity for fleet f and population p,

$l_{\min}$ is the first length-class,

$l_{\max}$ is the last length-class,

$w_a^{g,p}$ is the mass of a fish of age a, sex g and population p, and

$\phi_{l,a}^{g,p}$ is the probability that an individual of age a, sex g and population p is in length-class l.

The $\phi_{l,a}^{g,p}$ are computed by assuming that length-at-age is normally distributed about its expected value with a CV that depends on age and sex, i.e:

$$\phi_{l,a}^{g,p} = \int_{L_l-\Delta l/2}^{L_l+\Delta l/2} \frac{1}{\sqrt{2\pi}\sigma_a^g \bar{L}_a^{g,p}} e^{-\frac{(L-\bar{L}_a^{g,p})^2}{2(\sigma_a^g \bar{L}_a^{g,p})^2}} dL \tag{B.9}$$

where $\bar{L}_a^{g,p}$ is the mean length of a fish of sex g, age a and population p (based on the von Bertalanffy growth equation (Figure 3),

σ_a^g is the CV of the length of a fish of age a and sex g:

$$\sigma_a^g = CV_{\min} + \frac{(CV_{\max} - CV_{\min})(a-1)}{x-1}$$

$CV_{\min}$ is the CV of length-at-age for an animal of age 1,

$CV_{\max}$ is the CV of length-at-age for an animal of age x-1,

L_l is the midpoint of length-class l, and

Δl is the width of each length-class.

Initial conditions

Each population is assumed to be at its pre-exploitation equilibrium size at the start of 1930 (the assumed start of harvesting).

$$N_{t,a}^{p} = \begin{cases} R_0^p \, e^{-aM} & 0 \le a \le x-1 \\ R_0^p \, e^{-xM} \, /(1-e^{-M}) & a = x \end{cases} \tag{B.10}$$

where y_1 is the first year considered (1930).

Appendix C: The Likelihood Function

Indices of abundance

Catch-rate data

The contribution of the catch-rate data to the likelihood function is based on the assumption that the observed catch-rate data are lognormally distributed about their expected values:

$$I_t^p = q_c^p\, B_t^p\, e^{\eta_t^p} \qquad\qquad \eta_t^p \sim N(0;(\sigma_{c,t}^p)^2) \tag{C.1}$$

where I_t^p is the (standardized) catch-rate index for population *p* and year *t*,

q_c^p is the catchability coefficient for population *p*,

$\sigma_{c,t}^p$ is the standard deviation of the fluctuations in log(catchability):

$$\sigma_{c,t}^p = \sigma_c^p\, \tilde{\sigma}_{c,t}^p \tag{C.2}$$

$\tilde{\sigma}_{c,t}^p$ is the pre-specified CV of the catch-rate index for population *p* and year *t* (see Table 7),

σ_c^p is an overall catchability variability scaling factor for population *p*,

B_t^p is the exploitable biomass (in the middle of the year) corresponding to I_t^p:

$$B_t^p = \sum_g \sum_{a=0}^{x} w_a^{g,p}\, s_a^{g,p,f''} (N_{t,a}^{g,p}\, e^{-M/2} - C_{t,a}^{g,p}/2) \tag{C.3}$$

f'' is the fleet (commercial or recreational) to which the catch-rate index relates.

The negative of the log-likelihood function (ignoring constant terms) is:

$$-\ell\text{n}L = \sum_p \sum_t \left\{ \ell\text{n}\, \sigma_{c,t}^p + \frac{1}{2(\sigma_{c,t}^p)^2} \left[\ell\text{n}I_t^p - \ell\text{n}(q_c^p\, B_t^p) \right]^2 \right\} \tag{C.4}$$

where the summation over *t* is taken over all years for which catch-rates are available.

Spawning stock size index

The contribution of the indices of reproductive output to the likelihood function is based on the assumption that the observed indices are lognormally distributed about their expected values:

$$J_t^p = q_s^p\, S_{t-1}^p\, e^{\nu_t^p} \qquad\qquad \nu_t^p \sim N(0;(\sigma_{s,t}^p)^2) \tag{C.5}$$

where J_t^p is the index of reproductive output (males and females combined) for year *t* and population *p*,

q_s^p is the catchability coefficient for the index of reproductive output for population p,

$\sigma_{s,t}^p$ is the standard deviation of the fluctuations in log(catchability):

$$\sigma_{s,t}^p = \sigma_s^p \, \tilde{\sigma}_{s,t}^p \qquad \text{(C.6)}$$

$\tilde{\sigma}_{s,t}^p$ is the pre-specified CV of the index of reproductive output for population p and year t, and

σ_s^p is an overall catchability variability scaling factor for population p.

The negative of the log-likelihood function (ignoring constant terms) is:

$$-\ell\text{n}L = \sum_p \sum_t \left\{ \ell\text{n}\,\sigma_{s,t}^p + \frac{1}{2(\sigma_{s,t}^p)^2}\left[\ell\text{n}J_t^p - \ell\text{n}(q_s^p\, S_t^p)\right]^2 \right\} \qquad \text{(C.7)}$$

where the summation over t is taken over all years for which the reproductive output index data are available.

Recruitment index
The contribution of the juvenile impingement index to the likelihood function is based on the assumption that an observed index is lognormally distributed about its expected value:

$$K_t^p = q_K^p \, \tilde{N}_t^p \, e^{\upsilon_t^p} \qquad \upsilon_t^p \sim N(0;(\sigma_{K,t}^p)^2) \qquad \text{(C.8)}$$

where K_t^p is the index of juvenile impingement for population p and year t,

q_K^p is the catchability coefficient for the index of juvenile abundance for population p,

$\sigma_{K,t}^p$ is the standard deviation of the fluctuations in log(catchability):

$$\sigma_{K,t}^p = \sigma_K^p \, \tilde{\sigma}_{K,t}^p \qquad \text{(C.9)}$$

$\tilde{\sigma}_{K,t}^p$ is the pre-specified CV of the index of juvenile impingement for population p and year t,

σ_K^p is an overall catchability variability scaling factor for population p, and

$\tilde{N}_t^p$ is the number of juveniles expected to be vulnerable to impingement and hence that correspond to K_t^p:

$$\tilde{N}_t^p = \sum_g N_{t,0}^{g,p} + 0.5 \sum_g N_{t,1}^{g,p} \qquad \text{(C.10)}$$

Note that all fish of age 0 are assumed to be vulnerable to impingement, but only half of the individuals of age 1.

The negative of the log-likelihood function (ignoring constant terms) is:

$$-\ell nL = \sum_p \sum_t \left\{ \ell n\, \sigma_{K,t}^p + \frac{1}{2(\sigma_{K,t}^p)^2}\left[\ell nK_t^p - \ell n(q_K^p\, \tilde{N}_t^p)\right]^2 \right\} \tag{C.11}$$

where the summation over t is taken over all years for which the juvenile impingement index is available.

Catch length-frequency

The contribution of the sex-aggregated catch-at-length data to the likelihood function is based on the assumption that the observed catch-at-length data are multinomially distributed:

$$-\ell nL = -\sum_d \omega^d \sum_t \sum_g \sum_{l=l_{\min}}^{l_{\max}} \rho_{t,l,d}^p\ \ell n(\hat{\rho}_{t,l}^p / \rho_{t,l,d}^p) \tag{C.12}$$

where $\hat{\rho}_{t,l}^{p,f}$ is the model estimate of the proportion of the catch (in number) of fish of population p caught by fleet f (data source d is assumed to be based on the catches by fleet f) during year t that is in length-class l:

$$\hat{\rho}_{t,l}^{p,f} = \frac{s_l^{g,p,f} \sum_g \sum_a \phi_{l,a+0.5}^{g,p}\, N_{t,a}^{g,p} e^{-M/2}}{\sum_{g'} \sum_{a'=0}^{x} C_{t,a'}^{g',p,f}} \tag{C.13}$$

$\rho_{t,l,d}^p$ is the observed fraction of the catch (in number) of fish of population p during year t that is in length-class l based on data-source d,

ω^d is a weighting factor (the effective sample size) for data source d.

Penalties and priors

Penalty on the recruitment residuals

The prior placed on the recruitment anomalies is implemented by adding the following penalty term to the objective function minimized to find the estimates for the model parameters:

$$P_1 = (2002 - y_{\rm rec} + 1)\ell n\sigma_R + \frac{1}{2\sigma_R^2} \sum_p \left(\sum_{t=y_{\rm rec}}^{2002} (\varepsilon_t^p + \sigma_R^2/2)^2 \right) \tag{C.14}$$

where $y_{\rm rec}$ is the first year for which a recruitment residual is estimated.

Appendix D-1: Numbers (in 1000s)-at-age matrix.

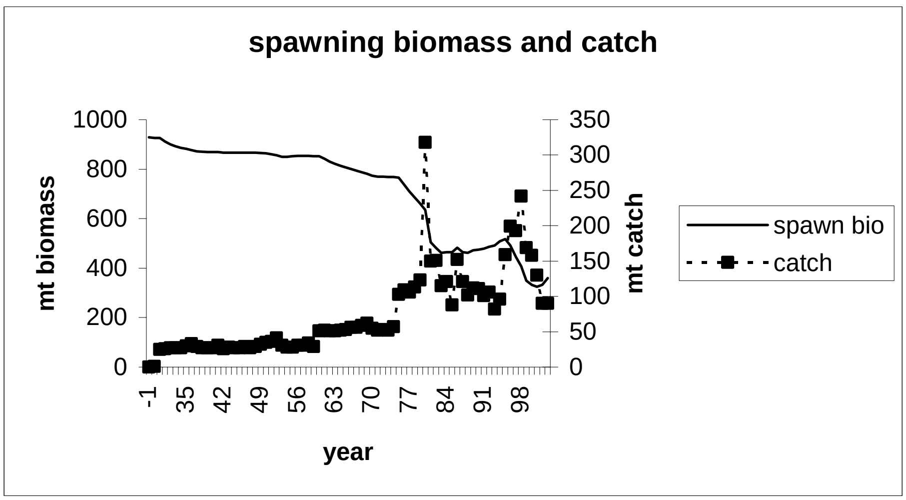
(a) Females

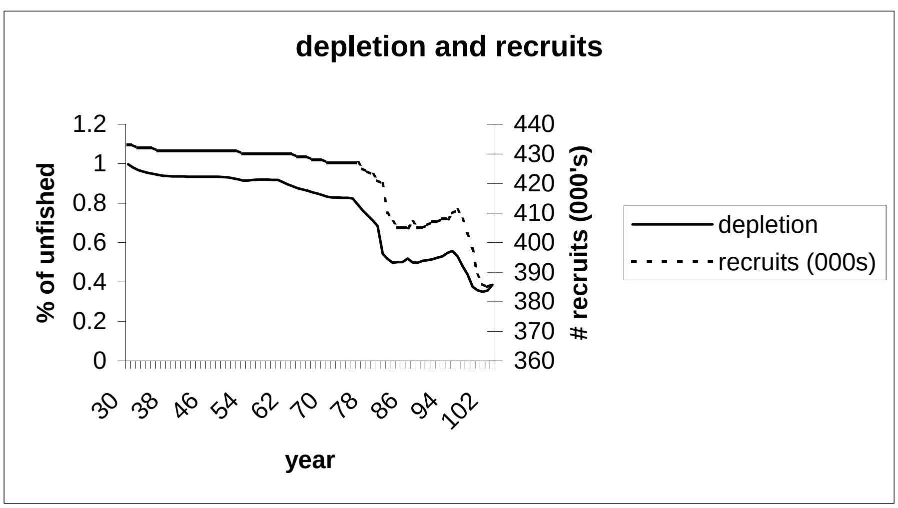
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1930	258	201	156	122	95	74	57	45	35	27	21	16	13	10	8	27
1940	254	198	154	120	93	71	54	41	32	24	18	14	10	8	6	21
1950	253	197	154	119	92	70	54	41	31	24	18	14	10	8	6	18
1960	253	197	153	119	92	70	53	40	31	23	17	13	10	7	6	17
1965	251	195	152	118	90	68	51	38	28	21	16	12	9	7	5	15
1966	250	195	152	117	90	68	51	38	28	21	15	11	9	6	5	14
1967	250	195	152	117	90	68	51	38	28	21	15	11	8	6	5	14
1968	249	194	151	117	89	68	51	38	28	20	15	11	8	6	4	13
1969	249	194	151	117	89	67	50	37	27	20	15	11	8	6	4	13
1970	249	194	151	116	89	67	50	37	27	20	15	11	8	6	4	12
1971	248	194	151	116	89	67	50	37	27	20	15	11	8	6	4	12
1972	248	193	150	116	89	67	50	37	27	20	14	11	8	6	4	12
1973	248	193	150	116	89	67	50	37	27	20	14	11	8	6	4	11
1974	248	193	150	116	89	67	50	37	27	20	14	10	8	6	4	11
1975	358	193	150	116	88	67	50	37	27	20	14	10	8	6	4	11
1976	208	278	150	115	87	65	48	35	25	19	13	10	7	5	4	10
1977	171	162	216	115	86	63	46	33	24	17	12	9	6	5	3	9
1978	409	133	125	165	85	62	44	32	22	16	12	8	6	4	3	8
1979	538	318	103	96	122	61	43	30	21	15	11	8	5	4	3	7
1980	275	418	246	78	70	87	42	29	20	14	10	7	5	3	2	6
1981	309	213	320	180	52	42	46	21	13	9	6	4	3	2	1	3
1982	236	240	165	240	128	35	26	28	12	8	5	3	2	1	1	3
1983	276	183	185	123	170	85	22	16	17	7	4	3	2	1	1	2
1984	399	215	142	141	90	119	57	14	10	10	4	3	2	1	1	2
1985	216	310	166	107	103	63	80	37	9	6	6	3	2	1	1	1
1986	131	168	240	127	80	74	44	55	26	6	4	4	2	1	1	1
1987	277	102	130	182	92	55	49	28	34	15	4	3	3	1	1	1
1988	157	216	78	99	133	65	37	32	18	22	10	2	2	2	1	1
1989	208	122	167	60	73	95	45	25	21	12	14	6	1	1	1	1
1990	297	162	94	127	44	52	65	30	17	14	8	9	4	1	1	1
1991	164	231	125	72	93	31	35	43	19	11	9	5	6	2	1	1
1992	163	128	179	95	53	66	21	23	28	13	7	6	3	4	2	1
1993	603	127	99	136	70	37	45	14	15	18	8	4	3	2	2	2
1994	648	469	98	75	101	50	26	30	9	10	12	5	3	2	1	2
1995	231	504	363	74	55	70	34	17	20	6	6	8	3	2	1	2
1996	494	179	390	270	51	35	44	20	10	12	3	4	4	2	1	2
1997	155	384	139	288	182	32	21	25	11	5	6	2	2	2	1	2
1998	98	121	297	103	196	116	19	12	14	6	3	3	1	1	1	1
1999	74	77	93	218	68	119	66	11	7	8	3	2	2	1	1	1
2000	111	58	59	69	151	44	75	41	6	4	5	2	1	1	0	1
2001	140	87	45	44	48	99	28	46	25	4	2	3	1	1	1	1
2002	273	109	67	34	31	32	63	18	28	15	2	1	2	1	0	1
2003	214	213	84	51	24	22	22	42	11	18	10	2	1	1	0	1
2004	209	167	165	63	36	16	14	14	26	7	11	6	1	1	1	1

(b) Males

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1930	258	201	156	122	95	74	57	45	35	27	21	16	13	10	8	27
1940	254	198	154	120	93	71	55	42	32	25	19	14	11	8	6	22
1950	253	197	153	119	92	71	54	41	32	24	18	14	11	8	6	20
1960	253	197	153	119	91	70	54	41	31	24	18	14	10	8	6	19
1965	251	195	152	117	90	69	52	39	30	22	17	13	10	7	5	17
1966	250	195	152	117	90	69	52	39	29	22	17	12	9	7	5	17
1967	250	195	151	117	90	68	52	39	29	22	16	12	9	7	5	16
1968	249	194	151	117	89	68	51	39	29	22	16	12	9	7	5	16
1969	249	194	151	116	89	68	51	38	29	21	16	12	9	7	5	15
1970	249	194	151	116	89	67	51	38	28	21	16	12	9	7	5	15
1971	248	193	150	116	89	67	50	38	28	21	16	12	9	6	5	15
1972	248	193	150	116	89	67	51	38	28	21	16	12	9	6	5	14
1973	248	193	150	116	89	67	51	38	28	21	16	12	9	6	5	14
1974	248	193	150	116	89	67	51	38	28	21	16	12	9	6	5	14
1975	358	193	150	116	88	67	51	38	28	21	16	12	9	6	5	14
1976	208	278	149	115	87	65	49	36	27	20	15	11	8	6	4	13
1977	171	162	215	114	86	64	47	35	26	19	14	10	8	6	4	12
1978	409	133	125	164	85	63	46	34	25	18	13	10	7	5	4	11
1979	538	318	103	95	122	62	45	33	24	17	12	9	7	5	4	10
1980	275	418	245	78	70	88	44	31	22	16	12	8	6	4	3	9
1981	309	213	317	178	52	44	52	25	17	12	8	6	4	3	2	6
1982	236	240	163	236	127	36	29	33	16	11	7	5	4	3	2	5
1983	276	183	184	122	169	87	24	19	21	10	7	4	3	2	2	4
1984	399	214	141	139	89	120	61	16	13	14	6	4	3	2	1	4
1985	216	310	165	106	102	64	84	42	11	9	9	4	3	2	1	3
1986	131	168	240	126	79	75	46	60	29	8	6	7	3	2	1	3
1987	277	101	129	180	92	56	51	31	39	19	5	4	4	2	1	3
1988	157	215	78	98	133	66	39	35	21	27	13	3	3	3	1	3
1989	208	122	166	59	73	96	47	28	25	14	18	9	2	2	2	3
1990	297	162	94	126	44	52	68	33	19	17	10	12	6	2	1	3
1991	164	231	125	71	93	31	37	47	22	13	11	7	8	4	1	3
1992	163	127	178	95	53	67	22	26	32	15	9	8	4	5	3	2
1993	603	127	98	134	69	38	47	15	17	22	10	6	5	3	4	3
1994	648	468	98	75	100	51	27	33	11	12	15	7	4	3	2	5
1995	231	504	362	74	55	71	35	18	22	7	8	10	5	3	2	4
1996	494	179	388	267	51	36	46	22	11	14	4	5	6	3	2	4
1997	155	384	137	283	182	33	22	28	13	7	8	2	3	3	2	3
1998	98	120	295	101	195	119	21	14	17	8	4	5	1	2	2	3
1999	74	77	92	214	68	122	72	12	8	9	4	2	3	1	1	3
2000	111	58	59	68	149	45	79	46	8	5	6	3	1	2	0	2
2001	140	87	45	44	48	100	29	51	29	5	3	4	2	1	1	2
2002	273	109	67	33	31	33	66	19	33	18	3	2	2	1	1	2
2003	214	213	84	50	24	22	22	45	13	22	12	2	1	1	1	1
2004	209	167	164	63	36	17	15	15	30	8	14	8	1	1	1	1

A stock reduction analysis was performed using stock synthesis to corroborate the results of the more complex base-case results used in the projections. Model components were the same as the base-case: steepness was fixed at 0.7, M=0.25, selectivity of both fisheries was assumed to be asymptotic and time-invariant. The major difference between the stock reduction analysis and the base-case model was that recruitment was not estimated but was instead constrained to the stock recruitment relationship, resulting in a less complex analysis. Ending spawning biomass was estimated at 359 mt with a depletion level of 38.6% (see figures below). These results indicate that catches above 150 mt resulted in stock decline but catches under 100 mt did not. These results are consistent with the more complex base-case model and verify that the addition of complexity had not caused a radical change in the description of the stock dynamics.





Appendix F. Example input file for the projection software.

#Title,,
Cabezon – base-case,,
Number of sexes,,
2,,
Age range to consider (minimum age; maximum age),,
0,15,
Number of fleets
2
First year of projection,,
2003,,
Year declared overfished
2003
Is the maximum age a plus-group (1=Yes;2=No),,
1,,
Generate future recruitments using historical recruitments (1), historical recruits/spawner (2), or a stock-recruitment (3)
2,,
Constant fishing mortality (1) or constant Catch (2) projections,,
1,,
Pre-specify the year of recovery (or -1) to ignore,,
-1,,
Fecundity-at-age,,,,,,,,,,,,,,,,,,,,
0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15
0 0.00825525 0.084551 0.376094 0.816357 1.23825 1.62711 1.99226 2.33286 2.64524
2.927 3.17753 3.39776 3.58955 3.75535 4.16801
Age specific information (Females then males) weight, selectivity
Females - Commerical
0.0522189 0.194185 0.428807 0.734307 1.08324 1.4505 1.81634 2.1668 2.49299
2.79008 3.05615 3.29134 3.49707 3.67554 3.82932 4.20998
0.000304952 0.0177052 0.211343 0.568303 0.809861 0.920338 0.965753 0.984496
0.992572 0.996243 0.998005 0.998892 0.99936 0.999616 0.999762 0.999847
Females - Recreational
0.0522189 0.194185 0.428807 0.734307 1.08324 1.4505 1.81634 2.1668 2.49299
2.79008 3.05615 3.29134 3.49707 3.67554 3.82932 4.20998
0.0069125 0.0326784 0.109161 0.249165 0.415607 0.564615 0.679191 0.761387
0.818976 0.859326 0.887936 0.908572 0.923744 0.935116 0.943798 0.950543
Males - Commerical
0.0846179 0.249546 0.467291 0.699729 0.920723 1.11653 1.28221 1.41811 1.52714
1.61327 1.68054 1.73263 1.77274 1.80346 1.82693 1.87009
0.00113472 0.0423843 0.258105 0.532868 0.721072 0.828066 0.887711 0.922203
0.943222 0.956738 0.965875 0.972335 0.977086 0.980702 0.983533 0.985802
Males - Recreational
0.0846179 0.249546 0.467291 0.699729 0.920723 1.11653 1.28221 1.41811 1.52714
1.61327 1.68054 1.73263 1.77274 1.80346 1.82693 1.87009

0.0113761 0.047042 0.124888 0.231785 0.339005 0.429636 0.500296 0.553596
0.593426 0.62325 0.645747 0.662886 0.676094 0.686398 0.694543 0.701072
M and initial age-structure
Females
0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25
214.259 212.827 84.1825 50.6529 24.1601 21.5057 21.5282 41.7018 11.3941 18.3422
9.7127 1.51827 0.917558 1.03423 0.456564 0.792626
Males
0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25
214.259 212.713 83.813 50.0912 23.9751 21.7142 22.3874 44.9633 12.8517 21.747
12.1504 2.00947 1.27609 1.49581 0.68603 1.38847
Initial age-structure
214.259 212.827 84.1825 50.6529 24.1601 21.5057 21.5282 41.7018 11.3941 18.3422
9.7127 1.51827 0.917558 1.03423 0.456564 0.792626
214.259 212.713 83.813 50.0912 23.9751 21.7142 22.3874 44.9633 12.8517 21.747
12.1504 2.00947 1.27609 1.49581 0.68603 1.38847
Year for Tmin Age-structure
2003
Number of simulations,,,,,,,,,,,,,,,,,,,,
1000,,,,,,,,,,,,,,,,,,,,
recruitment and biomass,,,,,,,,,,,,,,,,,,,,
Number of historical assessment years ,,,,,,,,,,,,,,,,,,,,
74,,,,,,,,,,,,,,,,,,,,
Historical data,,,,,,,,,,,,,,,,,,,,
year,recruitment,spawner,in B0,in R project,in R/S project,,,,,,,,,,,,,,,
1930 515.1 902.074 1 0 0
1931 514.112 886.178 0 0 0
1932 513.177 871.592 0 0 0
1933 512.306 858.379 0 0 0
1934 511.539 847.037 0 0 0
1935 510.869 837.355 0 0 0
1936 510.165 827.38 0 0 0
1937 509.422 817.073 0 0 0
1938 508.938 810.483 0 0 0
1939 508.612 806.103 0 0 0
1940 508.34 802.482 0 0 0
1941 508.112 799.458 0 0 0
1942 507.743 794.611 0 0 0
1943 507.639 793.256 0 0 0
1944 507.47 791.064 0 0 0
1945 507.369 789.763 0 0 0
1946 507.285 788.68 0 0 0
1947 507.125 786.617 0 0 0
1948 507.073 785.95 0 0 0
1949 506.941 784.266 0 0 0
1950 506.688 781.048 0 0 0

1951 506.322 776.441 0 0 0
1952 505.947 771.762 0 0 0
1953 505.378 764.765 0 0 0
1954 505.341 764.31 0 0 0
1955 505.468 765.863 0 0 0
1956 505.593 767.395 0 0 0
1957 505.567 767.075 0 0 0
1958 505.54 766.753 0 0 0
1959 505.375 764.731 0 0 0
1960 505.46 765.771 0 0 0
1961 504.386 752.824 0 0 0
1962 503.36 740.811 0 0 0
1963 502.494 730.935 0 0 0
1964 501.734 722.453 0 0 0
1965 501.016 714.596 0 0 0
1966 500.331 707.232 0 0 0
1967 499.562 699.128 0 0 0
1968 498.875 692.019 0 0 0
1969 498.097 684.115 0 0 0
1970 497.225 675.45 0 0 0
1971 496.851 671.781 0 0 0
1972 496.714 670.449 0 0 0
1973 496.551 668.87 0 0 0
1974 496.47 668.09 0 0 0
1975 715.791 664.606 0 1 1
1976 415.965 633.503 0 1 1
1977 341.413 606.598 0 1 1
1978 818.025 592.277 0 1 1
1979 1075.17 571.706 0 1 1
1980 550.025 543.359 0 1 1
1981 618.26 425.35 0 1 1
1982 471.084 452.717 0 1 1
1983 551.906 477.027 0 1 1
1984 797.987 502.123 0 1 1
1985 432.595 508.245 0 1 1
1986 261.172 530.102 0 1 1
1987 554.698 517.586 0 1 1
1988 313.835 512.639 0 1 1
1989 416.482 498.606 0 1 1
1990 594.625 473.311 0 1 1
1991 327.953 446.701 0 1 1
1992 325.914 428.094 0 1 1
1993 1205.27 415.955 0 1 1
1994 1296.31 417.373 0 1 1
1995 461.304 422.228 0 1 1
1996 987.152 443.313 0 1 1

1997 309.74 484.187 0 1 1
1998 196.956 512.305 0 1 1
1999 148.699 488.619 0 1 1
2000 222.676 470.761 0 1 1
2001 279.232 416.561 0 1 1
2002 546.954 354.102 0 0 0
2003 428.517 312.59 0 0 0
Number of years with pre-specified catches,,,,,
1,,,,,
catches for years with pre-specified catches,,
2003,90,
Number of future recruitments to override,,
0,,
Process for overiding (-1 for average otherwise index in data list),,
Which probability to product detailed results for (1=0.5; 2=0.6; etc.),,
8,,
Steepness,sigma-R,Auto-correlation
0.5,0.5,0.717
Target SPR rate (FMSY Proxy)
0.45
Target SPR information: Use (1=Yes) and power
0 20
Discount rate (for cumulative catch),,
0.1,,
Truncate the series when 0.4B0 is reached (1=Yes),,
0,,
Set F to FMSY once 0.4B0 is reached (1=Yes)
0
Percentage of FMSY which defines Ftarget
0.9
Maximum possible F for projection (-1 to set to FMSY)
2
Conduct MacCall transition policy (1=Yes)
0
Defintion of recovery (1=now only;2=now or before)
2
Results for rec probs by Tmax (1) or 0.5 prob for various Ttargets (2)
1
Definition of the "40-10" rule
10 40
Produce the risk-reward plots (1=Yes)
0
Calculate coefficients of variation (1=Yes)
0
Number of replicates to use
20

```
# Random number seed
-89102
# Conduct projections for multiple starting values (0=No;else yes)
0
# File with multiple parameter vectors
MCMC.STO
# Number of parameter vectors
100
# User-specific projection (1=Yes); Output replaced (1->6)
2 7 3 0.51
# Catches and Fs (Year; 1/2 (F or C); value); Final row is -1
2004 2 1000
2005 2  400
2010 1 0.05
2030 1 0.10
-1 -1 -1
# Split of Fs
2003 1 1
-1 1 1
```

Appendix G. ADMB code and input file.

```
//*************************************************************************************
// Cabezon model
//   model by Punt, Minte-Vera, Cope, Piner
//   programmed by Carolina V. Minte-Vera using
//        AD Model Builder version 5.0.1 copyright (c) 1993 2000 Otter Research Ltd.
//        for Microsoft Visual C++ 6.0 compiler
//
// This is a two-sexes, two-population, two-fisheries (in each population) model fitted to
// length frequency data (sex-aggregated and separated by population),
// catch-rate indices (for both populations),
// spawning abundance indices (for both populations) and recruitment index (for
California)
// using Bayesian methods (MCMC). Catchabilities and sampling variances are set to
their MLEs.
//
// Additional features:
// 1) the model can be reduced to 1 population model, by changing the options in
// the cabezon.dat file. The population can be specified South = 1, North =2.
// 2) there is a debugging mode, that can be turn on/off in the cabezon.ctl file, no
parameter
// is estimated and the deterministic calculations are performed and can be checked
//
// The model is flexible to be increased to more
// then 2 populations and more then 2 sexes (or growth morphs) with minor
modifications.
//
// cabezon.dat has the data
// cabezon.ctl has the controls
// cabezon.pin has the initial values for the parameters
//
//  type cabezon -? to see the command line arguments
//
//*************************************************************************************
//   May 21 2003: selectivity, size transition, initial conditions
//   May 24 2003: numbers at age, catch at age
//   May 27: recruitment
//   May 29: enter data,
//   May 30: predictions
//   June 01: likelihood
//   June 02: prior and penalties, report section
//   June 9-10: MLE for q and sigmas
//   June 11: replaced the initialization section for a pin file
```

```
//   June 24: corrections for sigma MLE
//   July 01-02: MLE for Q, MLE for sigma, likelihood
//   July 07-08: two fleets by population
//   July 10:  one vector of recruitment residuals by population
//   July 11: outputs for R, effective sample size for multinomial
//   July 17-18: options for one population
//   July 19-21: recruitment prior, double logistic
//   July 28: R graphs
//   August 07: the harvest rate and the catches depend on the weight at age at the middle
of the year
//           option to estimate or not the extra variability around the abundance indices
//
//TO DO:
//
//    use calculated effective sample size (neffective) for multinomial to re-weight the data
//
// ----------------------------------------------------------------------------
// Naming Conventions:
//
//  GENERAL:
//    styr, endyr begining year and ending year of model (catch data available)
//    pop         number of populations
//    gender      number of sexes
//    nages       number of age groups considered
//    nlength     number of length groups considered
//    rec         relative to recruitment
//
//  DATA SPECIFIC:
//    catch_bio   Observed catch biomass
//    com         Commercial fleet
//    rec         Recreational fleet
//
//    indices:
//    nyr         number of observations available to specific data set
//    yr          vector with the actual years where observations were made in specific data
set
//    obs         observed index
//    exp         expected values corresponding to the index (function of pop dynamic)
//    cv          observed CV, derived from bootstrap of observed values
//
//    cr          catch rate
//    sp          spawning biomass index
//    imp         impingment recruitment index
//
//    ca          California
//    or          Oregon
```

```
//   wa         Washingtn
//   nth        North Stock (OR + WA)
//
//   length frequencies:
//   lnyr       number of observations available to specific data set
//   lyr        actual years where observations were made in specific data set
//   ltrips     numbers of trips
//   langl      number of angler
//   lsamp      number of samples
//   lnb        number of bins
//   lbin       vector with the actual bins used
//   osc        observed size composition
//   esc        expected size composition
//
//   rec        recreational fisheries data
//
//*******************************************************************
****************
//
DATA_SECTION

  //*****************MODEL DIMENSIONS
***********************************************
  init_int styr  //start year of the model
  init_int endyr // end year of the model
  init_int pop   // number of populations
  init_int popID // if pop = 1, popID indicates which population to be assessed (1 -South,
2-North)
  init_int fleet // number of fleets (each one with a different selectivity function)
  init_int gender // number of genders
  ivector years(styr,endyr) // vector of the years of the model

   // prepare age vector
  init_int    nages // plus group
  ivector     age_vector(1,nages)
  !! for (a=1;a<=nages;a++) age_vector(a) = a;

  // prepare length vector
  init_int    nlength //number of length classes
  init_number len_start // firts length bin
  init_number len_step  // size of the length bins
  vector size_vector(1,nlength)  //vector with all length bins

 LOCAL_CALCS
  years(styr) = styr;
  for (i=styr+1;i<=endyr;i++) years(i)=years(i-1)+1; //year vector
```

```
  size_vector(1) = len_start;
  for (z=2;z<=nlength;z++)
   size_vector(z) = size_vector(z-1) + len_step;
 END_CALCS
  !!cout<<"nages "<<nages<<" nlength "<<nlength<<endl;

  //************BIOLOGICAL INFORMATION ************************
  // growth curve parameters, first population =1 south, then pop=2 north, females
gender=1, then males gender=2
  // Von Bertalanffy growth fumction reparametrized as Lmin, Lmax, K intead of Linf, t0
and K
  init_matrix Lmin(1,2,1,gender)//TO EXPAND FOR MORE THEN 2 POPULATIONS,
CHANGE 2 for pop,
  init_matrix Lmax(1,2,1,gender)//need to change the .DAT file also
  init_matrix K(1,2,1,gender)
  init_matrix CVLmin(1,2,1,gender)
  init_matrix CVLmax(1,2,1,gender)

   // Age-length keys for populations 1 and 2
  3darray age_length_pop1(1,gender,0,nages,1,nlength)
  3darray age_length_pop2(1,gender,0,nages,1,nlength)
  3darray Average_Size(1,pop,1,gender,0,nages);
  3darray Sd_Size(1,pop,1,gender,0,nages);


   // length-weight parameters, same for both genders and populations
  init_number WL_intercept
  init_number WL_slope
   // weight at age in kg, females then males
  init_3darray wt_input(1,2,1,gender,0,nages) //3d array: beginning of the year weight,
middle of the year weight, gender, ages
                                              //CHANGE FOR 1 POP, IF GROWTH
PARAMETERS CHANGE,
                                             // MODIFY HERE!this need to be changed when
setting a different nages

  matrix wt_age(1,gender,0,nages) //weight at the beginning of the year
  matrix wt_age_middle(1,gender,0,nages)//weight at the middle of the year

   // maturity-at-age parameters, same for both genders and populations
  init_number mat_intercept
  init_number mat_slope
  vector mat_age(0,nages)
   //relative fecundity at age, is the maturity times the weight-at-age for females
  vector fec(0,nages)
```

```
  //*******CATCH biomass, first south pop=1 then north pop = 2,
  // first commercial fleet=1, then recreational fleet =2
 init_matrix catch_bio1(1,fleet,styr,endyr)
 init_matrix catch_bio2(1,fleet,styr,endyr)
  3darray catch_bio(1,pop,1,fleet,styr,endyr) //CHANGE FOR 1 POP!!


//*********DATA*******************************************************
************
  // Catch rate index CA - CPFV(observer), Number of years, Year, value, CV,
  // and observed standard deviation computed from the CV and observed index
 init_int     nyr_cr_ca
 init_ivector yr_cr_ca(1,nyr_cr_ca)
 init_vector  obs_cr_ca(1,nyr_cr_ca)
 init_vector  cv_cr_ca(1,nyr_cr_ca)

  // NOT USED Catch rate index CA - CPFV(logbook) first series, Number of years,
Year, value, CV
  // and observed standard deviation computed from the CV and observed index
 init_int     nyr_cr_ca2
 init_ivector yr_cr_ca2(1,nyr_cr_ca2)
 init_vector  obs_cr_ca2(1,nyr_cr_ca2)
 init_vector  cv_cr_ca2(1,nyr_cr_ca2)

  // NOT USED Catch rate index CA - CPFV(logbook) second series,  Number of years,
Year, value, CV
  // and observed standard deviation computed from the CV and observed index
 init_int     nyr_cr_ca3
 init_ivector yr_cr_ca3(1,nyr_cr_ca3)
 init_vector  obs_cr_ca3(1,nyr_cr_ca3)
 init_vector  cv_cr_ca3(1,nyr_cr_ca3)

  // Catch rate index CA - CPFV(logbook) all years, Number of years, Year, value, CV
  // and observed standard deviation computed from the CV and observed index
 init_int     nyr_cr_ca4
 init_ivector yr_cr_ca4(1,nyr_cr_ca4)
 init_vector  obs_cr_ca4(1,nyr_cr_ca4)
 init_vector  cv_cr_ca4(1,nyr_cr_ca4)

  // Catch rate index Oregon, Number of years, Year, value, CV
  // and observed standard deviation computed from the CV and observed index
 init_int     nyr_cr_or
 init_ivector yr_cr_or(1,nyr_cr_or)
 init_vector  obs_cr_or(1,nyr_cr_or)
```

```
  init_vector  cv_cr_or(1,nyr_cr_or)

   // Catch rate index Washington, Number of years, Year, value, CV
   // and observed standard deviation computed from the CV and observed index
  init_int     nyr_cr_wa
  init_ivector yr_cr_wa(1,nyr_cr_wa)
  init_vector  obs_cr_wa(1,nyr_cr_wa)
  init_vector  cv_cr_wa(1,nyr_cr_wa)

   // Spawning biomass index CA,  Number of years, Year, value, CV
   // and observed standard deviation computed from the CV and observed index
  init_int     nyr_sp_ca
  init_ivector yr_sp_ca(1,nyr_sp_ca)
  init_vector  obs_sp_ca(1,nyr_sp_ca)
  init_vector  cv_sp_ca(1,nyr_sp_ca)

   // Spawning biomass index North stock, Number of years, Year, value, CV
   // and observed standard deviation computed from the CV and observed index
  init_int     nyr_sp_nth
  init_ivector yr_sp_nth(1,nyr_sp_nth)
  init_vector  obs_sp_nth(1,nyr_sp_nth)
  init_vector  cv_sp_nth(1,nyr_sp_nth)

   // Impingement recruitment index CA, Number of years, Year, value, CV
   // and observed standard deviation computed from the CV and observed index
  init_int     nyr_imp_ca
  init_ivector yr_imp_ca(1,nyr_imp_ca)
  init_vector  obs_imp_ca(1,nyr_imp_ca)
  init_vector  cv_imp_ca(1,nyr_imp_ca)

   // Length frequencies, they get transformed in proportions in the Prelim_calcs section.
   // length frequency, California, commercial,Number of years, Year, number of trips,
number of samples
  init_int     lnyr_ca //number of years with data
  init_ivector lyr_ca(1,lnyr_ca) //actual years
  init_vector  ltrips_ca(1,lnyr_ca) //number of trips per year
  init_vector  lsamp_ca(1,lnyr_ca) //number of samples per year
  init_int     lnb_ca //number of length classes
  init_vector  lbin_ca(1,lnb_ca) //middle point of the length frequency bin
  init_matrix  osc_ca(1,lnyr_ca,1,lnb_ca) //matrix year*length with the length frequencies
  !! if(lnb_ca!=nlength) {cout<<"THE NUMBER OF LENGTH BINS FOR CA
("<<lnb_ca<<") DO NOT MATCH WITH THE MODEL "<<nlength<<endl;}

   // Length frequency, California, recreational, number of years, Year, number of anglers,
number of samples
  init_int     lnyr_carec
```

```
  init_ivector lyr_carec(1,lnyr_carec)
  init_vector  langl_carec(1,lnyr_carec)
  init_vector  lsamp_carec(1,lnyr_carec)
  init_int     lnb_carec
  init_vector  lbin_carec(1,lnb_carec)
  init_matrix  osc_carec(1,lnyr_carec,1,lnb_carec)
  !! if(lnb_carec!=nlength) {cout<<"THE NUMBER OF LENGTH BINS FOR CAREC DO NOT MATCH WITH THE MODEL"<<endl;}

   // length frequency, Oregon, commercial
  init_int     lnyr_or
  init_ivector lyr_or(1,lnyr_or)
  init_vector  ltrips_or(1,lnyr_or)
  init_vector  lsamp_or(1,lnyr_or)
  init_int     lnb_or
  init_vector  lbin_or(1,lnb_or)
  init_matrix  osc_or(1,lnyr_or,1,lnb_or)
  !! if(lnb_or!=nlength) {cout<<"THE NUMBER OF LENGTH BINS FOR OR DO NOT MATCH WITH THE MODEL"<<endl;}

   // length frequency, Oregon, recreational, Number of years, Year, number of trips, number of samples
  init_int     lnyr_orrec
  init_ivector lyr_orrec(1,lnyr_orrec)
  init_vector  ltrips_orrec(1,lnyr_orrec)
  init_vector  lsamp_orrec(1,lnyr_orrec)
  init_int     lnb_orrec
  init_vector  lbin_orrec(1,lnb_orrec)
  init_matrix  osc_orrec(1,lnyr_orrec,1,lnb_orrec)
  !! if(lnb_orrec!=nlength) {cout<<"THE NUMBER OF LENGTH BINS FOR ORREC DO NOT MATCH WITH THE MODEL"<<endl;}

   // length frequency, Washington, recreational, Number of years, Year, number of trips, number of samples
  init_int     lnyr_warec
  init_ivector lyr_warec(1,lnyr_warec)
  init_vector  ltrips_warec(1,lnyr_warec)
  init_vector  lsamp_warec(1,lnyr_warec)
  init_int     lnb_warec
  init_vector  lbin_warec(1,lnb_warec)
  init_matrix  osc_warec(1,lnyr_warec,1,lnb_warec)
  !! if(lnb_warec!=nlength) {cout<<"THE NUMBER OF LENGTH BINS FOR WAREC DO NOT MATCH WITH THE MODEL"<<endl;}

  ivector maxindx_nsamples(1,5);
```

```
 LOCAL_CALCS //this will allow to define a ragged array
  maxindx_nsamples(1) = lnyr_ca;
  maxindx_nsamples(2) = lnyr_carec;
  maxindx_nsamples(3) = lnyr_or;
  maxindx_nsamples(4) = lnyr_orrec;
  maxindx_nsamples(5) = lnyr_warec;
 END_CALCS
  matrix nsamples(1,5,1,maxindx_nsamples) //Effective sample size for multinomial,
ragged array

  //End of file indicator
  init_int endoffile
  !!cout<<"If you see 999, we got to the end of the data imput sucessfully!
"<<endoffile<<endl;



//*******CONTROLS*************************************************
****************
  //  Lets change the main datafile to a control data file for
  //  specifying controls over the estimation (range of parameters, weights of data sets,
  //  switch on and off data sets,etc.
 LOCAL_CALCS
   ad_comm::change_datafile_name("cabezon.ctl");
 END_CALCS
  init_int dummy;//dummy==1 turns off all parameters, makes determinitic projections
  int phase_dummy;

  init_int project_from_external_recs; // takes the values in ssrecs.ctl and uses them as
recruitment values

  //estimate the extra the variability around the observed abundance indices
  //(see Equation B.2, overall catchability scaling factor) yes==1, no==0
  init_int do_var;
  // 3 controls: Lower_limit, Upper_limit, phase_of_estimation
  init_number low_M;       init_number upp_M;       init_int phase_M;
  init_number low_ln_S0;   init_number upp_ln_S0;   init_int phase_ln_S0;
  init_number low_h;       init_number upp_h;       init_int phase_h;
  init_number low_c;       init_number upp_c;       init_int phase_c;
  init_number low_s2age;   init_number upp_s2age;   init_int phase_s2age;
  //Recruitment residuals:
  // 5 controls: start_year, end year,Lower_limit, Upper_limit, phase_of_estimation
          //South
  init_int start_rec; init_int end_rec;   init_number low_rec;   init_number upp_rec;
init_int phase_rec;
          //North
```

```
  init_int start_rec2; init_int end_rec2;   init_number low_rec2;   init_number upp_rec2;
init_int phase_rec2;

  ivector maxindx_priorrec(1,pop);
  ivector minindx_priorrec(1,pop);

 LOCAL_CALCS //this will allow to define a ragged array for recruitment prior
  if(pop==1)
   { //one population
    if(popID==1) {minindx_priorrec(1) = start_rec;  maxindx_priorrec(1) = end_rec;}
    if(popID==2) {minindx_priorrec(1) = start_rec2; maxindx_priorrec(1) = end_rec2;}
   }
  else
   {    //two populations
    maxindx_priorrec(1) = end_rec;
    maxindx_priorrec(2) = end_rec2;
    minindx_priorrec(1) = start_rec;
    minindx_priorrec(2) = start_rec2;
   }
 END_CALCS

  //Selectivity switch, 1 - logistic, 2 - double logistic
  //South Commercial SC, South Recreational SR, North Commercial NC, North
Recreational NR
  init_int switchSC; init_int switchSR; init_int switchNC; init_int switchNR;
  //Selectivity, option 1 - logistic
  // 3 controls: Lower_limit, Upper_limit, phase_of_estimation
  init_number low_Len50_S_com;   init_number upp_Len50_S_com;   init_int
phase_Len50_S_com;
  init_number low_LenDiff_S_com; init_number upp_LenDiff_S_com; init_int
phase_LenDiff_S_com;
  init_number low_Len50_S_rec;   init_number upp_Len50_S_rec;   init_int
phase_Len50_S_rec;
  init_number low_LenDiff_S_rec; init_number upp_LenDiff_S_rec; init_int
phase_LenDiff_S_rec;
  init_number low_Len50_N_com;   init_number upp_Len50_N_com;   init_int
phase_Len50_N_com;
  init_number low_LenDiff_N_com; init_number upp_LenDiff_N_com; init_int
phase_LenDiff_N_com;
  init_number low_Len50_N_rec;   init_number upp_Len50_N_rec;   init_int
phase_Len50_N_rec;
  init_number low_LenDiff_N_rec; init_number upp_LenDiff_N_rec; init_int
phase_LenDiff_N_rec;

  //Selectivity, option 2 - double logistic, stock synthesis parametrization
```

```
  init_int ph_sel_peak1;   init_int ph_sel_peak2;   init_int ph_sel_peak3;   init_int
ph_sel_peak4;   // phase for the ascending  peak synthesis sel option
  init_int ph_sel_init1;   init_int ph_sel_init2;   init_int ph_sel_init3;   init_int
ph_sel_init4;   // phase for the ascending init value synthesis sel option
  init_int ph_sel_infl1;   init_int ph_sel_infl2;   init_int ph_sel_infl3;   init_int
ph_sel_infl4;   // phase for the ascending inflection point synthesis sel option
  init_int ph_sel_slope1;  init_int ph_sel_slope2;  init_int ph_sel_slope3;  init_int
ph_sel_slope4;  // phase for the ascending slope synthesis sel option
  init_int ph_sel_final1;  init_int ph_sel_final2;  init_int ph_sel_final3;  init_int
ph_sel_final4;  // phase for the descending final value synthesis sel option
  init_int ph_sel_infl2_1; init_int ph_sel_infl2_2; init_int ph_sel_infl2_3; init_int
ph_sel_infl2_4; // phase for the descending inflection synthesis sel option
  init_int ph_sel_slope2_1;init_int ph_sel_slope2_2;init_int ph_sel_slope2_3;init_int
ph_sel_slope2_4;// phase for the descending slope synthesis sel option

  !!cout<<phase_ln_S0<<endl;

  //CHANGE this does not need to be integer
  init_vector surv_lambda(1,9)
  init_vector length_lambda(1,5)
  init_number lambda_rec
  init_ivector effective(1,5)// switch to use 0 - number of trips or number of anglers or  1
to use number of samples,
                  // or another value that will then be used as the effective sample size for all
the
                  // years...
  init_int Do_rec_Bias;
  !!cout << Do_rec_Bias << endl;

   //effective sample size for multinomial, maximum index for each row of the ragged
array "nsamples"
 LOCAL_CALCS
   if (effective(1) == 0)
    nsamples(1) =  ltrips_ca;
   else if (effective(1) == -1)
    nsamples(1) = lsamp_ca;
   else
    nsamples(1) = effective(1);
   if (effective(2) == 0)
    nsamples(2) =  langl_carec;
   else if (effective(2) == -1)
    nsamples(2) = lsamp_carec;
   else
    nsamples(2) = effective(2);
   if (effective(3) == 0)
    nsamples(3) =  ltrips_or;
```

```
  else if (effective(3) == -1)
   nsamples(3) = lsamp_or;
  else
   nsamples(3) = effective(3);
  if (effective(4) == 0)
   nsamples(4) =  ltrips_orrec;
  else if (effective(4) == -1)
   nsamples(4) = lsamp_orrec;
  else
   nsamples(4) = effective(4);
  if (effective(5) == 0)
   nsamples(5) =  ltrips_warec;
  else if (effective(1) == -1)
   nsamples(5) = lsamp_warec;
  else
   nsamples(5) = effective(5);

 if (switchSC == 1)
  { ph_sel_peak1 = -1; ph_sel_init1 = -1; ph_sel_infl1 = -1; ph_sel_slope1 = -1;
ph_sel_final1 = -1; ph_sel_infl2_1 = -1; ph_sel_slope2_1 = -1; }
 if (switchSC == 2)
  { phase_Len50_S_com = -1; phase_LenDiff_S_com = -1; }
 if (switchSR == 1)
  { ph_sel_peak2 = -1; ph_sel_init2 = -1; ph_sel_infl2 = -1; ph_sel_slope2 = -1;
ph_sel_final2 = -1; ph_sel_infl2_2 = -1; ph_sel_slope2_2 = -1; }
 if (switchSR == 2)
  { phase_Len50_S_rec = -1; phase_LenDiff_S_rec = -1; }
 if (switchNC == 1)
  { ph_sel_peak3 = -1; ph_sel_init3 = -1; ph_sel_infl3 = -1; ph_sel_slope3 = -1;
ph_sel_final3 = -1; ph_sel_infl2_3 = -1; ph_sel_slope2_3 = -1; }
 if (switchNC == 2)
  { phase_Len50_N_com = -1; phase_LenDiff_N_com = -1; }
 if (switchNR == 1)
  { ph_sel_peak4 = -1; ph_sel_init4 = -1; ph_sel_infl4 = -1; ph_sel_slope4 = -1;
ph_sel_final4 = -1; ph_sel_infl2_4 = -1; ph_sel_slope2_4 = -1; }
 if (switchNR == 2)
  { phase_Len50_N_rec = -1; phase_LenDiff_N_rec = -1; }


 //Turn off all the parameters if debbuging is on.
 if (dummy==1 || project_from_external_recs==1)
  {
  phase_dummy = 1;
  phase_Len50_S_com  =-1; phase_Len50_S_rec  =-1; phase_Len50_N_com  =-1;
phase_Len50_N_rec  =-1;
```

```
  phase_LenDiff_S_com=-1; phase_LenDiff_S_rec=-1; phase_LenDiff_N_com=-1;
phase_LenDiff_N_rec=-1;
  ph_sel_peak1      =-1; ph_sel_peak2      =-1; ph_sel_peak3      =-1; ph_sel_peak4 =-1;
  ph_sel_init1      =-1; ph_sel_init2      =-1; ph_sel_init3      =-1; ph_sel_init4 =-1;
  ph_sel_infl1      =-1; ph_sel_infl2      =-1; ph_sel_infl3      =-1; ph_sel_infl4 =-1;
  ph_sel_slope1     =-1; ph_sel_slope2     =-1; ph_sel_slope3     =-1; ph_sel_slope4 =-1;
  ph_sel_final1     =-1; ph_sel_final2     =-1; ph_sel_final3     =-1; ph_sel_final4 =-1;
  ph_sel_infl2_1    =-1; ph_sel_infl2_2    =-1; ph_sel_infl2_3    =-1; ph_sel_infl2_4 =-
1;
  ph_sel_slope2_1   =-1; ph_sel_slope2_2   =-1; ph_sel_slope2_3   =-1;
ph_sel_slope2_4 =-1;
  phase_M           =-6; phase_ln_S0       =-1; phase_h           =-5; phase_c=-6;
  phase_s2age       =-6; phase_rec         =-3; phase_rec2        =-3;
  }

 //Turn off the dummy_par is the debugging is off, o/w the hessian will have a 0
 if (dummy==0)  phase_dummy=-1;
 if (project_from_external_recs==1) phase_dummy=1;

 cout<<"phase_ln_S0: "<<phase_ln_S0<<endl;

 //Assessment of one population at a time only
 // Special features for South
 if (pop==1 && popID==1)
  {
   phase_rec2=-5;phase_c = -6;
   phase_Len50_N_com=-3;  phase_LenDiff_N_com=-4; phase_Len50_N_rec=-3;
phase_LenDiff_N_rec=-4;
   ph_sel_peak3     =-1;  ph_sel_peak4           =-1;
   ph_sel_init3     =-1;  ph_sel_init4     =-1;
   ph_sel_infl3     =-1;  ph_sel_infl4     =-1;
   ph_sel_slope3    =-1;  ph_sel_slope4   =-1;
   ph_sel_final3    =-1;  ph_sel_final4   =-1;
   ph_sel_infl2_3   =-1;  ph_sel_infl2_4  =-1;
   ph_sel_slope2_3  =-1;  ph_sel_slope2_4 =-1;
   surv_lambda(5)   = 0;  surv_lambda(6)  = 0;    surv_lambda(8) = 0;
   length_lambda(3) = 0; length_lambda(4) = 0;  length_lambda(5) = 0;
  }

 // Special features for North
 if (pop==1 && popID==2)
  {
   phase_c = -6; phase_rec=-5;
   phase_Len50_S_com=-3; phase_LenDiff_S_com=-4; phase_Len50_S_rec=-3;
phase_LenDiff_S_rec=-4;
   ph_sel_peak1     =-1; ph_sel_peak2          =-1;
```

```
    ph_sel_init1     =-1; ph_sel_init2    =-1;
    ph_sel_infl1     =-1; ph_sel_infl2    =-1;
    ph_sel_slope1    =-1; ph_sel_slope2          =-1;
    ph_sel_final1    =-1; ph_sel_final2 =-1;
    ph_sel_infl2_1   =-1; ph_sel_infl2_2 =-1;
    ph_sel_slope2_1  =-1; ph_sel_slope2_2 =-1;
    surv_lambda(1)   = 0; surv_lambda(2) = 0;    surv_lambda(3) = 0;
    surv_lambda(4)   = 0; surv_lambda(7) = 0;    surv_lambda(9) = 0;
    length_lambda(1) = 0;  length_lambda(2)= 0;
   }
 END_CALCS
  //!!cout<<"controls"<<start_rec<<","<<low_rec","<<upp_rec<<","<<phase_rec<<endl;

  init_int fim // end of file indicator
  !!cout<<"If you see 999, we got to the end of the control file sucessfully!
"<<fim<<endl;

 //HERE: new, read in SS recruitment just to check the projections

 LOCAL_CALCS
   if (project_from_external_recs==1)
    ad_comm::change_datafile_name("ssrecs.ctl");
 END_CALCS
 !! if (project_from_external_recs==1)
 init_vector ssrecs(styr,endyr)


//*********COUNTERS**************************************************
****************
  // All counters are declared globally (here) in this version
  int z // counters for size
  int l
  int g // counter for gender
  int a // counter for ages
  int p // counter for populations
  int t // counter for time
  int i
  int j
  int f // counter for fleet

 //
*=================================================================
===========*


PARAMETER_SECTION
```

```
  // remember: init_bounded_number(lower limit, upper limit, phase of estimation)
  // Dummy parameter for debugging (if dummy== 1, then turn all the parameters off)
  init_number dummy_par(phase_dummy)

   //recruitment and initial conditions
  init_bounded_number M(low_M,upp_M,phase_M)
  init_bounded_number ln_S0(low_ln_S0,upp_ln_S0,phase_ln_S0)
  init_bounded_number h_steep(low_h,upp_h,phase_h)
  init_bounded_number c(low_c,upp_c,phase_c)
  init_bounded_number sigmasq_rec(low_s2age,upp_s2age,phase_s2age)
  init_bounded_dev_vector rec_dev1(start_rec,end_rec,low_rec,upp_rec,phase_rec) //
recruitrment residuals population 1
  init_bounded_dev_vector rec_dev2(start_rec2,end_rec2,low_rec2,upp_rec2,phase_rec2)
// recruitment residuals population 2

  number S0
  vector S0_pop(1,pop)
  vector R0_pop(1,pop)
  matrix log_R0_pop(1,pop,1,gender)
  matrix Spbio(1,pop,styr,endyr)        //Spawning biomass
  matrix exp_rec(1,pop,minindx_priorrec,maxindx_priorrec) //expected value for
recruitment (deterministic)
  matrix pred_rec(1,pop,minindx_priorrec,maxindx_priorrec) //predicted value for
recruitment (stochastic)

  //likelihood profile numbers
  likeprof_number S0_lprof
  //likeprof_number h_steep_lprof

  4darray natage(styr,endyr,1,pop,1,gender,0,nages)
  5darray catage(styr,endyr,1,pop,1,fleet,1,gender,0,nages) // 5 dimensions!
  4darray catage_tot(styr,endyr,1,pop,1,gender,0,nages)//sum the catches for all fleets
  3darray Hrate(1,pop,1,fleet,styr,endyr) //Harvest Rate for each fleet

  // selectivity  option 1, sel at length by population and fleet, logistic -
  // South Commercial
  init_bounded_number
Len50_S_com(low_Len50_S_com,upp_Len50_S_com,phase_Len50_S_com)
  init_bounded_number
LenDiff_S_com(low_LenDiff_S_com,upp_LenDiff_S_com,phase_LenDiff_S_com)
  // South Recreational
  init_bounded_number
Len50_S_rec(low_Len50_S_rec,upp_Len50_S_rec,phase_Len50_S_rec)
  init_bounded_number
LenDiff_S_rec(low_LenDiff_S_rec,upp_LenDiff_S_rec,phase_LenDiff_S_rec)
  // North Commercial
```

```
  init_bounded_number
Len50_N_com(low_Len50_N_com,upp_Len50_N_com,phase_Len50_N_com)
  init_bounded_number
LenDiff_N_com(low_LenDiff_N_com,upp_LenDiff_N_com,phase_LenDiff_N_com)
  // North Recreational
  init_bounded_number
Len50_N_rec(low_Len50_N_rec,upp_Len50_N_rec,phase_Len50_N_rec)
  init_bounded_number
LenDiff_N_rec(low_LenDiff_N_rec,upp_LenDiff_N_rec,phase_LenDiff_N_rec)

  //selectivity option 2 - sel at length double logistic, stock synthesis parametrizatin
  // South Commercial SC
  init_bounded_number  sel_peak_SC(1,nlength,ph_sel_peak1);
  init_bounded_number  sel_init_SC(0.000001,1,ph_sel_init1);
  init_bounded_number  sel_infl_SC(1,nlength,ph_sel_infl1);
  init_number          sel_slope_SC(ph_sel_slope1);
  init_bounded_number  sel_final_SC(0.000001,1,ph_sel_final1);
  init_bounded_number  sel_infl2_SC(1,nlength,ph_sel_infl2_1);
  init_number          sel_slope2_SC(ph_sel_slope2_1);
  //South Recreational SR
  init_bounded_number  sel_peak_SR(1,nlength,ph_sel_peak2);
  init_bounded_number  sel_init_SR(0.000001,1,ph_sel_init2);
  init_bounded_number  sel_infl_SR(1,nlength,ph_sel_infl2);
  init_number          sel_slope_SR(ph_sel_slope2);
  init_bounded_number  sel_final_SR(0.000001,1,ph_sel_final2);
  init_bounded_number  sel_infl2_SR(1,nlength,ph_sel_infl2_2);
  init_number          sel_slope2_SR(ph_sel_slope2_2);
  //North Commercial NC
  init_bounded_number  sel_peak_NC(1,nlength,ph_sel_peak3);
  init_bounded_number  sel_init_NC(0.000001,1,ph_sel_init3);
  init_bounded_number  sel_infl_NC(1,nlength,ph_sel_infl3);
  init_number          sel_slope_NC(ph_sel_slope3);
  init_bounded_number  sel_final_NC(0.000001,1,ph_sel_final3);
  init_bounded_number  sel_infl2_NC(1,nlength,ph_sel_infl2_3);
  init_number          sel_slope2_NC(ph_sel_slope2_3);
  //North REcreational NR
  init_bounded_number  sel_peak_NR(1,nlength,ph_sel_peak4);
  init_bounded_number  sel_init_NR(0.000001,1,ph_sel_init4);
  init_bounded_number  sel_infl_NR(1,nlength,ph_sel_infl4);
  init_number          sel_slope_NR(ph_sel_slope4);
  init_bounded_number  sel_final_NR(0.000001,1,ph_sel_final4);
  init_bounded_number  sel_infl2_NR(1,nlength,ph_sel_infl2_4);
  init_number          sel_slope2_NR(ph_sel_slope2_4);


  // Selectivity-related parameters
```

```
  3darray sel(1,pop,1,fleet,1,nlength)
  4darray sel_age(1,pop,1,fleet,1,gender,0,nages) //selectivity at age= multiplication of the
age_length_key by the selectivity at length
  4darray sel_wt_age(1,pop,1,fleet,1,gender,0,nages) // multiplication of sel at age and
weigth at age

  //catchabilities and observation error variances

  // Q and sigmas - we are going to calculate the MLE' fo those, no need to declared them
as init parameters
  // one q and sigma for each data set
  number    log_q_cr_ca
  number    log_q_cr_ca2
  number    log_q_cr_ca3
  number    log_q_cr_ca4
  number    log_q_cr_or
  number    log_q_cr_wa
  number    log_q_sp_ca
  number    log_q_sp_nth
  number    log_q_imp_ca

  // this is only the estimable part of the variability of q
  //(see Equation B.2, overall catchability scaling factor)
  number    s2_cr_ca
  number    s2_cr_ca2
  number    s2_cr_ca3
  number    s2_cr_ca4
  number    s2_cr_or
  number    s2_cr_wa
  number    s2_sp_ca
  number    s2_sp_nth
  number    s2_imp_ca

   // this is the parameter times the observed variability , Equation B.2
   // standard deviation of the fluctuations in log(catchability)
  vector sd_cr_ca(1,nyr_cr_ca)
  vector sd_cr_ca2(1,nyr_cr_ca2)
  vector sd_cr_ca3(1,nyr_cr_ca3)
  vector sd_cr_ca4(1,nyr_cr_ca4)
  vector sd_cr_or(1,nyr_cr_or)
  vector sd_cr_wa(1,nyr_cr_wa)
  vector sd_sp_ca(1,nyr_sp_ca)
  vector sd_sp_nth(1,nyr_sp_nth)
  vector sd_imp_ca(1,nyr_imp_ca)
```

```
   //expected values for each index
  vector exp_cr_ca(1,nyr_cr_ca)
  vector exp_cr_ca2(1,nyr_cr_ca2)
  vector exp_cr_ca3(1,nyr_cr_ca3)
  vector exp_cr_ca4(1,nyr_cr_ca4)
  vector exp_cr_or(1,nyr_cr_or)
  vector exp_cr_wa(1,nyr_cr_wa)
  vector exp_sp_ca(1,nyr_sp_ca)
  vector exp_sp_nth(1,nyr_sp_nth)
  vector exp_imp_ca(1,nyr_imp_ca)

  // Expected length-frequency, the length dimension is the SAME as the model AND
  // the same as in the data if so specified, otherwise an error will be produced ("array out
of bounds")
  //  when calculating the likelihood we pick the right values
  matrix esc_ca(1,lnyr_ca,1,nlength)
  matrix esc_carec(1,lnyr_carec,1,nlength)
  matrix esc_or(1,lnyr_or,1,nlength)
  matrix esc_orrec(1,lnyr_orrec,1,nlength)
  matrix esc_warec(1,lnyr_warec,1,nlength)

  matrix neffective(1,5,1,maxindx_nsamples) //Estimated effective sample size for
multinomial, ragged array
                                            //See McAllister & Ianelli 1997 Appendix 2 for
derivation

  vector offset(1,5) // Compute OFFSET for multinomial (i.e, value for the multinonial
function
          // for a perfect fit, or observed length frequency equal expected length
frequency

  vector surv_like(1,9) // likelihood of the indices
  vector length_like(1,5)  // likelihood of the length-frequency data
  number prior_rec
  number CrashPen;

  objective_function_value obj_fun
  !!cout<<"end of parameter section"<<endl;

  sdreport_number Depl;

//
*==================================================================
===========*

PRELIMINARY_CALCS_SECTION
```

```
 //Reset
 //This will guarantee that the vectors are set = 0  at the beginning of the run
 catch_bio.initialize();age_length_pop1.initialize();age_length_pop2.initialize();
 wt_age.initialize();wt_age_middle.initialize();mat_age.initialize(); offset.initialize();

 //CATCHES
   //one population
 if (pop==1 && popID==1 ) //South
      catch_bio(1) = catch_bio1;
 if (pop==1 && popID==2 ) //North
      catch_bio(1) = catch_bio2;
 if (pop==2)
     { catch_bio(1) = catch_bio1;
      catch_bio(2) = catch_bio2;}
  //GROWTH
 for (g=1;g<=gender;g++)
  {
    age_length_pop1(g) =
SizeTrans(Lmin(1,g),Lmax(1,g),K(1,g),CVLmin(1,g),CVLmax(1,g),1);// 0 means
beginning of the year length
    age_length_pop2(g) =
SizeTrans(Lmin(2,g),Lmax(2,g),K(2,g),CVLmin(2,g),CVLmax(2,g),1); // 1 means
middle of the year
  }

 // wt_input(1) is beginning of the year weight, wt_input(2) is middle of the year weight,
from age 0 to nages
 for (g=1;g<=gender;g++)
  for (a=0;a<=nages;a++)
   {wt_age(g,a) = wt_input(1,g,a);
    wt_age_middle(g,a)=wt_input(2,g,a);}

 // MATURITY at age is being calculated from the parameters provided in the data input
 mat_age(0)=0;
 for (a=1;a<=nages;a++)
  mat_age(a)= 1/(1 + mfexp(mat_intercept + (mat_slope*age_vector(a))));

 // relative FECUNDITY age, is the product of the maturity at age and the weight at age
 //for the females (g=1) at the beginning pf the year
 fec = elem_prod(wt_age(1),mat_age);

 // Compute OFFSET for multinomial (i.e, value for the multinonial function for a
perfect fit, osc=esc)---------
 for (i=1; i <= lnyr_ca; i++)
 { osc_ca(i)=osc_ca(i)/sum(osc_ca(i));
    offset(1) -= nsamples(1,i) *(osc_ca(i))*log(0.0001+osc_ca(i)); }
```

```
  for (i=1; i <= lnyr_carec; i++)
  { osc_carec(i)=osc_carec(i)/sum(osc_carec(i));
    offset(2) -= nsamples(2,i) *(osc_carec(i))*log(0.0001+osc_carec(i)); }

  for (i=1; i <= lnyr_or; i++)
  { osc_or(i)=osc_or(i)/sum(osc_or(i));
    offset(3) -= nsamples(3,i) *(osc_or(i))*log(0.0001+osc_or(i)); }

  for (i=1; i <= lnyr_orrec; i++)
  { osc_orrec(i)=osc_orrec(i)/sum(osc_orrec(i));
    offset(4) -= nsamples(4,i) *(osc_orrec(i))*log(0.0001+osc_orrec(i)); }

  for (i=1; i <= lnyr_warec; i++)
  { osc_warec(i)=osc_warec(i)/sum(osc_warec(i));
    offset(5) -= nsamples(5,i) *(osc_warec(i))*log(0.0001+osc_warec(i)); }

  cout << "offset" << endl << offset << endl;
  if (dummy==1)
    {cout<<endl<<endl<<endl<<"Debugging is on, no parameters are being
estimated"<<endl;
     cout<<"model being projected using pin file values"<<endl<<endl<<endl;}
  else
    {cout<<endl<<endl<<endl<<"Estimating...please wait..."<<endl;
     if (do_var==0) cout<<endl<<"Please note: extra variability around observations is not
been estimated"<<endl;}

//
*=================================================================
===========*

PROCEDURE_SECTION

  // Reset the crash penalty
  CrashPen = 0;

  // selectivity does not change over time, it can be compute only once in each iteration
  get_selectivity(); // cout<<"end of get selectivity"<<endl;

  get_initial_conditions(); // cout<<"end of get initial conditions"<<endl;

  get_numbers_at_age();  //cout<<"end of get numbers at age"<<endl;

   //compute the penalty used for the recruitment residuals
  get_recruitment_prior();   // cout<<"end of get recruitment prior"<<endl;
```

```
  // compute the expected values for the indices and the length frequency
  // compute likelihood functions and include all  in the obj_fun
  get_predictions();
  evaluate_the_objective_function();

  Depl = Spbio(1,2003)/Spbio(1,styr)*100;


  if (mceval_phase())
   {
    cout << obj_fun << " " << Depl << " " << ln_S0 << " ";
    cout << Len50_S_com << " " << LenDiff_S_com << " " << Len50_S_rec << " " <<
LenDiff_S_rec << " "
        << Len50_N_com << " " << LenDiff_N_com << " " << Len50_N_rec << " " <<
LenDiff_N_rec << " ";
    cout  << rec_dev1 << " ";
    if (pop==2) cout << rec_dev2 << " ";
    if (pop==1) cout << Spbio(1) << endl;
    if (pop==2) cout << Spbio(1) << " " << Spbio(2) << endl;
   }


//==============================================================
==========================

FUNCTION get_recruitment_prior
  dvariable chi,tmp;

  //The recruitment prior is assumed to be a lognormal pdf with expected
  // value equal to the deterministic stock-recruitment curve
  chi = 0;
  for (p=1;p<=pop;p++)
   if ((p==1 && phase_rec > 0) || (p==2 && phase_rec2 > 0))
    for (i=minindx_priorrec(p);i<=maxindx_priorrec(p);i++)
     {
     if (Do_rec_Bias==1)
      tmp = log( (exp_rec(p,i)+1e-8)/(pred_rec(p,i)+1e-8)) + sigmasq_rec/2;
     else
      tmp = log( (exp_rec(p,i)+1e-8)/(pred_rec(p,i)+1e-8));
     chi += square(tmp)/(2*sigmasq_rec) + log(sqrt(sigmasq_rec));
     }
  prior_rec = chi;

  if (!last_phase() ) // Recruitment variability: EARLY PHASES ONLY
   {
    if(pop==2 || popID==1) prior_rec += 1. * norm2(rec_dev1);//South
```

```
   if(pop==2 || popID==2) prior_rec += 1. * norm2(rec_dev2);//North
  }

  // Adjust to weight
  prior_rec *= lambda_rec ;

//=====================================================================
========================

FUNCTION get_numbers_at_age
  dvariable vul_bio=0.0;                 // Vulnerable biomass
  dvariable harvest_rate=0.0;             // Harvest rate
  dvariable Spaw_bio=0.0;                 // Spawning biomass
  dvariable Recruits=0.0;                // Age0 Recruits

  // Reset variables
  catage.initialize();  catage_tot.initialize();
  //h_steep_lprof = h_steep; //for likelihood profile

  //loop over populations
  for (p=1;p<=pop;p++)
   {
   //loop over time
   for (t=styr;t<=endyr-1;t++)
    {

     //loop over fleets
     //In this loop get the harvest rate and catch at age --------------------------------------
     catage_tot(t,p)=0.0;
     for (f=1;f<=fleet;f++)
      {
      harvest_rate = 0.0; //reset
         if (catch_bio(p,f,t) > 0)
       {
        // vul_bio for each fleet, need this to calculate the harvest rate (Equation B.6)
        vul_bio = 0.0;
        for (g=1;g<=gender;g++)
         vul_bio += (natage(t,p,g)*mfexp(-M/2))*sel_wt_age(p,f,g);//HERE: I inserted "*
mfexp(-M/2)"

        // Compute the harvest rate and store it
        if (vul_bio > catch_bio(p,f,t))
          harvest_rate = catch_bio(p,f,t)/vul_bio;
        else
          {
          harvest_rate = 0.99 ;
```

```
          CrashPen += 100;
         }
        Hrate(p,f,t) = harvest_rate;

        // Compute the predicted catch at age
        for (g=1;g<=gender;g++)
         {
         catage(t,p,f,g) = harvest_rate* elem_prod( (natage(t,p,g)*mfexp(-M/2) )
,sel_age(p,f,g));//HERE: I inserted "* mfexp(-M/2)"
         for (a=1;a<=nages;a++)
          if (catage(t,p,f,g,a)<=0.0) {catage(t,p,f,g,a) = 0.0;}  // avoid negative catches
         catage_tot(t,p,g) += catage(t,p,f,g);                //catch at age for all fleets, this is
summing the two fleets
        }
       }
         else
       Hrate(p,f,t) = 0.0;

      } //end fleet loop

     // Update the dynamics-----------------------------------------------------------------------
     for (g=1;g<=gender;g++)
      {
      // Recruitment (by gender)
      natage(t+1,p,g,0) = 0;

      // the rest of the ages (Equation A.1)
      for (a=1;a<nages;a++)
       natage(t+1,p,g,a) = natage(t,p,g,a-1)*mfexp(-M)-catage_tot(t,p,g,a-1)*mfexp(-
M/2);

      // plus group (Equation A.1)
      natage(t+1,p,g,nages) = natage(t,p,g,nages-1)*mfexp(-M) - catage_tot(t,p,g,nages-
1)*mfexp(-M/2);
      natage(t+1,p,g,nages) += natage(t,p,g,nages)*mfexp(-M) -
catage_tot(t,p,g,nages)*mfexp(-M/2);

      // now make sure all numbers at age are above 0
      for (a=0;a<=nages;a++)
       if (natage(t+1,p,g,a)<=0.0) {natage(t+1,p,g,a) = 0.0;}
      }

     // Compute the spawning biomass (males and females)-------------------------------------
----
     Spaw_bio = 0.0;
     Spaw_bio = fec*natage(t+1,p,1); // + fec*natage(t+1,p,2);  //no males
```

```
    if (Spaw_bio < 0.0) {Spaw_bio= 0.0;}
    Spbio(p,t+1) = Spaw_bio;                              //store it for the report

    // Compute recruitment-------------------------------------------------------------------------
    // deterministic
    if (project_from_external_recs==1) Recruits=ssrecs(t);
    else
    Recruits =  (4*h_steep*R0_pop(p)*Spaw_bio) / ((S0_pop(p)/gender)*(1-
h_steep)+(5*h_steep-1)*Spaw_bio) ; //deterministic

    // add stochastics bits and store the quantities we need for the recruitment prior
    if ( (pop == 2 && p == 1) || pop == 1 && popID == 1)
     if (t+1 >= start_rec && t+1 <=end_rec)
       {
        exp_rec(p,t+1)  = Recruits;                       //store deterministic
        Recruits = Recruits*mfexp(rec_dev1(t+1));
        pred_rec(p,t+1) = Recruits;                       //store stochastic
       }

     if ( (pop == 2 && p == 2) || pop == 1 && popID == 2)
      if (t+1 >= start_rec2 && t+1 <= end_rec2)
       {
        exp_rec(p,t+1)  = Recruits;
        Recruits = Recruits*mfexp(rec_dev2(t+1));
        pred_rec(p,t+1) = Recruits;
       }

    // Recruitment (by gender)
    for (g=1;g<=gender;g++)
     natage(t+1,p,g,0) =  Recruits/gender;

   } //close time loop
  } //close population loop

//=====================================================================
====================

FUNCTION get_selectivity
  int Ip;

  //Reset variables
  sel.initialize(); sel_age.initialize();sel_wt_age.initialize();

  //----------------------------Selectivity at length------------------------------
    // South options
  if(pop==2 || popID == 1)
```

```
 {
  if (switchSC==1) //logistic
   sel(1,1) = 1/(1+mfexp(-log(19)*(size_vector-Len50_S_com)/LenDiff_S_com));
  else           //double logistic
   sel(1,1) = DoubLogistic(sel_peak_SC, sel_init_SC,sel_infl_SC,
                          sel_slope_SC, sel_final_SC,sel_infl2_SC,sel_slope2_SC);
  if (switchSR==1)
   sel(1,2) = 1/(1+mfexp(-log(19)*(size_vector-Len50_S_rec)/LenDiff_S_rec));
  else
   sel(1,2) = DoubLogistic(sel_peak_SR, sel_init_SR,sel_infl_SR,
                          sel_slope_SR, sel_final_SR,sel_infl2_SR,sel_slope2_SR);
 }

if(pop==2 || popID == 2)
 {
  if (pop==1) Ip = 1; else Ip = 2;

  if (switchNC==1) //logistic
   sel(Ip,1) = 1/(1+mfexp(-log(19)*(size_vector-Len50_N_com)/LenDiff_N_com));
  else          //double logistic
   sel(Ip,1) = DoubLogistic(sel_peak_NC, sel_init_NC,sel_infl_NC,
                          sel_slope_NC, sel_final_NC,sel_infl2_NC,sel_slope2_NC);
  if (switchNR==1)
   sel(Ip,2) = 1/(1+mfexp(-log(19)*(size_vector-Len50_N_rec)/LenDiff_N_rec));
  else
   sel(Ip,2) = DoubLogistic(sel_peak_NR, sel_init_NR,sel_infl_NR,
                          sel_slope_NR, sel_final_NR,sel_infl2_NR,sel_slope2_NR);
 }

//--------------Selectivity at age, is the selectivity at length times the Age-Length Key
//  sel_wt_age is the selectivity at age times the weight at age at the middle of the year
if (pop==2 || popID == 1)
 {
  for (f=1;f<=fleet;f++)
   for(g=1;g<=gender;g++)
    {
     for (a=0;a<=nages;a++)
      sel_age(1,f,g,a)= sel(1,f)*age_length_pop1(g,a);
     sel_wt_age(1,f,g) = elem_prod(sel_age(1,f,g), wt_age_middle(g));
    }
 }
if (pop==2 || popID == 2)
 {
  if (pop==1) Ip = 1; else Ip = 2;

  for (f=1;f<=fleet;f++)
```

```
    for(g=1;g<=gender;g++)
     {
      for (a=0;a<=nages;a++)
       sel_age(Ip,f,g,a)= sel(Ip,f)*age_length_pop2(g,a);
      sel_wt_age(Ip,f,g) = elem_prod(sel_age(Ip,f,g), wt_age_middle(g));
     }
   }

//=================================================================
=======

FUNCTION get_initial_conditions
  dvariable sum_fec=0.0;

  // reset
  S0_pop.initialize(); natage.initialize();
  //Virgin_Recruitment (by population)
  S0 = mfexp(ln_S0);

  S0_lprof = S0; //for likelihood profile

  if(pop == 1) // assessment of one population
    S0_pop(1) = S0;
  else          // assessment of two populations
    { S0_pop(1) = c*S0; S0_pop(2) = (1-c)*S0; }

  //Calculate R0 from S0 and fecundity at age
  for (p=1;p<=pop;p++)
   {
    sum_fec = fec(nages)*mfexp(-M*double(nages))/(1-mfexp(-M));
    for (a=1;a<nages;a++)
     sum_fec  += fec(a)*mfexp(-M*double(age_vector(a)));
    R0_pop(p) = S0_pop(p)/sum_fec;
    Spbio(p,styr) = S0_pop(p)/gender;
   }

  //Allocate half of the recruitment for each gender
  for (g=1;g<=gender;g++)
   {
    for (p=1;p<=pop;p++)
     if (R0_pop(p) > 0)
      log_R0_pop(p,g)= log (R0_pop(p)/gender);
     else
      log_R0_pop(p,g) = 0.0;
   }
```

```
 //Initial age structure
 for (p=1;p<=pop;p++)
  for (g=1;g<=gender;g++)
  {
   if(project_from_external_recs==1)  {
    natage(styr,p,g,0) =ssrecs(styr)/2;
    for (j=1;j<=nages-1;j++)
     natage(styr,p,g,j) =  (ssrecs(styr)/2)*mfexp(-M*double(j));
    natage(styr,p,g,nages) =( (ssrecs(styr)/2) * mfexp(-M*double(nages)) )/(1-mfexp(-
M));}

   else {
    natage(styr,p,g,0) = mfexp(log_R0_pop(p,g));
    for (j=1;j<=nages-1;j++)
     natage(styr,p,g,j) = mfexp(log_R0_pop(p,g)-M*double(j));
    natage(styr,p,g,nages) = (mfexp(log_R0_pop(p,g)-M*double(nages)))/(1-mfexp(-
M));}
  }

//
============================================================
===============

FUNCTION get_predictions
 int iyr,Ip;

 // Clear the effective population size
 neffective.initialize();

 //--------------SOUTH--------<><-------<><---------
 if(pop==2 || popID==1)
 { // SEE HERE ----------- predictions for abundance indices -----------------

  //catch-rate data (CA)
  log_q_cr_ca = 0;
  for (i=1;i<=nyr_cr_ca;i++)
   {
    exp_cr_ca(i)  = 0.0;
    for (g=1;g<=gender;g++)
     exp_cr_ca(i) += sel_wt_age(1,1,g) * ( mfexp(-M/2)* natage(yr_cr_ca(i),1,g) -
catage(yr_cr_ca(i),1,1,g) );
    if (exp_cr_ca(i)<=0) exp_cr_ca(i)= 0.001;
    log_q_cr_ca += log(obs_cr_ca(i)/exp_cr_ca(i))/square(cv_cr_ca(i));
   }
  // MLE for ln(q) and sigma
  log_q_cr_ca /= sum( pow(cv_cr_ca, -2) );
```

```
  if (do_var==1){
    s2_cr_ca    = sum( pow( elem_div( (log(obs_cr_ca) -log(exp_cr_ca) - log_q_cr_ca) ,
cv_cr_ca) , 2) );
    s2_cr_ca    = sqrt (s2_cr_ca/nyr_cr_ca);
    sd_cr_ca    = s2_cr_ca * cv_cr_ca ;}
   else sd_cr_ca    =  cv_cr_ca;

  // Catch-rate data (CA4)
  log_q_cr_ca4 = 0;
  for (i=1;i<=nyr_cr_ca4;i++)
   {
    exp_cr_ca4(i)  = 0.0;
    for (g=1;g<=gender;g++)
     exp_cr_ca4(i) += sel_wt_age(1,2,g) * ( (mfexp(-M/2)* natage(yr_cr_ca4(i),1,g)) -
catage(yr_cr_ca4(i),1,2,g) );
    if (exp_cr_ca4(i)<=0) exp_cr_ca4(i)= 0.001;
    log_q_cr_ca4 += log(obs_cr_ca4(i)/exp_cr_ca4(i))/square(cv_cr_ca4(i));
   }
  // MLE for ln(q) and sigma
  log_q_cr_ca4 /= sum( pow(cv_cr_ca4, -2) );
  if (do_var==1){
    s2_cr_ca4    = sum( pow( elem_div( (log(obs_cr_ca4) - log(exp_cr_ca4) -
log_q_cr_ca4) , cv_cr_ca4) , 2) );
    s2_cr_ca4    = sqrt (s2_cr_ca4/nyr_cr_ca4);
    sd_cr_ca4    = s2_cr_ca4 * cv_cr_ca4 ; }
  else sd_cr_ca4    = cv_cr_ca4 ;

  // spawning stock size indices, ATTENTION: the index in year t is proportional to the
spawning stock size in year t-1, Equation B.7
  log_q_sp_ca = 0;
  for (i=1;i<=nyr_sp_ca;i++)
   {
    exp_sp_ca(i)  = 0.0;
    for (g=1;g<=gender;g++)
     exp_sp_ca(i) +=fec*natage((yr_sp_ca(i)-1),1,g);
    if (exp_sp_ca(i) <=0 ) exp_sp_ca(i)= 0.001;
    log_q_sp_ca += log(obs_sp_ca(i)/exp_sp_ca(i))/square(cv_sp_ca(i));
   }
  // MLE for ln(q) and sigma
  log_q_sp_ca /= sum( pow(cv_sp_ca, -2) ) ;
  if (do_var==1){
    s2_sp_ca    = sum( pow( elem_div( (log(obs_sp_ca) -log(exp_sp_ca) - log_q_sp_ca) ,
cv_sp_ca) , 2) );
    s2_sp_ca    = sqrt (s2_sp_ca / nyr_sp_ca);
    sd_sp_ca    = s2_sp_ca*cv_sp_ca ; }
  else sd_sp_ca    = cv_sp_ca ;
```

```
//recruitment index
log_q_imp_ca = 0;
for (i=1;i<=nyr_imp_ca;i++)
 {
  exp_imp_ca(i)  = 0.0;
  for (g=1;g<=gender;g++)
   exp_imp_ca(i) += natage(yr_imp_ca(i),1,g,0) + ( 0.5 * natage(yr_imp_ca(i),1,g,1) ) ;
  if (exp_imp_ca(i)<=0) exp_imp_ca(i)= 0.001;
  log_q_imp_ca += log(obs_imp_ca(i)/exp_imp_ca(i))/square(cv_imp_ca(i));
 }
// MLE for ln(q) and sigma
log_q_imp_ca /= sum( pow(cv_imp_ca, -2) ) ;
if (do_var==1){
  s2_imp_ca    = sum( pow( elem_div( (log(obs_imp_ca) -log(exp_imp_ca) -
log_q_imp_ca) , cv_imp_ca) , 2) );
  s2_imp_ca    = sqrt (s2_imp_ca / nyr_imp_ca);
  sd_imp_ca    = s2_imp_ca * cv_imp_ca ; }
else sd_imp_ca    = cv_imp_ca ;

//---------------predictions for length frequency----------------------
// California Commercial
for (i=1;i<=lnyr_ca;i++) //loop over years
 {  // get the year we need the predicted value for
  iyr = lyr_ca(i);
  esc_ca(i) = 0;
  for (l=1;l<=nlength;l++)
   {
    for (g=1;g<=gender;g++)
     for (j=0;j<=nages;j++)
      esc_ca(i,l) += natage(iyr,1,g,j)*age_length_pop1(g,j,l);
    esc_ca(i,l) *= sel(1,1,l);
    if (esc_ca(i,l) <= 0) esc_ca(i,l)= 0.00001;
   }
  esc_ca(i)  = esc_ca(i) / sum(esc_ca(i));
  neffective(1,i)  = sum(elem_prod(esc_ca(i),(1-esc_ca(i))));
  neffective(1,i) /= sum(elem_prod((osc_ca(i)-esc_ca(i)),(osc_ca(i)-esc_ca(i))));
 }

// California Recreational
for (i=1;i<=lnyr_carec;i++)
 {
  iyr=lyr_carec(i);
  esc_carec(i) = 0;
  for (l=1;l<=nlength;l++)
   {
```

```
      for (g=1;g<=gender;g++)
       for (j=0;j<=nages;j++)
        esc_carec(i,l) += natage(iyr,1,g,j)*age_length_pop1(g,j,l);
      esc_carec(i,l) *= sel(1,2,l);
      if (esc_carec(i,l) <= 0) esc_carec(i,l)= 0.00001;
     }
    esc_carec(i)  = esc_carec(i) / sum(esc_carec(i));
    neffective(2,i)  = sum(elem_prod(esc_carec(i),(1-esc_carec(i))));
    neffective(2,i) /= sum(elem_prod((osc_carec(i)-esc_carec(i)),(osc_carec(i)-
esc_carec(i))));
   }
  } //-------------end of South---<><-----------------------------------------


  //--------------NORTH--------<><-------<><---------
  if(pop==2 || popID==2)
  {

   if (pop==1) Ip = 1; else Ip = 2;

   // Catch-rate data (OR)
   log_q_cr_or = 0;
   for (i=1;i<=nyr_cr_or;i++)
    {
    exp_cr_or(i)  = 0.0;
    for (g=1;g<=gender;g++)
     exp_cr_or(i) += sel_wt_age(Ip,2,g) * ( (mfexp(-M/2)* natage(yr_cr_or(i),Ip,g)) -
catage(yr_cr_or(i),Ip,2,g) );
    if (exp_cr_or(i)<=0) exp_cr_or(i)= 0.001;//make sure there is no negative values or 0 s
    log_q_cr_or += log(obs_cr_or(i)/exp_cr_or(i))/square(cv_cr_or(i));
    }
   // MLE for ln(q) and sigma
   log_q_cr_or /= sum( pow(cv_cr_or, -2) ) ;
   if (do_var==1){
   s2_cr_or    = sum( pow( elem_div( (log(obs_cr_or) -log(exp_cr_or) - log_q_cr_or) ,
cv_cr_or) , 2) );
   s2_cr_or    = sqrt (s2_cr_or / nyr_cr_or);
   sd_cr_or    = s2_cr_or * cv_cr_or ; }
   else sd_cr_or    = cv_cr_or ;

   // Catch-rate data (WA)
   log_q_cr_wa = 0;
   for (i=1;i<=nyr_cr_wa;i++)
    {
    exp_cr_wa(i)  = 0.0;
    for (g=1;g<=gender;g++)
```

```
      exp_cr_wa(i) += sel_wt_age(Ip,2,g) * ( (mfexp(-M/2)* natage(yr_cr_wa(i),Ip,g)) -
catage(yr_cr_wa(i),Ip,2,g) );
     if (exp_cr_wa(i)<=0) exp_cr_wa(i)= 0.001;//make sure there is no negative values or 0
s
     log_q_cr_wa += log(obs_cr_wa(i)/exp_cr_wa(i))/square(cv_cr_wa(i));
    }
   // MLE for ln(q) and sigma
   log_q_cr_wa /= sum( pow(cv_cr_wa, -2) ) ;
   if (do_var==1){
     s2_cr_wa    = sum( pow( elem_div( (log(obs_cr_wa) -log(exp_cr_wa) - log_q_cr_wa)
, cv_cr_wa) , 2) );
     s2_cr_wa    = sqrt (s2_cr_wa/nyr_cr_wa);
     sd_cr_wa    = s2_cr_wa * cv_cr_wa ; }
   else sd_cr_wa    = cv_cr_wa ;

   // Spawning stock index (north)
   log_q_sp_nth = 0;
   for (i=1;i<=nyr_sp_nth;i++)
    {
     exp_sp_nth(i)  = 0.0;
     for (g=1;g<=gender;g++)
      exp_sp_nth(i) +=fec*natage((yr_sp_nth(i)-1),Ip,g);
     if (exp_sp_nth(i)<=0) exp_sp_nth(i)= 0.001;
     log_q_sp_nth += log(obs_sp_nth(i)/exp_sp_nth(i))/square(cv_sp_nth(i));
    }
   // MLE for ln(q) and sigma
   log_q_sp_nth /= sum( pow(cv_sp_nth, -2) ) ;
   if (do_var==1){
     s2_sp_nth    = sum( pow( elem_div( (log(obs_sp_nth) -log(exp_sp_nth) -
log_q_sp_nth) , cv_sp_nth) , 2) );
     s2_sp_nth    = sqrt (s2_sp_nth / nyr_sp_nth);
     sd_sp_nth    = s2_sp_nth * cv_sp_nth ;}
   else sd_sp_nth    = cv_sp_nth;

   //---------Predictions for length frequency---------
   // Oregon Commercial
   for (i=1;i<=lnyr_or;i++)
    {
     iyr=lyr_or(i);
     esc_or(i) = 0;
     for (l=1;l<=nlength;l++)
      {
       for (g=1;g<=gender;g++)
        for (j=0;j<=nages;j++)
         esc_or(i,l) += natage(iyr,Ip,g,j)*age_length_pop2(g,j,l);
       esc_or(i,l) *= sel(Ip,1,l);
```

```
      if (esc_or(i,l) <= 0) esc_or(i,l)= 0.00001;
     }
    esc_or(i)  = esc_or(i) / sum(esc_or(i));
    neffective(3,i)  = sum(elem_prod(esc_or(i),(1-esc_or(i))));
    neffective(3,i) /= sum(elem_prod((osc_or(i)-esc_or(i)),(osc_or(i)-esc_or(i))));
   }

  // Oregon Recreational
  for (i=1;i<=lnyr_orrec;i++)
   {
    iyr=lyr_orrec(i);
    esc_orrec(i) = 0;
    for (l=1;l<=nlength;l++)
     {
      for (g=1;g<=gender;g++)
       for (j=0;j<=nages;j++)
        esc_orrec(i,l) += natage(iyr,Ip,g,j)*age_length_pop2(g,j,l);
      esc_orrec(i,l) *= sel(Ip,2,l);
      if (esc_orrec(i,l) <= 0) esc_orrec(i,l)= 0.00001;
     }
    esc_orrec(i)  = esc_orrec(i) / sum(esc_orrec(i));
    neffective(4,i)  = sum(elem_prod(esc_orrec(i),(1-esc_orrec(i))));
    neffective(4,i) /= sum(elem_prod((osc_orrec(i)-esc_orrec(i)),(osc_orrec(i)-
esc_orrec(i))));
   }

  // Washington Recreational
  for (i=1;i<=lnyr_warec;i++)
   {
    iyr=lyr_warec(i);
    esc_warec(i) = 0;
    for (l=1;l<=nlength;l++)
     {
      for (g=1;g<=gender;g++)
       for (j=0;j<=nages;j++)
        esc_warec(i,l) += natage(iyr,Ip,g,j)*age_length_pop2(g,j,l);
      esc_warec(i,l) *= sel(Ip,2,l);
      if (esc_warec(i,l) <= 0) esc_warec(i,l)= 0.00001;
     }
    esc_warec(i)  = esc_warec(i) / sum(esc_warec(i));
    neffective(5,i)  = sum(elem_prod(esc_warec(i),(1-esc_warec(i))));
    neffective(5,i) /= sum(elem_prod((osc_warec(i)-esc_warec(i)),(osc_warec(i)-
esc_warec(i))));
   }

 }//------------------end of North---:->----------------------------------
```

```
//==========================================================================
==========================

FUNCTION evaluate_the_objective_function

 //reset
 surv_like.initialize();   length_like.initialize();


 //----------------LIKELIHOODS------------------------------------

 // Fit to indices (lognormal)
 // catch-rate data, spawning biomass index, recruitment index
 if (do_var==1) //loglikelihood using MLE of s2
 {
  if (pop==2 || popID == 1) {
   surv_like(1) = nyr_cr_ca  * log(s2_cr_ca)  + (nyr_cr_ca  / 2);
   surv_like(4) = nyr_cr_ca4 * log(s2_cr_ca4) + (nyr_cr_ca4 / 2);
   surv_like(7) = nyr_sp_ca  * log(s2_sp_ca)  + (nyr_sp_ca  / 2);
   surv_like(9) = nyr_imp_ca * log(s2_imp_ca) + (nyr_imp_ca / 2); }
 if (pop==2 || popID == 2) {
   surv_like(5) = nyr_cr_or  * log(s2_cr_or)  + (nyr_cr_or  / 2);
   surv_like(6) = nyr_cr_wa  * log(s2_cr_wa)  + (nyr_cr_wa  / 2);
   surv_like(8) = nyr_sp_nth * log(s2_sp_nth) + (nyr_sp_nth / 2); }
 }
 else //loglikelihood assuming s2 is 1, i.e. there is no extra variance in the observations
 {
  if (pop==2 || popID == 1) {
   surv_like(1) =( sum( pow( elem_div( (log(obs_cr_ca) -log(exp_cr_ca) - log_q_cr_ca) ,
cv_cr_ca) , 2) ) ) / 2;
   surv_like(4) =( sum( pow( elem_div( (log(obs_cr_ca4) - log(exp_cr_ca4) -
log_q_cr_ca4) , cv_cr_ca4) , 2) ) ) / 2;
   surv_like(7) =( sum( pow( elem_div( (log(obs_sp_ca) -log(exp_sp_ca) - log_q_sp_ca)
, cv_sp_ca) , 2) ) ) / 2;
   surv_like(9) =( sum( pow( elem_div( (log(obs_imp_ca) -log(exp_imp_ca) -
log_q_imp_ca) , cv_imp_ca) , 2) ) ) /2 ;
  }
  if (pop==2 || popID == 2) {
   surv_like(5) = ( sum( pow( elem_div( (log(obs_cr_or) -log(exp_cr_or) - log_q_cr_or) ,
cv_cr_or) , 2) ) ) / 2;
   surv_like(6) =( sum( pow( elem_div( (log(obs_cr_wa) -log(exp_cr_wa) -
log_q_cr_wa) , cv_cr_wa) , 2) ) ) / 2;
   surv_like(8) =( sum( pow( elem_div( (log(obs_sp_nth) -log(exp_sp_nth) -
log_q_sp_nth) , cv_sp_nth) , 2) ) )/ 2;
  }
```

```
 }

 //cout<<"surv_like:"<<endl<<elem_prod(surv_lambda,surv_like)<<endl;
 //catch length frequency (multinomial)

 // more matrix calculations,  elem_prod( osc_ca , log(esc_ca + 0.001) ) is a matrix
 // rowsum( elem_prod( osc_ca , log(esc_ca + 0.001) ) ) is a vector
 // nsamples(1) is a vector too.
 // so...vector * vector is a scalar

 if (pop==2 || popID == 1)
  { length_like(1) = - ( nsamples(1) * rowsum( elem_prod( osc_ca , log(esc_ca + 0.001) )
) );
    length_like(1) -=offset(1); }

 if (pop==2 || popID == 1)
  { length_like(2) = - ( nsamples(2) * rowsum( elem_prod( osc_carec , log(esc_carec +
0.001) ) ) );
     length_like(2) -=offset(2); }

 if (pop==2 || popID == 2)
  { length_like(3) = - ( nsamples(3) * rowsum( elem_prod( osc_or , log(esc_or + 0.001) )
) );
    length_like(3) -=offset(3); }

 if (pop==2 || popID == 2)
  { length_like(4) = - ( nsamples(4) * rowsum( elem_prod( osc_orrec , log(esc_orrec +
0.001) ) ) );
    length_like(4) -=offset(4); }

 if (pop==2 || popID == 2)
  { length_like(5) = - ( nsamples(5) * rowsum( elem_prod( osc_warec , log(esc_warec +
0.001) ) ) );
    length_like(5) -=offset(5); }

 if (dummy == 1) //debugging mode, turn off all parameters
  obj_fun= dummy_par*dummy_par;
 else
 {
  obj_fun = 0;
  obj_fun += sum(elem_prod(surv_lambda,surv_like)); //Lambdas are controls that turns
on (when > 1) and off (0) the data set,
  obj_fun += sum(elem_prod(length_lambda,length_like));//and specify the weight that
each data set will have, the values of lambda should be specified in the Control file

  obj_fun += prior_rec;
```

```
   obj_fun += CrashPen;
   if (!mceval_phase()) cout << obj_fun << endl;
//   cout << surv_like << endl;
//   cout << length_like << endl;
  }

//
*=====================================================================
===========*

REPORT_SECTION

  report << "Catches used" << endl;
  report << catch_bio << endl;

   //Number and catch at age for quick look
  report << "Estimated numbers of fish " << endl;
    for (p=1;p<=pop;p++)
     for (g=1;g<=gender;g++)
      {report << "Population "<<p<<" gender "<<g<<endl;
       report << "Age "<<"0 "<<age_vector <<endl;
       for (i=styr;i<=endyr;i++)
        report <<i<<" "<< natage(i,p,g) << endl;}
   report <<endl<< "Estimated catch at age " << endl;
    for (p=1;p<=pop;p++)
     for (g=1;g<=gender;g++)
      for (f=1;f<=fleet;f++)
       {report << "Population "<<p<<" fleet "<<f<<" gender "<<g<<endl;
        report << "Age "<<"0 "<<age_vector <<endl;
        for (i=styr;i<=endyr;i++)
         report <<i<<" "<<catage(i,p,f,g)  << endl;}
   report <<endl<< "Estimated total catch at age " << endl;
    for (p=1;p<=pop;p++)
     for (g=1;g<=gender;g++)
      {report << "Population "<<p<<" gender "<<g<<endl;
      report << "Age "<<"0 "<<age_vector <<endl;
      for (i=styr;i<=endyr;i++)
       report <<i<<" "<<catage_tot(i,p,g)  << endl;}

  //---------.dat files---------------------------
  // Abundance index information
  ofstream out1("ind.dat");
  out1<<"index"<<" "<<"year"<<" "<<"obs"<<" "<<"exp"<<" "<<"CV"<<endl;
  if (pop == 2 || popID == 1) abund_South(out1);
  if (pop == 2 || popID == 2) abund_North(out1);
```

```
  // Length-frequency information
  ofstream out2("lf.dat");
  out2<<"dataset"<<" "<<"year"<<" "<<"effectiveN"<<" "<<"length"<<" "<<"obs"<<"
"<<"exp"<<endl;
  if (pop == 2 || popID == 1) lf_South(out2);
  if (pop == 2 || popID == 2) lf_North(out2);

  report << " " << endl;
  report << fec << endl;
  report << wt_age_middle << endl;
  for (p=1;p<=pop;p++)
   {
   report << sel_age(p) << endl;
   for (t=styr;t<endyr;t++)
     report<< t << " " << 2*natage(t,p,1,0)/1000 << " " << Spbio(p,t)/1000 << " 0 0 0" <<
endl;
   for (i=0;i<= nages;i++) report << natage(endyr-1,p,1,i)/1000 << " "; report << endl;
   for (i=0;i<= nages;i++) report << natage(endyr-1,p,2,i)/1000 << " "; report << endl;

   }

  //Likelihood components
  ofstream out3("like.dat");
  like(out3);

  //Trajectories
  ofstream out4("traj.dat");
  trajectories(out4);

  //Selectivity at length
  ofstream out5("selL.dat");
  selL(out5);

  //Selectivity at age
  ofstream out6("selA.dat");
  selA(out6);

  // Growth stuff
  cout << "Here" << endl;
  ofstream out7("Size.dat");
  out7 << pop << " " << gender << " " << nages << " " << nlength << endl;
  for (p=1;p<=pop;p++)
   for (g=1;g<=gender;g++)
    for (j=1;j<=nlength;j++)
     {
      out7 << size_vector(j) << " ";
```

```
      for (i=0;i<=nages;i++)
       {
        if (p==1) out7 << age_length_pop1(g,i,j) << " " ;
        if (p==2) out7 << age_length_pop2(g,i,j) << " " ;
       }
      out7 << endl;
     }

   // Number and catch at age for R graphs
   ofstream out8("dynamic.dat");
   for(p=1;p<=pop;p++)
     report_dynamic(out8,p);

    //MLE for q and s2
    ofstream out9("mle.dat");
    if (do_var==1){//report MLE for sigma only if we are estimating it
           if (pop==2 || popID == 1) out9<<"s2_cr_ca " <<s2_cr_ca<<endl;
           if (pop==2 || popID == 1) out9<<"s2_cr_ca4 " <<s2_cr_ca4<<endl;
           if (pop==2 || popID == 2) out9<<"s2_cr_or " <<s2_cr_or<<endl;
           if (pop==2 || popID == 2) out9<<"s2_cr_wa " <<s2_cr_wa<<endl;
           if (pop==2 || popID == 1) out9<<"s2_sp_ca " <<s2_sp_ca<<endl;
           if (pop==2 || popID == 2) out9<<"s2_sp_nth " <<s2_sp_nth<<endl;
           if (pop==2 || popID == 1) out9<<"s2_imp_ca " <<s2_imp_ca<<endl;
    }

    if (pop==2 || popID == 1) out9<<"log_q_cr_ca " <<log_q_cr_ca<<endl;
    if (pop==2 || popID == 1) out9<<"log_q_cr_ca4 " <<log_q_cr_ca4<<endl;
    if (pop==2 || popID == 2) out9<<"log_q_cr_or " <<log_q_cr_or<<endl;
    if (pop==2 || popID == 2) out9<<"log_q_cr_wa " <<log_q_cr_wa<<endl;
    if (pop==2 || popID == 1) out9<<"log_q_sp_ca " <<log_q_sp_ca<<endl;
    if (pop==2 || popID == 2) out9<<"log_q_sp_nth " <<log_q_sp_nth<<endl;
    if (pop==2 || popID == 1) out9<<"log_q_imp_ca " <<log_q_imp_ca<<endl;

//----------------------------------------------------------------------------------------------
FUNCTION void report_dynamic(ofstream& file, int& p)

   file <<"Pop"<<" "<<"gender"<<" "<<"year"<<" "<<"age"<<" "<<"N"<<"
"<<"Ccom"<<" "<<"Crec"<<" "<<"Ctot"<<endl;
   for(g=1;g<=gender;g++)
    for (i=styr;i<=endyr;i++)
     for (a=0;a<=nages;a++)
      file <<p<<" "<<g<<" "<<i<<" "<<a<<" "<<natage(i,p,g,a)<<"
"<<catage(i,p,1,g,a)<<" "<<catage(i,p,2,g,a)<<" "<<catage_tot(i,p,g,a)<<endl;
   file << " " << endl;
   file << natage << endl;
```

```
//-----------------------------------------------------------------------------------------

FUNCTION void like(ofstream& file)//output likelihood components

  file << "Likelihood components " <<endl;
  file <<" indices "<<endl<<elem_prod(surv_like,surv_lambda)<<endl;
  file <<" length frequency "<<elem_prod(length_like,length_lambda)<<endl;
  file <<" penalties "<<prior_rec<< " " << CrashPen <<endl;

//-----------------------------------------------------------------------------------------

FUNCTION void selA(ofstream& file)

  file<<"pop"<<" "<<"fleet"<<" "<<"sex"<<" "<<"age"<<" "<<"selA"<<endl;
  for(p=1;p<=pop;p++)
   for(f=1;f<=fleet;f++)
    for(g=1;g<=gender;g++)
     for(a=0;a<=nages;a++)
      file<<p<<" "<<f<<" "<<g<<" "<<a<<" "<<sel_age(p,f,g,a)<<endl;

//-----------------------------------------------------------------------------------------

FUNCTION void selL(ofstream& file)

  file<<"pop"<<" "<<"fleet"<<" "<<"size"<<" "<<"selL"<<endl;
  for(p=1;p<=pop;p++)
   for(f=1;f<=fleet;f++)
    for(l=1;l<=nlength;l++)
     file<<p<<" "<<f<<" "<<size_vector(l)<<" "<<sel(p,f,l)<<endl;

//-----------------------------------------------------------------------------------------

FUNCTION void trajectories(ofstream& file)

  file<<"pop"<<" "<<"year"<<" "<<"depletion"<<" "<<"spaw_bio"<<" ";
  file<<"recruit"<<" "<<"hrate_com"<<" "<<"hrate_rec"<<endl;

  for (p=1;p<=pop;p++)
   for (t=styr;t<endyr;t++)
    {
     file<<p<<" "<<t<<" "<<(2*Spbio(p,t)/S0_pop(p))<<" "<<Spbio(p,t);
     file<<" "<<2*natage(t,p,1,0)<<" "<<Hrate(p,1,t)<<" "<<Hrate(p,2,t)<<endl;
    }

//-----------------------------------------------------------------------------------------
```

```
FUNCTION void lf_North(ofstream& out2)//output length frequencies for the North

  for(t=1;t<=lnyr_or;t++)
   for(l=1;l<=nlength;l++)
    {
     out2<<"lf3"<<" "<<lyr_or(t)<<" "<<nsamples(3,t)<<" "<<neffective(3,t)<<" ";
     out2<<size_vector(l)<<" "<<osc_or(t,l)<<" "<<esc_or(t,l)<<endl;
    }

  for(t=1;t<=lnyr_orrec;t++)
   for(l=1;l<=nlength;l++)
    {
     out2<<"lf4"<<" "<<lyr_orrec(t)<<" "<<nsamples(4,t)<<" "<<neffective(4,t)<<" ";
     out2<<size_vector(l)<<" "<<osc_orrec(t,l)<<" "<<esc_orrec(t,l)<<endl;
    }

  for(t=1;t<=lnyr_warec;t++)
   for(l=1;l<=nlength;l++)
    {
     out2<<"lf5"<<" "<<lyr_warec(t)<<" "<<nsamples(5,t)<<" "<<neffective(5,t)<<" ";
     out2<<size_vector(l)<<" "<<osc_warec(t,l)<<" "<<esc_warec(t,l)<<endl;
    }

//----------------------------------------------------------------------------------------

FUNCTION void lf_South(ofstream& out2)//output length frequencies for the South

  for(t=1;t<=lnyr_ca;t++)
   for(l=1;l<=nlength;l++)
    {
     out2<<"lf1"<<" "<<lyr_ca(t)<<" "<<nsamples(1,t)<<" "<<neffective(1,t)<<" ";
     out2<<size_vector(l)<<" "<<osc_ca(t,l)<<" "<<esc_ca(t,l)<<endl;
    }

  for(t=1;t<=lnyr_carec;t++)
   for(l=1;l<=nlength;l++)
    {
     out2<<"lf2"<<" "<<lyr_carec(t)<<" "<<nsamples(2,t)<<" "<<neffective(2,t)<<" ";
     out2<<size_vector(l)<<" "<<osc_carec(t,l)<<" "<<esc_carec(t,l)<<endl;
    }

//----------------------------------------------------------------------------------------

FUNCTION void abund_South(ofstream& out1)

  for (t=1;t<=nyr_cr_ca;t++)
```

```
    out1<<"I1"<<" "<<yr_cr_ca(t)<<" "<<obs_cr_ca(t)<<"
"<<mfexp(log_q_cr_ca)*exp_cr_ca(t)<<" "<<sd_cr_ca(t)<<endl;

   for (t=1;t<=nyr_cr_ca4;t++)
    out1<<"I2"<<" "<<yr_cr_ca4(t)<<" "<<obs_cr_ca4(t)<<"
"<<mfexp(log_q_cr_ca4)*exp_cr_ca4(t)<<" "<<sd_cr_ca4(t)<<endl;

   for (t=1;t<=nyr_sp_ca;t++)
    out1<<"I5"<<" "<<yr_sp_ca(t)<<" "<<obs_sp_ca(t)<<"
"<<mfexp(log_q_sp_ca)*exp_sp_ca(t)<<" "<<sd_sp_ca(t)<<endl;

   for (t=1;t<=nyr_imp_ca;t++)
    out1<<"I7"<<" "<<yr_imp_ca(t)<<" "<<obs_imp_ca(t)<<"
"<<mfexp(log_q_imp_ca)*exp_imp_ca(t)<<" "<<sd_imp_ca(t)<<endl;

//--------------------------------------------------------------------------------------------

FUNCTION void abund_North(ofstream& out1)

   for (t=1;t<=nyr_cr_or;t++)
    out1<<"I3"<<" "<<yr_cr_or(t)<<" "<<obs_cr_or(t)<<"
"<<mfexp(log_q_cr_or)*exp_cr_or(t)<<" "<<sd_cr_or(t)<<endl;

   for (t=1;t<=nyr_cr_wa;t++)
    out1<<"I4"<<" "<<yr_cr_wa(t)<<" "<<obs_cr_wa(t)<<"
"<<mfexp(log_q_cr_wa)*exp_cr_wa(t)<<" "<<sd_cr_wa(t)<<endl;

   for (t=1;t<=nyr_sp_nth;t++)
    out1<<"I6"<<" "<<yr_sp_nth(t)<<" "<<obs_sp_nth(t)<<"
"<<mfexp(log_q_sp_nth)*exp_sp_nth(t)<<" "<<sd_sp_nth(t) << endl;

//
*=================================================================
========================*
//
*=================================================================
========================*

RUNTIME_SECTION
  maximum_function_evaluations 1000 1000 1000 2000;
  convergence_criteria 0.01,0.01,0.01,1e-7;

//
*=================================================================
=========================*
```

```
//
*=============================================================================
========================*

TOP_OF_MAIN_SECTION
  arrmblsize = 5000000;
  gradient_structure::set_GRADSTACK_BUFFER_SIZE(56000);
  gradient_structure::set_CMPDIF_BUFFER_SIZE(1500000);
  gradient_structure::set_MAX_NVAR_OFFSET(500);
  gradient_structure::set_NUM_DEPENDENT_VARIABLES(500);
  time(&start); //this is to see how long it takes to run
  cout<<endl<<"Start time : "<<ctime(&start)<<endl;

//
*=============================================================================
========================*

GLOBALS_SECTION
  #include <admodel.h>
  #include <time.h>
  time_t start,finish;
  long hour,minute,second;
  double elapsed_time;

//--------------------------------------------------------------------------------------

FUNCTION dmatrix SizeTrans(_CONST double& Lbeg,_CONST double&
Lmax,_CONST double& K,_CONST double& CVLmin,_CONST double&
CVLmax,_CONST int& m)
   {
   RETURN_ARRAYS_INCREMENT(); //Need this statement because the function
   // m is a switch, if m==0, the function will calculate the length transition for the
beginning of the year,
   //                 if m==1, the function will calculate it for the middle of the year;
   dmatrix Size_Trans(0,nages,1,nlength);
   dvector Average_Size(0,nages);
   dvector Sd(0,nages);
   double age;
   for (i=0; i<=nages;i++)
    {
    //first calculate average values...
    if(m==0) age=double(i);//beginning of the year
    else age=double(i)+0.5;//middle of the year
    Average_Size(i) = Lmax + (Lbeg - Lmax) * mfexp (- K * (age-1));
    Sd(i)= (CVLmin+(age-1)*(CVLmax-CVLmin)/(nages-1))*Average_Size(i);
```

```
    //...then calculate the distribution arround those values
    // first bin, note: need to standarize before using cumd_norm;
    Size_Trans(i,1)=((size_vector(1)+(size_vector(2)-size_vector(1))/2)-
Average_Size(i))/Sd(i);
    Size_Trans(i,1)=cumd_norm(Size_Trans(i,1));

    //other bins but the last;
    for (j=2;j<=nlength-1;j++)
     {
      Size_Trans(i,j)= 0;
      Size_Trans(i,j)= cumd_norm(((size_vector(j)+(size_vector(j+1)-size_vector(j))/2)-
Average_Size(i))/Sd(i));
      Size_Trans(i,j)-= cumd_norm(((size_vector(j)-(size_vector(j)-size_vector(j-1))/2)-
Average_Size(i))/Sd(i));
     }
    //last bin;
    Size_Trans(i,nlength)= 1 - cumd_norm(((size_vector(nlength)-(size_vector(nlength)-
size_vector(nlength-1))/2)-Average_Size(i))/Sd(i));
   }

  RETURN_ARRAYS_DECREMENT(); // Need this to decrement the stack increment
                  // caused by RETURN_ARRAYS_INCREMENT();
  return(Size_Trans);

  }

//--------------------------------------------------------------------------------
//SEE if we have any problem because I didn't declare the arguments to be _CONST
//According to Jim this may cause the arguments to be changed within the function
// But there is a limit to the number of strings I can pass, so if I include the _CONST will
exceed the limit

FUNCTION dvar_vector DoubLogistic(dvariable& pk,dvariable& in,dvariable&
infl,dvariable& sl,dvariable& fin,dvariable& infl2,dvariable& sl2)
  {
  //This code is based on POP model (from Ian J. Stewart, SAFS-UW)
  RETURN_ARRAYS_INCREMENT(); //Need this statement because the function
  dvar_vector sel_at_length(1,nlength);

  for (j=1; j<=nlength; j++)  //calculate the value over length bins
        {
         if (double(j) < pk) // ascending limb
         {
           sel_at_length(j)= in +
                   (1 - in)/((1 / (1 + (mfexp(-1 * sl * (pk - infl))))) -
                (1 / (1 + (mfexp(-1 * sl * (1 - infl)))))) *
```

```
            ((1/(1+mfexp(-1*sl*(size_vector(j)-infl)))) -
                (1 / (1 + (mfexp(-1 * sl * (1 - infl))))));
         }
         else
         {
           if (double(j) > (pk + 1)) // descending limb
           {
             sel_at_length(j) = 1 +
                  (fin - 1)/((1 / (1 + (mfexp(-1 * sl2 * (size_vector(nlength) - infl2))))) -
                (1 / (1 + (mfexp(-1 * sl2 * ((pk+1) - infl2)))))) *
                ((1/(1+mfexp(-1*sl2*(size_vector(j)-infl2)))) -
                  (1 / (1 + (mfexp(-1 * sl2 * ((pk+1) - infl2))))));
           }
           else // between the peaks
           {
               sel_at_length(j) = 1.0;
           };
        };
      };

   RETURN_ARRAYS_DECREMENT(); // Need this to decrement the stack increment
                   // caused by RETURN_ARRAYS_INCREMENT();
   return(sel_at_length);
  }

//*==============================================================
==========================*=/

FINAL_SECTION
  //Calculates how long is taking to run
  // this code is based on the Widow Rockfish model (from Erik H. Williams, NMFS-
Santa Cruz)
  time(&finish);
  elapsed_time = difftime(finish,start);
  hour = long(elapsed_time)/3600;
  minute = long(elapsed_time)%3600/60;
  second = (long(elapsed_time)%3600)%60;
  cout<<endl<<endl<<"starting time: "<<ctime(&start);
  cout<<"finishing time: "<<ctime(&finish);
  cout<<"This run took: ";
  cout<<hour<<" hours, "<<minute<<" minutes, "<<second<<"
seconds."<<endl<<endl<<endl;
```

Cabezon

STAR Panel Meeting Report

NOAA/Northwest Fisheries Science Center
Seattle, Washington
September 15-19, 2003

STAR Panel
Han-Lin Lai, NOAA/Northwest Fisheries Science Center, PFMC SSC (Chair)
Chris Legault, NOAA/Northeast Fisheries Science Center
Mark Maunder, Inter-American Tropical Tuna Commission (CIE Reviewer)
David Smith, Primary Industries Research Victoria, Australia
Tony Smith, CSIRO Marine Research, Australia (Rapporteur)

PFMC
Tom Barnes, California Department of Fish and Game, PFMC GMT
Tom Ghio, PFMC GAP

STAT Team
Kevin Piner, NOAA/Northwest Fisheries Science Center
Jason Cope, University of Washington, School of Aquatic and Fishery Sciences
Carolina Minte-Vera, University of Washington, School of Aquatic and Fishery Sciences
Andre Punt, University of Washington, School of Aquatic and Fishery Sciences

Overview

The STAR Panel (hereafter the Panel) reviewed the draft assessment report for cabezon (*Scorpaenichthys marmoratus*) prepared by the STAT Team and dated September 5, 2003. The entire STAT Team was available to present and discuss aspects of the report. This assessment represents the first quantitative assessment for cabezon, and the first for any of the inshore groundfish species under the PFMC FMP.

Considerable effort had gone into compiling the relevant data and information for this species (Table 1). Nonetheless, the STAT Team stressed the limited amount of data and the uncertainties in the data, and the lack of critical biological information on the species and stocks. For this assessment, two stocks are assumed for the west coast of the US – a northern stock (Washington and Oregon) and a southern stock (California). There is a lot less data for the northern "stock" and the Panel agreed with the STAT Team that the model results for this stock were implausible. The assessment therefore focuses on the status of the southern stock.

A feature of this assessment is that there is no dedicated fishery independent biomass index for this species or any inshore species. The assessment examined several time series of potential abundance indices, including recreational catch rates, larval surveys (CalCOFI), and "impingement" data (a possible index for recruitment). The assessment also used commercial and recreational length composition data. There is considerable uncertainty in all data series, particularly pre-1980 catches (especially recreational). The assessment model is a two-fleet age and sex structured catch at length model with variable recruitment about a Beverton-Holt stock recruitment relationship. Results were presented for two base cases and a range of sensitivity analyses (to uncertainties in data inputs and fixed model parameters). Maximum Posterior Density (MPD) estimates were presented for the sensitivity analyses, and Bayesian results only for the base cases. Results for the base cases were checked by running the model using two independently derived sets of software.

Both base case models involved fitting to recreational CPUE derived from Commercial Passenger Fishing Vessel logbooks ("CPFV Logbook") and recreational and commercial catch length composition. Base Case A assumed a fixed CV for the CPUE index, while Base Case B estimated the CV scaling parameter. Neither model fitted the data particularly well, but the fit to the CPUE index for Base Case A was not consistent with the assumed confidence intervals for the index. Biomass estimates for Base Case B were more uncertain, but estimates of depletion for Base Case B were less sensitive to data and model assumptions. Base Case B estimated the stock to be less depleted than Base Case A.

For the reasons given above, the Panel asked the STAT Team to re-run and present results for a new Base Case which was a modification of the original Base Case B. The new Base Case involved the addition of two times series of abundance indices (RecFIN CPUE and the CA Impingement Index), a differential weighting on commercial and recreational length composition data, and setting the stock recruitment steepness parameter to 0.7. A similar set of sensitivity analyses was run for this new Base Case.

The MPD results for the new Base Case were intermediate between the previous Base Cases in terms of level of depletion in 2003 (35% with a standard deviation of 7%), and in general showed less sensitivity to data and assumptions. The greatest sensitivities were to pre-specified values of natural mortality and stock recruitment steepness. The assessment was also sensitive to one of the values for the CV on length at age. The previous high sensitivity to the pre 1980 recreational catch levels was greatly reduced. Initial diagnostics for the Bayesian analysis supported their use in the projections.

The Panel agreed that the new Base Case model could be used for stock projections and as a basis for management decisions about the Californian fisheries. The Panel reiterated the considerable uncertainties in the data and biological information on which this assessment was based, but considered that (with the inclusion of several key uncertainties in the projections, outlined below in recommendations) it represented the best available science for the purpose of providing management advice.

Given the uncertainties, the Panel has provided a list of key recommendations for future research and monitoring for this fishery.

The Panel commended the STAT Team for their efforts in putting together this first assessment for cabezon, and thanked them for their cooperation and assistance during the course of the meeting.

Additional analyses requested by the STAR Panel

1. **Discussion of gear and market selectivity led to the suggestion that a sensitivity test be run to use of dome shaped selectivity (decline at 4 lbs, to half at maximum age).** This change resulted in a worse fit overall to the data, and so was not included in the new Base Case.
2. **Discussion of differences by sex in growth led to the suggestion to test the effect of sex dependent natural mortality (0.2 female, 0.3 male).** This could only be tested using Stock Synthesis software, and the results were not significantly different from the Base Case.
3. **Variability in recruitment was discussed, including the possibility of "regime shift" effects (perhaps evident in impingement data, and thought to occur for some other species along the coast).** It was agreed that high sigma R could capture this effect (if it was present), The Panel suggested reducing steepness to 0.7 (from 1) for the new Base Case, in line with results from meta-analyses.
4. **There was evidence in the preliminary results of differences between commercial and recreational length composition data in effective sample size.** It was suggested that the new Base Case use effective sample sizes of 60 for commercial and 40 for recreational data.

5. **The Panel requested a sensitivity test to the use of increasing CV of length at age in the growth model, for the sake of completeness.** The results were not qualitatively different from the sensitivity tests already conducted.
6. **A request was made to present (for the Base Case runs) a single figure with time series for catch, reproductive output, and recruitment.**
7. **The Panel discussed the large recreational catch in 1980 (approximately double adjacent catches), and its possible validity. The Panel requested a sensitivity test to reducing the large recreational catch in 1980 to the average of catches in 1981 to 1983.** This resulted in a slightly more depleted stock. The Panel examined the catch by fishing mode, and found no basis to reject the 1980 data. It was therefore included in the new Base Case.
8. **The Panel requested the presentation of CVs on output parameters (especially management related quantities such as level of depletion) in output diagnostics.** This was found to be useful in comparing apparent differences in levels of depletion between different scenarios.
9. **The Panel and the meeting discussed the use of the various abundance time series in the new Base Case. The Panel recommended including RecFIN CPUE, and the CA Impingement Index in the Base Case (as well as the CPFV logbook CPUE), but not including the CalCOFI data and the CPFV observer CPUE.** This was based on generally including rather than excluding data, but noting concerns about sample size, including two indices based on the same data source, and representativeness of the data.
10. **The Panel recommended incorporating "model" uncertainty in projections by combining separate posteriors using combinations of fixed levels for steepness and natural mortality.** Due to time constraints, the full set of Bayesian analyses could not be completed during the meeting.
11. **In addition to yield projections based on NMFS decision rules, the Panel requested yield projections based on the decision rule specified in the CA Nearshore Fishery Management Plan (yield at $F_{50\%}$, adjusted using a 60-20 precautionary reduction).** No yield calculations were available for review at the meeting.

Comments on technical issues and remedies

Technical issues were mainly dealt with in the specific requests to the STAT Team, and to some extent in the recommendations for future research. The Panel specifically noted and endorsed the value of conducting and comparing assessments of different levels of complexity, and using independently coded software.

Areas of disagreement

There were no areas of disagreement between the STAR Panel and the STAT Team.

Unresolved problems and major uncertainties

The Panel noted the following unresolved problems and uncertainties:

1. The lack of a credible assessment for the northern stock.
2. Major uncertainties in historical catch levels.
3. Problems with trends in residuals for the fits to the CPUE data.
4. Lack of fishery independent abundance data for this species.
5. Lack of age data for this species.
6. Uncertainties about stock structure, although the panel noted that studies are underway.
7. Different trends in catch rates along the coast.
8. The current ADMB model does not allow for sex specific M.
9. The habitat ratio scalar between the northern and southern areas is highly uncertain. However the Panel questioned the usefulness of this approach, due to inconsistencies in assumptions about productivity versus carrying capacity between areas.

Recommendations

The following recommendations are not given in priority order.

Data and monitoring issues

1. The Panel considered that the highest priority for monitoring is the development of a fishery independent index of abundance for inshore species. Various survey methods should be considered, including use of trap and hook and line gears. In addition, the Panel recommended consideration of a coast wide tagging study for cabezon. Such a study would potentially provide not only an index of abundance, but also additional biological information on growth, movement and stock structure. The Panel strongly endorsed a joint science / industry survey and tagging study.
2. The Panel endorsed the recommendation in the STAT report that improved and accurate accounting of removals for both commercial and recreational sectors was essential to sound assessment. This should include better reporting of location of fishing. Techniques such as electronic card swiping at point of landing could be considered for the commercial sector.
3. The Panel suggested that further investigation of the unusually high estimate of the 1980 recreational catch be undertaken, for example by comparing the catches in the same and adjoining years for other inshore species. This uncertainty was not resolved in this meeting.
4. The Panel noted the potential value of sampling the sex ratio of the catch, but also noted the difficulty of doing so given that the commercial fishery is mainly a live fishery.
5. The Panel endorsed the suggestion for a workshop to understand, analyze and interpret recreational CPUE data, particularly for nearshore species.

Modelling and assessment issues

6. With regard to calculating yield projections in 2003, the Panel recommended incorporating "model" uncertainty in projections by combining separate posteriors using combinations of fixed levels for steepness and natural mortality. The values recommended were (suggested weights shown in square brackets): M = 0.2 [0.25], 0.25 [0.5] and 0.3 [0.25]; h = 0.5, 0.7, 0.9 with equal weighting for the values of steepness. In the longer term, the Panel recommended including such parameter uncertainty directly in the Bayesian analysis.
7. The Panel endorsed the value of using multiple assessment packages and models (including simple "production" models and SRA) in undertaking stock assessments. The Panel noted and endorsed the suggestion to develop an ADModel Builder version of Stock Synthesis. The Panel was encouraged by the PhD proposal by Jason Cope incorporating the testing of harvest strategies using a wide range of assessment models. The Panel strongly endorsed the approach in this dissertation to evaluate strategies for assessing and managing low information species, and asked for cooperation by agencies in providing data for this study.
8. Noting the (surprising) sensitivity of the cabezon assessment to uncertainty in the CV for length at age, the Panel recommended that this issue be explored in the context of this assessment and others which rely substantially on fitting to length-frequency data.
9. The Panel recommended that further exploration of the spatial structure of this fishery be undertaken, and that consideration be given in the future to the use of spatially explicit models.
10. The Panel suggested that the implications of regime shifts and environmental variability for assessments and management reference points be examined.
11. The Panel endorsed the presentation and use of the range of diagnostics for the Bayesian analyses, and the reporting of CVs on management performance statistics.
12. The Panel suggested that the possibility of sex specific natural mortality should be investigated.

Table 1. Data presented to the STAR Panel Meeting. Highlighted years are the data used in the base case. (*: no assessment undertaken for the northern stock due to data limitations; **: assumed; ***: assume equal to 2002)

CABEZON	**Northern Stock***	**Southern Stock**
Catch Data		
[redacted]	[redacted]	1930-2002, 2003***
[redacted]	[redacted]	1930-1979**; 1980-2002; 2003 ***
Abundance Indices		
CPFV observer	None	1987-1998
[redacted]	[redacted]	1960-1978; 1980-2001
[redacted]	[redacted]	1980-1989; 1993-2001
OR Ocean boat survey	1979-1987; 1999-2002	None
WA Ocean Sampling	1990-2001	None
CalCOFI	None	1979-2002
AFSC WA&OR larval index	1980-1985; 1987	None
[redacted]	[redacted]	1972-2002
Catch at Length (sex-aggregated)		
[redacted]	[redacted]	1995-2002
[redacted]	[redacted]	1980-1989; 1993-2002

Exhibit D.6
Attachment 3
November 2003

Assessment of Lingcod (*Ophiodon elongatus*)

for the

Pacific Fishery Management Council

in 2003

by

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October 2003

Executive Summary

Stock
This assessment applies to lingcod (*Ophiodon elongatus*) in the full Pacific Fishery Management Council (PFMC) management zone (the US-Vancouver, Columbia, Eureka, Monterey, and Conception INPFC areas). Separate assessment models were constructed to describe population trends in the northern (LCN: US-Vancouver, Columbia) and southern (LCS: Eureka, Monterey, Conception) areas.

Catches
Commercial Landings
Commercial lingcod catch history in California waters is available beginning 1916 (personal communication Brenda Erwin, PSMFC) and averaged 428 mt between 1916 and 1955. Commercial lingcod landings in Oregon were first reported in 1950 (Mark Freeman, personal communication) and averaged 264 mt between 1950 and 1953. Washington commercial lingcod landings were first reported in 1937 (anonymous, 1956, WDFW report) and averaged 106 mt until 1955.

Catch data were compiled from agency reports and personal communication for all years preceding 1981. The PacFIN database was queried for catch information in subsequent years. Landings peaked in 1985 at 3,129 mt in northern waters (Columbia and Vancouver INPFC areas) and in 1974 at 1,735 mt in southern waters (Eureka, Monterey and Conception INPFC Areas). Commercial fishery restrictions under lingcod rebuilding management (1998-present) dropped catches to an annual average below 135 mt in both northern and southern waters in recent years.

Over the last two decades, trawl gear has made up the majority of commercial landings for the northern (83%) and southern (62%) coast. In recent years (1998-2002), commercial fishery restrictions constrained the trawl portion of the catch to 54% and 45% for the northern and southern coast, respectively. In 2002, coastwide commercial landings totaled 223 mt and were distributed as follows by INPFC area: U.S.-Vancouver 63 mt (22%), Columbia 52 mt (30%), Eureka 63 mt (27%), Monterey 35 mt (16%), Conception 10 mt (5%).

Recreational Landings
Recreational fishers in California have targeted lingcod since the early 1940's and catch averaged 65.3 mt annually between 1947-1954. Recreational lingcod catch information is not available until 1977 for Oregon waters. Removals averaged 52.3 mt annually between 1977 and 1979. Recreational lingcod catch in Washington was first estimated in 1967 to be 25.3 mt, and annual catch estimates have been provided since 1975.

Recreational catch estimates were extracted from the RecFIN database for years 1980–1989 and 1993 to present for California waters. California recreational catch estimates for all other years were compiled previously in the 2000 lingcod assessment (Jagielo et al., 2000). Oregon recreational catch data were provided by ODFW (Don Bodenmiller, personal communication). Washington recreational catch data were obtained from the WDFW Ocean Sampling Program.

Recreational catch in southern waters has declined dramatically since catch peaked in 1980 at 2,226 mt. In contrast, recreational catch in northern waters peaked at 236 mt in 1994; 127 mt was landed in 2002.

Historically, recreational landings have comprised a larger proportion of the total landings for the southern area, compared to the northern area. In recent years, the recreational portion of the total landings has increased substantially in both the southern and northern areas. In 2002, recreational fisheries harvested 83% of the total lingcod catch in the south and 52% in the north.

Data and Assessment

Present Modeling Approach and Assessment Program

The present assessment updates the previous coastwide assessment (Jagielo et al. 2000) and is implemented in Coleraine using the executable code COLERA20.EXE (Hilborn et al. 2000). Coleraine is a statistical catch-at-age model programmed in AD Model Builder with a Microsoft Excel user interface and has been used for New Zealand assessments including blue whiting, ling, elephant fish, orange roughy and black oreo; in 2000 for Icelandic cod; and recently on the U.S. west coast for sablefish (Hilborn et al. 2001).

In Coleraine, recruitments are assumed to follow a Beverton-Holt spawner recruit curve with a lognormal penalty function for recruitment deviates (Hilborn et al. 2000, section 1.2.3). The parameters are: average recruitment in the unfished state (R_0), steepness (h) - the fraction of recruitment obtained at 20% of virgin spawning biomass, and the standard deviation of annual recruitment residuals (Hilborn et al. 2000). In this stock assessment, the initial age composition was determined by assuming that the population was in equilibrium with a fixed, sex specific exploitation rate - U_{init}. (Hilborn et al. 2000, section 1.2.2).

As in the previous assessment, separate age structured models were constructed to analyze stock dynamics for the northern (LCN: US-Vancouver, Columbia) and southern (LCS: Eureka, Monterey, Conception) areas.

The LCN model incorporated the following likelihood components, which are described mathematically in Hilborn et al.(2000). Input data sources are specified by Table number in the body of the 2003 assessment document which follows:

1) Commercial Catch-At-Age: 1979-2002 (Table 7).
2) Recreational Catch-At-Age: 1980, 1986-2002 (Table 8).
3) Commercial Catch-At-Length: 1975-1978 (Table 11).
4) Recreational Catch-At-Length: 1981-1983 (Table 11).
5) NMFS Trawl Survey Catch-At-Age: 1992, 1995, 1998 and 2001 (Table 9).
6) NMFS Trawl Survey Catch-At-Length: 1986 and 1989 (Table 10)
7) WDFW Tag Survey Catch-At-Age: 1994-1997 (Table 9).
8) WDFW Tag Survey Catch-At-Length: 1986-1993 (Table 10).
9) NMFS Trawl Survey Biomass (mt): 1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, and 2001 (Table 18).
10) WDFW Tag Survey Abundance (Numbers of Fish): 1986-1992 (Table 19).
11) Trawl Fishery Logbook CPUE Index: Washington and Oregon lingcod CPUE estimates (lbs/hr) derived from a Delta GLM analysis of trawl logbook information, 1976-1997 (Table 21).

The LCS model incorporated the following likelihood components:

1) Commercial Catch-At-Age: 1992-1998, 2000-2002 (Table 12).
2) Recreational Catch-At-Age: 1992-1998, 2000-2002 (Table 12).
3) NMFS Trawl Survey Catch-At-Age: 1995, 1998 and 2001 (Table 12).
4) NMFS Trawl Survey Biomass (mt): 1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, and 2001 (Table 18).
5) Trawl Fishery Logbook CPUE Index: Oregon and California lingcod CPUE estimates (lbs/hr) derived from a Delta GLM analysis of trawl logbook information, 1978-1997 (Table 22).

Unresolved Problems and Major Uncertainties

Uncertainty regarding stock status is higher for the southern area relative to the northern area, primarily because historical data from the southern area were sparse relative to the northern area. The time series of fishery age data available for the southern (LCS) model is short and samples sizes are small, resulting in a shorter time series of estimated recruitments relative to the northern area. More assumptions about the early recruitments in the LCS time series were required, which resulted in greater uncertainty in the estimation of assessment parameters and stock productivity for the southern area. Age data for the NMFS trawl survey were sparse for both regions, but particularly for the southern region. Assumptions about fixed selectivity for this index of abundance were required for the LCS model.

Management-implemented minimum size limits have resulted in limiting the utility of fishery information for estimation of recent stock recruitment in both regions, and fishery trip limits have compromised the utility of recent fishery CPUE data as viable indices of abundance.

Management Reference Points

Comparison of the spawning stock estimates for 2002 with the estimates of virgin spawning stock size under the asymptotic fishery selectivity model assumption indicate that the recent coastwide spawning population size is approximately 25% of virgin levels (Table ES1). Under the domed fishery selectivity model assumption, the estimate of depletion was similar at 24%. By contrast, the model estimates of F_{45} differed between the asymptotic ($F_{45} = 0.12$) vs. domed

(F_{45} = 0.18) cases, indicating higher productivity under the domed fishery selectivity assumption. Consequently, projected yields under the domed fishery selectivity model assumption tend to be higher than under the asymptotic fishery selectivity model assumption (Table ES2).

When compared to the domed fishery selectivity model, the asymptotic fishery selectivity model is generally more consistent with the assumptions made in the previous lingcod stock assessment (Jagielo et al. 2000) and rebuilding analysis (Jagielo and Hastie 2001). (In the 2000 lingcod stock assessment, all fisheries were assumed to be asymptotic, with the exception for male fishery selectivity in the northern area, which was allowed to be dome shaped.) Estimates of F_{45} for the 2003 asymptotic model (0.12-north, 0.12-south) are similar to the estimates of F_{45} from the 2000 assessment (0.12-north, 0.14-south), with a slightly higher value for the south.

Spawning Stock Biomass

For the asymptotic fishery selectivity model, Coleraine estimates of the coastwide female spawning stock biomass declined from 22,918 mt in 1973 to 1,942 mt in 1994, and subsequently increased to 10,776 in 2003 (Figure ES1-Top). The trend over time was similar for the northern and southern areas. Female spawning biomass depletion (B_0/B_t) ranged from 0.53 in 1973 to a low of 0.05 in 1994, and subsequently increased to 0.25 in 2003.

For the dome shaped fishery selectivity model, Coleraine estimates of the coastwide female spawning stock biomass declined from 31,682 mt in 1973 to 1,897 mt in 1994, and subsequently increased to 10,665 mt in 2003 (Figure ES2-Top). Female spawning biomass depletion (B_0/B_t) ranged from 0.67 in 1973 to a low of 0.04 in 1994 and subsequently increased to 0.23 in 2003 (Figure ES2-Bottom). Estimated depletion was somewhat greater for the northern area compared to the southern area in the early part of the time series.

It should be noted that the Coleraine estimate of depletion can differ from the estimate obtained from the rebuilding analysis (Appendix II), because the rebuilding analysis computes B_0 using the average of recruitments from 1973-2002, while Coleraine uses the estimate of R_0 obtained in the model according to the formula provided in Hilborn et al.(2000). Additionally, the depletion values reported for Coleraine are with reference to 2003 spawning biomass, while those reported in the rebuilding analysis are with reference to 2002 spawning biomass.

Recruitment

For the asymptotic fishery selectivity model, estimated recruitment was higher in the early part of the time series and relatively low by comparison through the 1990's. From 1973-1985, coastwide recruitment averaged 3,173 (thousand age 1 fish). From 1986-2002, coastwide recruitment averaged 2,832 (thousand age 1 fish). For the dome shaped fishery selectivity model, coastwide recruitment averaged 3,527 (thousand age 1 fish) from 1973-1985; from 1986-2002, coastwide recruitment averaged 2,869 (thousand age 1 fish).

Exploitation Status

Under coastwide rebuilding management, the asymptotic fishery selectivity model estimates of exploitation rate (catch/available biomass) in the northern area averaged 0.03 (commercial fishery) and 0.02 (recreational fishery) in recent years (1998-2002). In the southern area exploitation rates averaged 0.03 (commercial fishery) and 0.11 (recreational fishery) for the same period. Estimates from the dome shaped fishery selectivity model for the same time period were 0.03 (commercial-north), 0.03 (recreational-north), 0.07 (commercial-south) and 0.13 (recreational-south).

Management Performance

The first lingcod ABC's based on a quantitative assessment were implemented in 1995. A comparison of reported landings and ABC values shows good correspondence through 2001, when landings were typically at or below the target ABC values (Figure ES3). In 2002, landings exceeded the coastwide ABC by 17% and the coastwide OY was exceeded by 51%.   Harvest in excess of the OY can be attributed in part to the northern California recreational fishery; RecFIN catch estimates increased from 140mt in 2001 to 430 mt in 2002.

Forecasts and Decision Table

Six rebuilding analysis projections were produced using separate sets of information derived from the present stock assessment (Appendix II). The six rebuilding analysis input files were: 1) a pooled, coastwide asymptotic fishery selectivity model; 2) a pooled, coastwide domed fishery selectivity model, 3) separate northern and southern area asymptotic fishery selectivity models, and 4) separate northern and southern area domed fishery selectivity models. The population projections were configured to begin in 2002 with rebuilding scheduled to occur by the start of 2009 (year 10 from the original rebuilding start year of 1999).

The projected coastwide yields for 2004-2008 under both the asymptotic and domed fishery selectivity assumptions are constrained by the ABC rule, for values of $P < 0.6$ (Table ES2). Coastwide ABC yield for 2004-2008 ranges from 1,820 mt to 2,053 mt for the asymptotic fishery selection model, compared to 2,141 mt to 2,123 mt for the domed fishery selectivity model.

Recommendations: Research and Data Collection Needs

Emphasis should be placed on improving fishery age structure sampling size and geographical coverage in both regions. More frequent and synoptic fishery independent surveys should be conducted in both regions to aid in determination of stock status and recent recruitment. In the southern region, the CPFV observer project CPUE data should be analyzed (on a reef-specific basis) using a General Linear Model (GLM) analysis, for evaluation as an index of abundance. Coastwide enumeration of at-sea discards (e.g. by an on-board observer program) is needed to properly account for total fishery mortality.

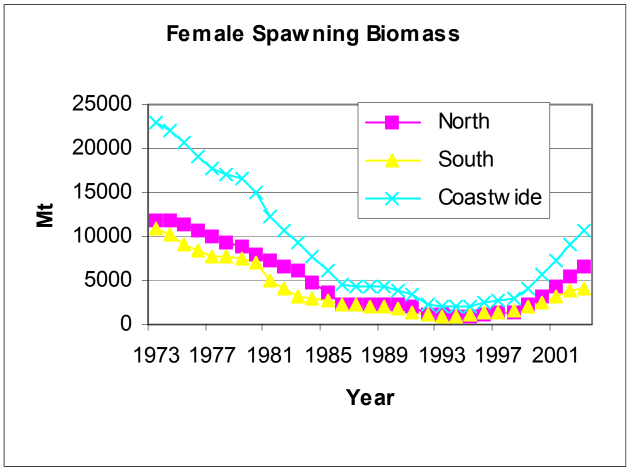
Table ES1. Management reference points derived from the 2003 lingcod stock assessment (Jagielo et al. 2003). Alternative models included the assumption of asymptotic vs. domed fishery selectivity. Under each assumption, rebuilding projection input files were constructed for 1) coastwide (northern and southern model data pooled) and 2) northern and southern area model data separately.

	Asymptotic Fishery Selectivity			Domed Fishery Selectivity		
	Coastwide	Northern	Southern	Coastwide	Northern	Southern
FMSY proxy	0.121	0.124	0.122	0.184	0.165	0.190
FMSY SPR / SPR(F=0)	0.45	0.45	0.45	0.45	0.45	0.45
Virgin SPR	12.41	13.27	11.20	11.77	13.27	11.20
Virgin Spawning Output (mt)	36967	19434	16969	37115	19518	18848
Target Spawning Output (mt)	14787	7774	6788	14846	7807	7539
Current (2002) Spawning Output (mt)	9160	5410	3751	8931	5679	3253
Depletion ($SpBio_{2002}/SpBio_{Virgin}$)	0.25	0.28	0.22	0.24	0.29	0.17
Spawning Output (ydecl) (mt)	4203	2226	1972	4077	2464	1608

Table ES2. Projected yield (mt) under model assumptions of asymptotic vs. domed fishery selectivity. Yields are shown for probability of recovery values ranging from P=0.5 to P=0.9, and for the 40-10 and ABC rules.

Model	Year	P= .5	P= .6	P= .7	P= .8	P= .9	Yr=Tmid	F=0	40-10 Rule	ABC Rule
Coastwide Asymptotic	**2004**	1843	1799	1750	1693	1631	1767	0	1429	1820
	2005	1947	1906	1859	1805	1744	1875	0	1753	1926
	2006	2006	1968	1924	1873	1816	1939	0	1970	1986
	2007	2043	2008	1967	1920	1866	1981	0	2085	2025
	2008	2069	2037	1999	1955	1904	2012	0	2102	2053
North Asymptotic	**2004**	1342	1328	1305	1285	1255	1339	0	1050	1109
	2005	1359	1346	1326	1309	1281	1356	0	1156	1149
	2006	1354	1343	1326	1311	1287	1352	0	1174	1168
	2007	1331	1322	1307	1294	1273	1330	0	1172	1168
	2008	1312	1304	1291	1279	1261	1311	0	1170	1166
South Asymptotic	**2004**	686	660	626	594	547	650	0	492	759
	2005	752	725	692	659	610	715	0	664	823
	2006	794	768	736	704	655	759	0	800	862
	2007	830	805	774	742	694	796	0	898	894
	2008	859	836	805	775	728	827	0	961	920
Coastwide Domed	**2004**	2058	2009	1962	1905	1838	2032	0	1616	2041
	2005	2135	2089	2045	1992	1930	2111	0	1966	2118
	2006	2138	2098	2058	2010	1953	2117	0	2137	2124
	2007	2139	2102	2066	2022	1969	2120	0	2182	2126
	2008	2135	2101	2067	2025	1976	2117	0	2167	2123
North Domed	**2004**	1512	1496	1478	1462	1440	1509	0	1164	1185
	2005	1477	1464	1449	1435	1416	1475	0	1198	1195
	2006	1438	1427	1414	1403	1387	1436	0	1194	1192
	2007	1376	1366	1355	1346	1332	1374	0	1165	1163
	2008	1339	1330	1320	1312	1300	1337	0	1148	1146
South Domed	**2004**	600	571	538	502	455	603	0	421	803
	2005	658	629	595	557	509	661	0	618	858
	2006	687	659	626	588	540	690	0	764	877
	2007	711	683	650	613	564	714	0	860	893
	2008	736	708	676	639	589	738	0	924	911

Figure ES1. Female spawning biomass (top) and depletion (bottom) estimated under the assumption of asymptotic fishery selectivity.



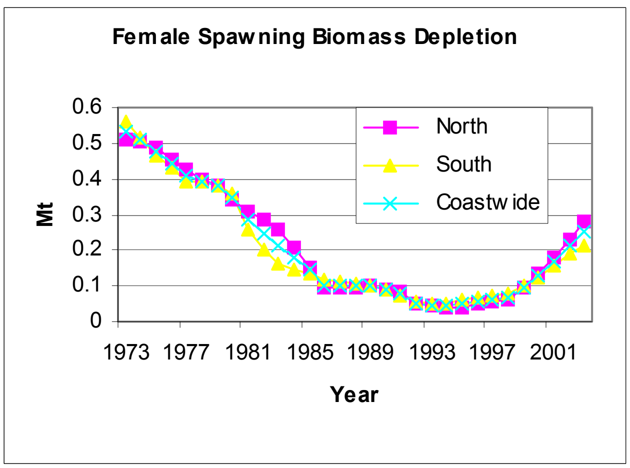
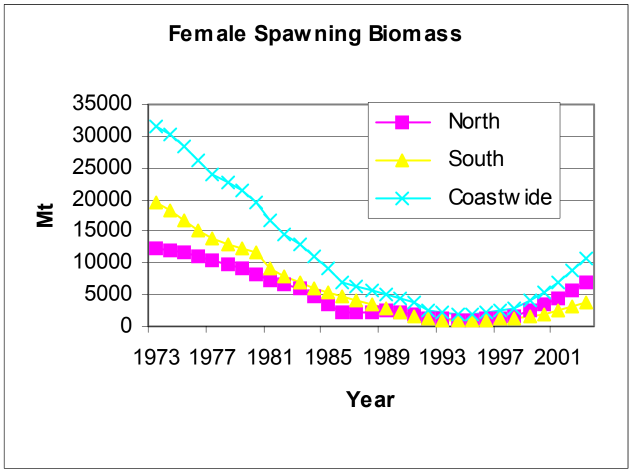


Figure ES2. Female spawning biomass (top) and depletion (bottom) estimated under the assumption of dome shaped fishery selectivity.



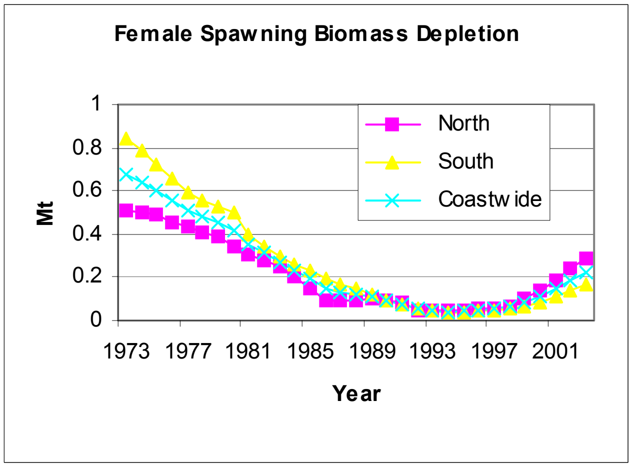
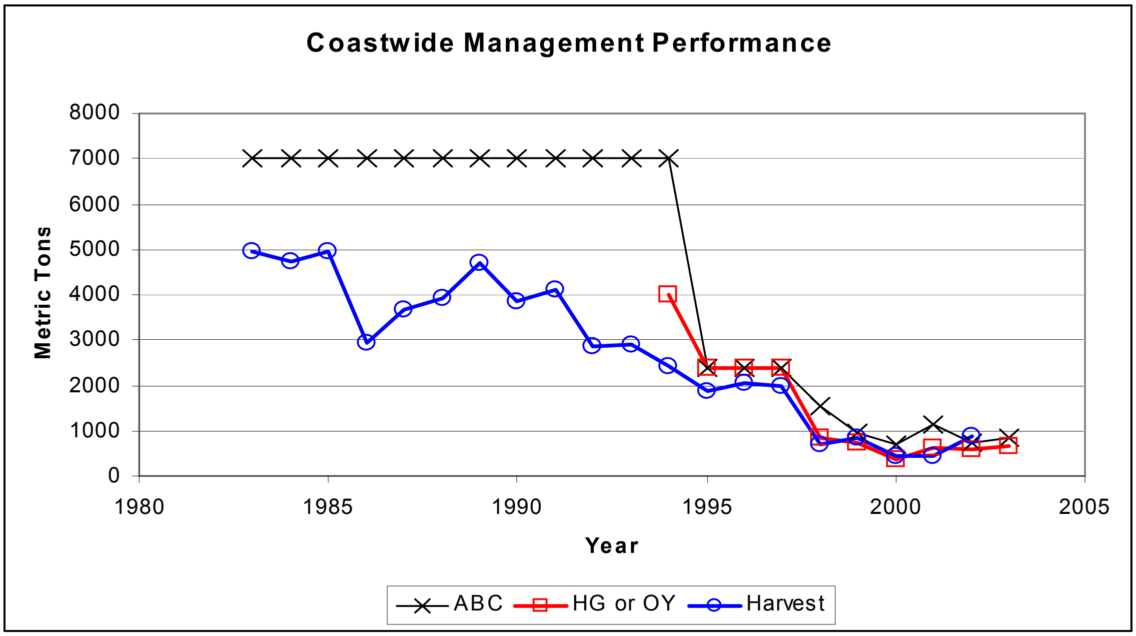


Figure ES3. Comparison of lingcod ABC, OY and landings (mt) between 1983 and 2003.



Introduction

Stock Structure and management Units

This document provides an updated coastwide assessment of the lingcod population in 2003 for the full PFMC management zone. Evidence from genetics analysis (Jagielo et al. 1996) and tagging studies (Cass et al. 1990, Jagielo 1995, Jagielo 1999a) suggest that the fish found within this entire area are of one intermingling stock unit. However, because of regional differences in data sources and data availability, the assessment was divided into two separately modeled units: Lingcod-North (LCN) and Lingcod-South (LCS), as it was in the previous assessment (Jagielo et al. 2000) (Figure 1). A study currently underway by WDFW indicates that there are significant differences in growth in lingcod found in southern Eureka, Monterey and Conception INPFC Areas), and northern coastal waters (Columbia and Vancouver INPFC areas). Based on this evidence, we continue to support and provide a separate assessment for southern and northern areas.

Life History

Lingcod (*Ophiodon elongatus*) are top order predators of the family *Hexagrammidae*. The species ranges from Kodiak Island in the Gulf of Alaska to Baja California, and its center of abundance is near British Columbia and Washington (Hart 1973). An analysis of genetic variation indicates that lingcod are genetically similar throughout the range (Jagielo et al. 1996). Among the *Hexagrammidae*, the genus *Ophiodon* is ecologically intermediate between the more littoral genera *Hexagrammos*, *Agrammus*, and *Oxylebius* and the more pelagic *Pleurogrammus* (Rutenberg 1962). Lingcod are demersal on the continental shelf, most abundant in waters less than 200 m deep, and patchily distributed among areas of hard bottom and rocky relief (Smith and Forrester 1973; Jagielo 1988). Lingcod are considered non-migratory, though some tagged individuals have moved exceptional distances and indirect evidence suggests a seasonal onshore movement associated with spawning (Jagielo 1995, 1999). Larval lingcod hatch in late winter and become epipelagic. When about 3 months old, juveniles settle on sandy bottom near eelgrass or kelp beds. By age 1 or 2, lingcod move into rocky habitats similar to those occupied by adults, but shallower. Fishery and survey data indicate that male lingcod tend to be more abundant than females in shallow waters, and the size of both sexes increases with depth (Jagielo 1994). In late fall, male lingcod aggregate and become territorial in areas suitable for spawning. Mature females are rarely seen at the spawning grounds and it is assumed that they move into spawning areas for only a brief time to deposit eggs. Following egg nest deposition, males assume a guardian role through the period of hatch-out. Hatch out is typically complete by April in Washington but has been reported as early as January and as late as June throughout the species range (Jagielo 1994). A more detailed review of lingcod life history can be found in Jagielo (1994), Adams and Hardwick (1992), and Cass et al. (1990).

History of the fishery

Lingcod have been a target of commercial fisheries since the early 1900's in California (CDFG Reports), and since the late 1930's in Oregon (Unpublished, ODFW Report, 1950) and Washington (Anonymous WDF Report, 1955) waters (Table 4). Recreational fishers have targeted lingcod since the 1920's in California. A modest recreational fishery (less than 20 mt annually) has taken place in Washington and Oregon since at least the 1970's.

Management

History

From 1983 through 1994, a coastwide ABC of 7,000 mt was in effect with the INPFC area components: US Vancouver (1000 mt), Columbia (4,000 mt), Eureka (500 mt), Monterey (1,100 mt) and Conception (400 mt) (Table 1). In 1994 a coastwide harvest guideline (HG) of 4,000 mt was established. Following an assessment for the northern area (Jagielo 1994), the coastwide ABC and Harvest Guideline were reduced for 1995 through 1997 to 2,400 mt with separate ABC's for the US Vancouver-Columbia (1,300 mt), Eureka (300 mt), Monterey (700 mt), and Conception (100 mt) areas. In 1998, following an updated assessment for the northern area (Jagielo et al.1997), the coastwide ABC was reduced to 1,532 mt with a Harvest Guideline of 838 mt. Separate ABC's by area were: Vancouver (including a portion of Canadian waters)-Columbia (1,021 mt), Eureka (139 mt), Monterey (325 mt), and Conception (46 mt). For 1999, the Council established a coastwide ABC of 960 mt and a Harvest Guideline of 730 mt, with area specific ABC's of US Vancouver-Columbia (450 mt), Eureka (139 mt), Monterey (325 mt), and Conception (46 mt). Following a new assessment for the southern area (Adams et al.1999) and a rebuilding analysis (Jagielo 1999b), the coastwide ABC for 2000 was reduced to 700 mt which included area values of US Vancouver-Columbia (450 mt) and Eureka-Monterey-Conception (250 mt). Subsequently, a coastwide stock assessment (Jagielo et al. 2000) provided a northern ABC was of 610 mt and a southern ABC of 509 mt. Based on a revised rebuilding analysis (Jagielo and Hastie 2001) the 2001-coastwide lingcod OY was set at 611 mt, which is the harvest level derived from a constant exploitation rate that was expected to have a 60-percent probability of rebuilding the stock to B_{msy} within 9 years. The coastwide lingcod OY was similarly set at 577 mt in 2002 and 651 mt in 2003.

Regulations

A history of lingcod commercial trawl trip limits is summarized in Table 2. No trip limits were in effect prior to 1995, and trip limits have become increasingly restrictive since then as annual harvest guidelines have decreased.

A history of PFMC enacted recreational size and bag limits is summarized in Table 3. In California, a 5 fish bag limit was enacted in 1980 followed by a 22 inch size limit in 1981. These regulations remained in effect for 17 years. In March 1998, the bag limit was reduced from 5 to 3 fish and concurrently the size limit was increased to 24 inches. The bag limit was lowered again from 3 fish to 2 fish with in January 1999. In January 2000, the size limit increased from 24 to 26 in. and a seasonal closure (January through February) was implemented from the U.S.-Mexico border north to Lopez Point (36 deg 00 min N., Monterey County), and for March through April from Lopez Point north to Cape Mendocino (40 deg 10 min N., Humboldt County) The bag limit remained at 2 fish. A gear restriction was also enacted at this time limiting the number of hooks to 3, although this was primarily directed toward rockfish effort.

Performance

The first lingcod ABC's based on a quantitative assessment were implemented in 1995. A comparison of reported landings and ABC values shows good correspondence through 2001, when landings were typically at or below the target ABC values (Figure 2). In 2002, landings exceeded the coastwide ABC by 17% and the coastwide OY was exceeded by 51%. Harvest in excess of the OY can be attributed in part to the northern California recreational fishery; RecFIN catch estimates increased from 140mt in 2001 to 430 mt in 2002.

DATA

Catch

Commercial Landings

Commercial lingcod catch history in California waters is available beginning 1916 (personal communication Brenda Erwin, PSMFC) and averaged 428 mt between 1916 and 1955 (Table 4). Commercial lingcod landings in Oregon were first reported in 1950 (Mark Freeman, personal communication) and averaged 264 mt between 1950 and 1953. Washington commercial lingcod landings were first reported in 1937 (anonymous, 1956, WDFW report) and averaged 106 mt until 1955.

Catch data were compiled from agency reports and personal communication for all years preceding 1981. The PacFIN database was queried for catch information in subsequent years and catch detail is presented by gear and INPFC area in Table 6.

Commercial landings peaked in 1985 at 3,129 mt in northern waters (Columbia and Vancouver INPFC areas) and in 1974 at 1,735 mt in southern waters (Eureka, Monterey and Conception INPFC Areas)(Table 5). Average catch between 1990-1997 declined 40 % and 35% since the 1980's in northern and southern waters, respectively. Under rebuilding management, commercial fishery restrictions in recent years (1998-present) reduced catches to an annual average of less the 135 mt in both northern and southern waters (Figure 3).

Over the last two decades, trawl gear has made up the majority of commercial landings for the northern (83%) and southern (62%) coast (Table 6). In recent years (1998-2002), commercial fishery restrictions constrained the trawl portion of the catch to 54% and 45% for the northern and southern coast, respectively. In 2002, coastwide commercial landings totaled 223 mt and were distributed as follows by INPFC area: U.S.-Vancouver 63 mt (22%), Columbia 52 mt (30%), Eureka 63 mt (27%), Monterey 35 mt (16%), Conception 10 mt (5%).

Recreational Landings

Recreational fishers in California have targeted lingcod since the early 1940's. Catch averaged 65.3 mt annually between 1947-1954 (Leet et al., 1992). Recreational lingcod catch information is not available until 1977 for Oregon waters and averaged 52.3 mt annually between 1977 and 1979. Recreational lingcod catch in Washington was first estimated in 1967 to be 25.3 mt and annual catch estimates have been provided since 1975.

Recreational catch estimates were extracted from the RecFIN database for years 1980–1989 and 1993 to present for California waters. California recreational catch estimates for all other years were compiled in the 2000 lingcod assessment (Jagielo et al., 2000). Oregon recreational catch data were provided by ODFW (Don Bodenmiller personal communication). The recreational catch in Washington was provided by the WDFW Ocean Sampling Program.

Recreational catch in southern waters has declined since catch peaked in 1980 at 2,226 mt (Table 5, Figure 4). In contrast, recreational catch in northern waters peaked at 236 mt in 1994. In 2002, 127 mt was landed.

Historically, recreational landings have comprised a larger proportion of the total landings for the southern area, compared to the northern area. In recent years, the recreational portion of the total landings has increased substantially in both the southern and northern areas. In 2002 recreational fisheries harvested 83% of the total lingcod catch in the south and 52% in the north (Figure 5).

Discard

There are three sources of discard information for lingcod. These include the federal Marine Recreational Fisheries Statistical Survey (MRFSS), and both the Washington Department of Fish and Wildlife (WDFW) and the NMFS West-Coast Groundfish Observer Programs. MRFSS have collected B1 (reported by angler to be dead) and B2 (reported by angler to be alive) catches since 1980. Estimates of lingcod discarded alive have increased substantially in response to 1) management changes in 1998 (the size limit increased from 22 to 24 inches), and 2) a seasonal closure in California waters beginning in 2000 (Table 6a). It is interesting to note that estimates of fish discarded dead have decreased over time. Estimated live lingcod discarded in southern California was 306,000 fish in 2002. This compares to a total landed catch of 25,000 fish. WDFW began collecting discard information from the recreational fishery in 2002 and estimated that 57% of the catch was discarded. WDFW does not collect information on the portion of the catch discarded live or dead.

Based on an earlier study (Ricky, WDFW unpublished report), the PFMC Groundfish Management Team used a 20% inflation factor to adjust landed catch to account for unobserved lingcod mortality (personal communication, PFMC) in the commercial fishery beginning in 2002. Data collected by the Groundfish Observer program in 2001-2002 estimated that the percent discard of total observed catch was 78.8%. Because lingcod lack a swim bladder, it is likely that there is a relatively good survival rate for these fish.

Age and Size Composition

Age composition data from the northern area is summarized for the commercial fishery in Table 7. These data were derived by weighting the raw age frequencies from each WDFW vessel sample by the total landed weight of lingcod from that vessel. The recreational fishery age composition data, compiled from WDFW and ODFW recreational fishery samples, are summarized in Table 8. Age compositions derived from samples taken on board the NMFS Triennial Trawl shelf survey and age compositions obtained from sub-samples of lingcod taken for aging as part of the WDFW Cape Flattery Tag survey are summarized in Table 9. Survey and fishery size composition data (cm) used in the northern model, with associated sample sizes, are summarized by data source in Tables 10 and 11, respectively.

Age composition data and sample size information for the southern area are summarized for the commercial and recreational fisheries, and the NMFS Triennial Trawl shelf survey in Table 12.

Natural Mortality, Length, Weight, and Maturity at Age

Vectors of length, weight, and maturity-at-age by sex are summarized for the northern area in Table 13. Parameter estimates for these relationships, and natural mortality estimates used in the LCN model are summarized in Table 14. Comparable information for the southern area is summarized in Tables 16 and 17. Figure 6 shows the fit of female and male LCS and LCN lingcod to the von Bertalanffy growth equation.

Abundance Indices

NMFS Triennial Shelf Trawl Survey

Survey estimates of biomass (metric tons) and the associated coefficients of variation (CV's) from the triennial survey for 1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998 and 2001 are summarized in Table 18. The total sum of lingcod abundance estimates from the US Vancouver and Columbia area for all depth strata (55-183 m, 184-366 m and 367-500 m) was incorporated into the LCN model. The total sum of the Eureka and Monterey biomass estimates for each year and depth strata was used in the LCS model. Geographic distribution of lingcod biomass (kg/ha) for all tow catch data is displayed in Figures 7, 8 and 9 for coastwide, northern and southern areas, respectively.

Biomass estimates have been revised using a filtered dataset that excluded "water hauls". A complete description of the tow analysis and identification procedures of "water hauls" can be found in AFSC Processed Report 2001-03 (Zimmermann et al., 2001). Generally, lingcod biomass estimates from the filtered dataset increased with one exception. The 1980 Columbia INPFC lingcod biomass estimate was reduced from 8,699 mt to 3,219 mt, a difference of 5,480 mt (Table 18 and Figure 10). The difference resulted from a single large lingcod tow that was identified as a "water haul" and excluded from the dataset.

WDFW Cape Flattery Tag Survey

Annually, from 1986-1992, WDFW sampled lingcod from an established survey area in a consistent manner using bottomfish troll (dingle bar) hook and line gear. This sampling was initiated for the purpose of capturing fish for release as part of a multiple-year mark-recapture experimental design (Jagielo 1991, 1995). From 1986-1992, estimates of lingcod abundance in the Cape Flattery survey area were derived using external tags (Table 19). Voluntary tag returns from the recreational lingcod fishery at Neah Bay, Washington were used as the method for obtaining tag recaptures. Annual sampling with bottomfish troll gear continued beyond 1992 to extend the length composition time series, which had shown value as a recruitment index for previous lingcod stock assessments (Jagielo 1994, Jagielo et al.1997, Jagielo et al. 2000).

Trawl Fishery Logbook Catch-Per-Unit-Effort (CPUE) Index

Similar to the 2000 assessment, two independently estimated trawl fishery CPUE indices were incorporated into the northern and southern assessment models. These indices have been revised since the 2000 assessment. The new indices were constructed from Washington, Oregon and California trawl fishery logbook and fish ticket data dating back to 1976 (Table 20). Skipper's tow-by-tow estimates of retained catch were reconciled with fish ticket data (landing receipts). The adjusted catch and the skipper's estimate of tow duration was used to compute lingcod CPUE (lbs/hour)(Figures 11-14).

Following data verification and screening, a total of 474,946 tows in the southern area and 490,971 tows in the northern area were used in the analysis. Because of significant changes in management beginning in 1998 both the northern and southern time series were truncated after 1997. Furthermore, the 1976 and 1977 tow data from the southern area were deemed of insufficient sample size and were dropped from the time series used in the assessment model.

Tow-by-tow catch rates (CPUE) were fitted in a two-stage model process using Delta-Lognormal GLM procedure to predict abundance indices across the time series for each area. The model included a year, month, depth, and location (PFMC area) effect. A bootstrap procedure was used to estimate the standard errors of the year by year index values. The STAT Team determined and the Star Panel concurred that the bootstrap estimates of standard errors were unrealistically low and opted to use an assumed annual CV of 0.20 in both the southern and northern index.

The revised northern trawl logbook index trend used in the present assessment model corresponds well with the logbook index trend used in the 2000 stock assessment and shows a sharply declining stock since 1976 (Figure 15). The revised southern trawl logbook index also corresponds well to the logbook index used in the previous assessment and indicates a declining stock since 1979 (Figure 16). A summary of the Delta GLM results for the northern area is presented in Table 21 and results from the southern area are presented in Table 22.

Other Candidate Indices Considered But Not Used

At the request of the lingcod Stock Assessment Team (STAT), recreational catch and effort data from WDFW Ocean Sampling Program and RecFIN were analyzed by Drs. Alec MacCall and Steve Ralston (SWFSC, Santa Cruz) for four different regions including Southern and Northern California, Oregon and Washington (Table 23, Figure 17). Candidate indices were derived based on the Delta-GLM approach (assuming gamma error structure) that was used recently for black (Ralston and Dick, 2003) and bocaccio rockfish (MacCall, 2003). Evaluation of these new candidate indices of abundance resulted in the determination that potential biases in the input data sources precludes their use in the lingcod stock assessment. The STAT team concerns include 1) high index variability, 2) lack of a discernable index trend, 3) implausible temporal changes in abundance, and 4) unresolved input data assumptions.

In particular, the Washington database did not contain discard information needed to convert the estimate to total catch, as was done in the other estimates. For the other regions, analysis of RecFIN data indicated that the time trend of catch type A (landed catch) was constrained by bag limits and not informative. Discard was an integral part of estimating a CPUE trend from RecFIN data. MacCall calculated a "direct" CPUE from the raw intercept data on Aangs (anglers), Bangs (boat anglers), A, B1 (reported by angler to be dead) and B2 (reported by angler to be alive), but found cases in the dataset where Aangs had a value of 1, but the type B catches clearly represented the entire boat. The resulting indices were highly irregular and disregarded. To standardize RecFIN estimates (for the final "direct" catch estimate), MacCall assumed Aangs caught B1 and B2 catches and produced alternative indices where the year values from the delta GLM of type A catch and Aangs were expanded by the ratio of RecFIN estimated total catch (A+B1_B2)/A. The delta method was used to estimate variances of the "indirect" estimates from the variances of all the pieces and some assumed co-variances.

Because we were not confident that the type A catch and Aangs was reliable, the indices were not incorporated as model indices of abundance. We are concerned that the resulting catch rates may be affected by sampling and/or data entry error. A full evaluation of data quality is needed before using these data as a trend of lingcod abundance.

In addition to the candidate recreational indices discussed above, Jagielo et al. (2000) previously reviewed and analyzed a number of possible data sources for abundance trend information. Four indices of abundance, three derived from recreational CPUE data in the southern area and one derived from the shrimp trawl fishery bycatch in the northern area, were evaluated as candidates for modeling in 2000. Those candidate indices were not incorporated in final modeling in the 2000 assessment because it was difficult to assure that they were unbiased and/or representative of lingcod relative abundance. Recreational CPUE datasets are often problematic for use as unbiased indices of abundance, because catch rates may be effected by 1) variable target species by boat, 2) un-documented search time, 3) un-reported discards ,4) unknown spatial effort shifts, and 5) bag limit effects. Uncertainty also exists in the estimates of landings and effort due to sampling error.

Exploratory analyses conducted with the commercial trawl logbook data were also evaluated and subsequently not used in the model. Tow-by-tow catch rates (CPUE) were fitted to a two-stage model process using a generalized additive model (GAM, non-parametric method) to predict abundance indices across the time series. The data sets were filtered for tows where tow location (latitude and longitude) was known. Because of the lack of tow location, especially in the early part of the time series, index values in the early part of the time series were based on extrapolation. A comparison of Delta GLM and GAM results showed inconsistencies over the time series that appeared to be based on this extrapolation. Additionally, the GAM results included a smoothing process which may not have properly reflected underlying covariance in the data. Thus, the STAT team determined and the STAR panel concurred that the GAM analysis should be considered a work in progress and should not be used in the stock assessment.

Ageing error

Age reading error was modeled by incorporation of an age error transition matrix, which was developed from estimates of between-reader (within-lab) variability obtained from repeat age readings by two WDFW lingcod age readers (Figure 18). This age error transition matrix has not been modified since the last assessment.

Assessment

History of Modeling Approaches

The first assessment of lingcod provided to PFMC consisted of a yield-per-recruit analysis Adams (1986). Subsequently, an age structured assessment was prepared for a portion the northern area (PMFC areas 3A, 3B, and 3C-including Canada) by Jagielo (1994), using the Stock Synthesis model (Methot 1990). The assessment was subsequently updated to include the full Columbia INPFC area through 3C-N in Canada (Jagielo et al. 1997). Adams et al. (1999) subsequently conducted a length-based, age-structured assessment for the southern area (Eureka, Monterey, and Conception INPFC areas), using AD Model Builder (Fournier 1996). The first coastwide assessment of lingcod for the full PFMC management zone was conducted by Jagielo et al. 2000; that assessment (implemented in AD Model Builder) employed two age-structured models, conceptually and mathematically similar to the previous Stock Synthesis assessments of the northern area (Jagielo 1994, Jagielo et al. 1997).

Present Modeling Approach and Assessment Program

The present assessment updates the previous coastwide assessment (Jagielo et al. 2000) and is implemented in Coleraine using the executable code COLERA20.EXE (Hilborn et al. 2000). Coleraine is a statistical catch-at-age model programmed in AD Model Builder with a Microsoft Excel user interface and has been used for New Zealand assessments including blue whiting, ling, elephant fish, orange roughy and black oreo; in 2000 for Icelandic cod; and recently on the U.S. west coast for sablefish (Hilborn et al. 2001).

In Coleraine, recruitments are assumed to follow a Beverton-Holt spawner recruit curve with a lognormal penalty function for recruitment deviates (Hilborn et al. 2000, section 1.2.3); parameters are: average recruitment in the unfished state (R_0), steepness (h) - the fraction of recruitment obtained at 20% of virgin spawning biomass, and the standard deviation of annual recruitment residuals (Hilborn et al. 2000). In this stock assessment, the initial age composition was determined by assuming that the population was in equilibrium with a fixed, sex specific exploitation rate - U_{init}. (Hilborn et al. 2000, section 1.2.2)

As in the previous assessment, separate age structured models were constructed to analyze stock dynamics for the northern (LCN: US-Vancouver, Columbia) and southern (LCS: Eureka, Monterey, Conception) areas. To establish continuity between the previous and present assessments, the final data and parameter configuration for the northern area (LCN) model (derived in 2000) was implemented in Coleraine. The resulting estimates of female spawning biomass from Coleraine agreed well with the previous assessment results (Figure 19).

The following discussion covers the modeled data, model structure, and base model results; first for the northern area (LCN), followed by a discussion of the same topics for the southern area (LCS).

Lingcod-North (LCN): US-Vancouver and Columbia INPFC Areas

Model Description

List and Description of Likelihood Components in the LCN Model

The LCN model incorporated the following likelihood components, which are described mathematically in Hilborn et al.(2000); input data sources are specified by Table number:

12) Commercial Catch-At-Age: 1979-2002 (Table 7).
13) Recreational Catch-At-Age: 1980, 1986-2002 (Table 8).
14) Commercial Catch-At-Length: 1975-1978 (Table 11).
15) Recreational Catch-At-Length: 1981-1983 (Table 11).
16) NMFS Trawl Survey Catch-At-Age: 1992, 1995, 1998 and 2001 (Table 9).
17) NMFS Trawl Survey Catch-At-Length: 1986 and 1989 (Table 10)
18) WDFW Tag Survey Catch-At-Age: 1994-1997 (Table 9).
19) WDFW Tag Survey Catch-At-Length: 1986-1993 (Table 10).
20) NMFS Trawl Survey Biomass (mt): 1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, and 2001 (Table 18).
21) WDFW Tag Survey Abundance (Numbers of Fish): 1986-1992 (Table 19).
22) Trawl Fishery Logbook CPUE Index: Washington and Oregon lingcod CPUE estimates (lbs/hr) derived from a Delta GLM analysis of trawl logbook information, 1976-1997 (Table 21).

The NMFS Trawl Survey Biomass, WDFW Tag Survey Abundance, and Trawl Fishery Logbook CPUE Index likelihood components were fit under a lognormal error structure (Hilborn et al. 2000, section 1.4.2). The fishery and survey catch-at-age and catch-at-length likelihood components were fit assuming a robust lognormal for proportions (Hilborn et al. 2000, section 1.4.1). In addition to the likelihood components listed above, a likelihood penalty component was included which corresponded to prior assumptions about recruitment variability (Hilborn et al. 2000, section 1.4.3).

Base Model Configuration

The LCN base model assumed a Beverton-Holt stock-recruitment relationship with lognormal error structure (with a steepness parameter h = 0.9 and CV = 1.0) to constrain wide variations in recruitment (Hilborn et al. 2000, section 1.2.3). Selectivity for the commercial and recreational fisheries and the NMFS and WDFW surveys was parameterized by a curve formed from two normal distributions (Hilborn et al. 2000, section 1.2.6). Three parameters are used in this formulation: 1) an age where selectivity = 1.0 (Full), 2) a standard deviation on the left side to describe ascending selectivity (Left), and 3) a standard deviation on the right side to describe descending selectivity (Right). The model did not incorporate an explicit treatment of discards. Base model inputs including priors, likelihood specifications, and fixed parameter values are tabulated in Appendix I, Tables 1 and 2.

Model Selection and Evaluation

Model selection was conducted beginning essentially with the STAR Panel approved formulation from the previous assessment (Jagielo et al. 2000) and proceeded using a procedure where alternate models were evaluated for model fit to the data (using the Akaike Information Criterion (AIC) (Akaike 1972)), and plausibility.

The base LCN model described herein employs one-period (time invariant) commercial and recreational fishery selectivity with estimation of both the left and right side portions of the selectivity curve (dome shaped fishery selectivity). Time invariant age of full selectivity for each of the NMFS and WDFW survey data were estimated, however it was necessary to hold the left and right side selectivity parameters fixed to obtain stable model results. A summary of negative log likelihood values, and both estimated and fixed model parameters of the LCN base model is provided in Appendix I, Table 3.

Base-Run Results

Base run (dome shaped fishery selectivity) model results are presented in Appendix I, Tables 1-3 and Appendix I, Figures 1-10. The Coleraine estimate of B_0 for the northern area is 23952 mt. The estimate of female spawning biomass for 2003 is 6859 mt. It should be noted that the Coleraine estimate of depletion (0.29) can differ from the estimate obtained from the rebuilding analysis (Appendix II), because the rebuilding analysis computes B_0 using the average of recruitments from 1973-2002, while Coleraine uses the estimate of R_0 obtained in the model according to the formula provided in Hilborn et al.(2000). Additionally, the depletion values reported for Coleraine are with reference to 2003 spawning biomass, while those reported in the rebuilding analysis are with reference to 2002 spawning biomass.

Uncertainty and Sensitivity Analyses

Coleraine estimates of the standard deviation of all model parameters (dome shaped fishery selectivity) is provided in Table 3a1.

The results of model profiling over selected fixed values used in the assessment are included in Appendix I, Tables 3a-3e.

A series of base model runs were conducted to examine the effect of different values of the historical exploitation rate (U_{init}) (Appendix I Table 3a). This parameter, which is assumed at a fixed value of 0.09 in the model, is used to estimate the initial age composition of the model in 1973. The profile over U_{init} ranged from 0.03 to 0.15. The value of 0.09 was selected for the final base model, because it was used in the previous assessment, and is consistent with the observed landings prior to 1973.

The base model was also profiled over different fixed values of natural mortality (M) (Appendix I , Table 3b). The profile over M ranged from 0.14-0.22 for females, and 0.26-0.38 for males. The values of 0.18 (females) and 0.32 (males), as used in previous assessments, were chosen for use in the 2003 final base model.

An additional series of model runs were conducted where the effect of different fixed values of the Beverton-Holt stock-recruitment steepness parameter (*h*) was evaluated (Appendix I, Table

3c). The profile over *h* ranged from 0.5 to 0.9. This parameter was set at the fixed value of 0.9 in the final base model.

Base model profiles were also conducted using different combinations of the Beverton-Holt stock-recruitment steepness parameter (*h*) and natural mortality (M) (Table 3d), and different combinations of assumed asymptotic and dome shaped fishery selectivity (Table 3e).

A retrospective analysis was performed to compare the base model estimates of spawning biomass with a base model configured with 1999 as the end year (Appendix I, Figure 11a). The estimates of spawning biomass agreed well for the 1973-1999 time series.

An historic analysis was conducted by plotting the estimates of spawning biomass from the previous assessment (Jagielo et al. 2000) with the estimates of spawning biomass from the present assessment (Appendix I, Figure 11b). Both assessments showed a similar declining trend over the time series, with particularly close agreement since 1992.

Lingcod South (LCS): Eureka, Monterey, and Conception INPFC Areas

Model Description

List and Description of Likelihood Components in the LCS Model

The LCS model incorporated the following likelihood components, which are described mathematically in Hilborn et al. 2000; input data sources are specified by Table number:

1) Commercial Catch-At-Age: 1992-1998, 2000-2002 (Table 12).
2) Recreational Catch-At-Age: 1992-1998, 2000-2002 (Table 12).
3) NMFS Trawl Survey Catch-At-Age: 1995, 1998 and 2001 (Table 12).
4) NMFS Trawl Survey Biomass (mt): 1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, and 2001 (Table 18).
5) Trawl Fishery Logbook CPUE Index: Oregon and California lingcod CPUE estimates (lbs/hr) derived from a Delta GLM analysis of trawl logbook information, 1978-1997 (Table 22).

As for the northern model, the NMFS Trawl Survey Biomass and Trawl Fishery Logbook CPUE Index likelihood components for the southern model were fit under a lognormal error structure (Hilborn et al. 2000, section 1.4.2), and the fishery and survey catch-at-age and catch-at-length likelihood components were fit assuming a robust lognormal for proportions (Hilborn et al. 2000, section 1.4.1). In addition to the likelihood components listed above, a likelihood penalty component was included which corresponded to prior assumptions about recruitment variability (Hilborn et al. 2000, section 1.4.3).

Base Model Configuration

The southern (LCS) model was configured in a manner very similar to the northern (LCN) model. The LCS base model assumed a Beverton-Holt stock-recruitment relationship with lognormal error structure (with a steepness parameter *h* = 0.9 and CV = 1.0) to constrain wide variations in recruitment (Hilborn et al. 2000, section 1.2.3). Selectivity for the commercial and recreational fisheries and the NMFS survey was parameterized by a curve formed from two normal distributions (Hilborn et al. 2000, section 1.2.6). Three parameters are used in this formulation: 1) an age where selectivity = 1.0 (Full), 2) a standard deviation on the left side to describe ascending selectivity (Left), and 3) a standard deviation on the right side to describe descending selectivity (Right). The model did not incorporate an explicit treatment of discards. Base model inputs including priors, likelihood specifications, and fixed parameter values are tabulated in Appendix I, Tables 4 and 5.

Model Selection and Evaluation

Model selection was conducted beginning essentially with the STAR Panel approved formulation from the previous assessment (Jagielo et al. 2000) and proceeded using a procedure where alternate models were evaluated for model fit to the data (using the Akaike Information Criterion (AIC) (Akaike 1972)), and plausibility.

The base LCS model described herein employs one-period (time invariant) commercial and recreational fishery selectivity with estimation of left and right side portions of the selectivity curve. Compared to the northern (LCN) model, available data for the southern area are sparse. For the NMFS survey data, it was necessary to hold the age of full selectivity as well as left and right side selectivity parameters fixed to obtain stable model results. A summary of negative log likelihood values, and both estimated and fixed model parameters of the LCS base model is provided in Appendix I, Table 6.

Base-Run Results

Base run (dome shaped fishery selectivity) model results are presented in Appendix I, Tables 4-6 and Appendix I, Figures 12a-16. The Coleraine estimate of B_0 for the southern area is 23267 mt. The estimate of female spawning biomass for 2003 is 3806 mt. It should be noted that the Coleraine estimate of depletion (0.16) can differ from the estimate obtained from the rebuilding analysis (0.17)(Appendix II), because the rebuilding analysis computes B_0 using the average of recruitments from 1973-2002, while Coleraine uses the estimate of R_0 obtained in the model according to the formula provided in Hilborn et al.(2000). Additionally, the depletion values reported for Coleraine are with reference to 2003 spawning biomass, while those reported in the rebuilding analysis are with reference to 2002 spawning biomass.

Uncertainty and Sensitivity Analyses

Coleraine estimates of the standard deviation of all model parameters (dome shaped fishery selectivity) is provided in Table 6a1.

The results of model profiling over selected fixed values used in the assessment are included in Appendix I, Tables 6a-6e.

A series of base model runs were conducted to examine the effect of different values of the historical exploitation rate (U_{init}) (Appendix I Table 6a). This parameter, which is assumed at a fixed value of 0.07 in the model, is used to estimate the initial age composition of the model in 1973. The profile over U_{init} ranged from 0.03 to 0.10. The value of 0.07 was selected for the final base model, because it was used in the previous assessment, and is consistent with the observed landings prior to 1973.

The base model was also profiled over different fixed values of natural mortality (M) (Appendix I Table 6b). The profile over M ranged from 0.14-0.22 for females, and 0.26-0.38 for males. The values of 0.18 (females) and 0.32 (males), as used in previous assessments, were chosen for use in the 2003 final base model.

An additional series of model runs were conducted where the effect of different fixed values of the Beverton-Holt stock-recruitment steepness parameter (*h*) were evaluated (Appendix I Table 6c). This parameter was set at the fixed value of 0.9 in the model. The profile over *h* ranged from 0.5 to 0.9.

Base model profiles were also conducted using different combinations of the Beverton-Holt stock-recruitment steepness parameter (*h*) and natural mortality (M) (Table 6d), and different combinations of assumed asymptotic and dome shaped fishery selectivity (Table 6e).

An historic analysis was conducted by plotting the estimates of spawning biomass from the previous assessment (Jagielo et al, 2000) with the estimates of spawning biomass from the present assessment (Appendix I, Figure 17). Both assessments showed a declining trend over the time series and fairly close agreement in recent years; however, the present assessment shows a decline from substantially higher spawning stock size estimates early in the time series.

Coastwide Summary

Target Fishing Mortality Rates and Harvest Projections

As an overfished species with a rebuilding plan, target fishing mortality rates for lingcod are a function of alternative rebuilding trajectories, and are also constrained by the ABC rule. Six rebuilding analysis projections were produced using separate sets of information derived from the present stock assessment (Appendix II). The six rebuilding analysis input files were: 1) a pooled, coastwide asymptotic fishery selectivity model; 2) a pooled, coastwide domed fishery selectivity model, 3) separate northern and southern area asymptotic fishery selectivity models, and 4) separate northern and southern area domed fishery selectivity models. For both the asymptotic and domed fishery selectivity models, target fishing mortality and yield was constrained by the ABC rule. F_{45}% fishing mortality rates were 0.12 for the north, and 0.18 for the south (Appendix II, Table 1). Coastwide rebuilding yields for 2004-2008 (under the model assumption of asymptotic fishery selectivity) range from 1820 to 2053 mt**.** Coastwide rebuilding yields under the model assumption of dome shaped fishery selectivity range from 2041 to 2123 mt (Appendix II, Table 2).

Recommendations: Research and Data Needs

1) Emphasis should be placed on improving fishery age structure sampling size and geographical coverage in both regions.

2) More frequent and synoptic fishery independent surveys should be conducted in both regions to aid in determination of stock status and recent recruitment. Surveys of areas inaccessible to trawl survey gear should be conducted to address the issue of the habitat bias of trawl surveys.

3) In the southern region, CPFV observer project CPUE data should be analyzed (on a reef-specific basis) using a General Linear Model (GLM) analysis, and evaluated for use as an index of abundance.

4) Coastwide enumeration of at-sea discards (e.g. by an on-board observer program) is needed to properly account for total fishery mortality.

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Table 1. History of PFMC lingcod Acceptable Biological catches (ABC's), Harvest guidelines or Optimum yields (OT's) and landings. Source:PFMC SAFE 2001 document and personal communication with the PFMC Groundfish Management Team for most recent year's information.

	US Vancouver	Columbia	US Vancouver-Columbia		Eureka	Monterey	Conception	Eureka-Monterey-Conception		Coastwide		
Year	ABC	ABC	ABC	Landings	ABC	ABC	ABC	ABC	Landings	ABC	HG or OY	Harvest
1983	1,000	4,000	5,000	3,155	500	1,100	400	2,000	1,691	7,000		4,971
1984	1,000	4,000	5,000	3,163	500	1,100	400	2,000	1,555	7,000		4,719
1985	1,000	4,000	5,000	3,215	500	1,100	400	2,000	1,726	7,000		4,945
1986	1,000	4,000	5,000	1,396	500	1,100	400	2,000	1,517	7,000		2,934
1987	1,000	4,000	5,000	1,724	500	1,100	400	2,000	1,922	7,000		3,667
1988	1,000	4,000	5,000	1,763	500	1,100	400	2,000	2,044	7,000		3,930
1989	1,000	4,000	5,000	2,373	500	1,100	400	2,000	2,316	7,000		4,705
1990	1,000	4,000	5,000	1,868	500	1,100	400	2,000	1,966	7,000		3,845
1991	1,000	4,000	5,000	2,437	500	1,100	400	2,000	1,647	7,000		4,095
1992	1,000	4,000	5,000	1,391	500	1,100	400	2,000	1,467	7,000		2,870
1993	1,000	4,000	5,000	1,659	500	1,100	400	2,000	1,374	7,000		2,907
1994	1,000	4,000	5,000	1,449	500	1,100	400	2,000	1,091	7,000	4,000	2,424
1995			1,300	971	300	700	100	1,100	1,067	2,400	2,400	1,882
1996			1,300	1,120	300	700	100	1,100	937	2,400	2,400	2,070
1997			1,300	1,049	300	700	100	1,100	912	2,400	2,400	1,981
1998			1,021	225	139	325	46	510	496	1,532	838	707
1999			450	262	139	325	46	510	545	960	730	831
2000			450					250		700	378	446
2001			610					510		1,120	611	445
2002										745	577	873
2003										841	651	

Table 2. History of lingcod commercial trawl trip limits (thousand lbs) Source:PFMC SAFE 2001 document and personal communication with the PFMC Groundfish Management Team for most recent year's information. Note: Exception to commercial size limits: starting in 1996, trawl gear was allowed retention of 100 lb. at size less than minimum size limit.

<table>
<tr><th>Year</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>< 1995</td><td colspan="12">No trip limit regulations</td></tr>
<tr><td>1995</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td></tr>
<tr><td>1996</td><td colspan="2">40</td><td colspan="2">40</td><td colspan="2">40</td><td colspan="2">40</td><td colspan="2">40</td><td colspan="2">40</td></tr>
<tr><td>1997</td><td colspan="2">40</td><td colspan="2">40</td><td colspan="2">40</td><td colspan="2">40</td><td colspan="2">40</td><td colspan="2">40</td></tr>
<tr><td>1998</td><td colspan="2">1</td><td colspan="2">1</td><td colspan="2">1</td><td colspan="2">1</td><td colspan="2">1</td><td colspan="2">1</td></tr>
<tr><td>1999</td><td colspan="3">1.5</td><td colspan="3">1.5</td><td colspan="3">1</td><td>0.5</td><td>0.5</td><td>0.5</td></tr>
<tr><td>2000</td><td colspan="4">Prohibited</td><td>0.4</td><td>0.4</td><td>0.4</td><td>0.4</td><td>0.4</td><td>0.4</td><td colspan="2">Prohibited</td></tr>
<tr><td>2001</td><td colspan="4">Prohibited</td><td>0.4</td><td>0.4</td><td>0.4</td><td>0.4</td><td>0.4</td><td>0.5</td><td colspan="2">Prohibited</td></tr>
<tr><td>2002 [1/]</td><td colspan="2">0.8</td><td colspan="2">0.8</td><td colspan="2">1</td><td colspan="2">1</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td></tr>
<tr><td>2003</td><td colspan="2">0.8</td><td colspan="2">0.8</td><td colspan="2">1</td><td colspan="2">1</td><td colspan="2">0.8</td><td colspan="2">0.8</td></tr>
</table>

Prohibited Periods
Commercial size limit 0f 22" `1995-1997 then 24" thereafter
Gear restrictions for rockfish retention beginning in 2001
[1/] South of 40^0 10' lingcod prohibited beginning July 1st

Table 3. History of lingcod size limits (inches) and recreational bag limits (number of fish): Source: PFMC SAFE 2001 document and personal communication with the PFMC Groundfish Management Team for most recent year's information.

State	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
				Daily Bag Limits						
Washington	3	3	3	3	3	2	2	2	2	2
Oregon	3	3	3	3	3	2	2	2	2	2
California	5	5	5	5	5	2	2	2	2	2
				Size Limits (inches)						
Washington	none	22	22	22	24	24	24	24	24	24
Oregon	none	22	22	22	24	24	24	24	24	24
California 1/	none	22	22	22	24	24	26	26	22	22

1/ Beginning in 2000; South of 34^{0} 27' N. Lat lingcod prohibited January-February and South of Cape Mendencino and north of 34^{0} 27' N. Lat lingcod prohibited March-June

Table 4. Estimated commercial lingcod catch (mt) for California (1916-1955), Oregon (1950-1953) and Washington ()1935-1955).

Historical Commercial lingcod landings

Year	California 1/ Total (mt)	Oregon 2/ Total (mt)	Washington 3/ Total (mt)
1916	280		
1917	422		
1918	415		
1919	482		
1920	312		
1921	193		
1922	258		
1923	212		
1924	182		
1925	310		
1926	295		
1927	252		
1928	387		
1929	529		
1930	584		
1931	558		
1932	408		
1933	494		
1934	389		
1935	462		0
1936	344		0
1937	439		1
1938	293		0
1939	262		0
1940	314		10
1941	240		51
1942	143		41
1943	326		162
1944	338		523
1945	344		237
1946	524		229
1947	880		65
1948	933		132
1949	751		109
1950	869	312	92
1951	758	379	106
1952	620	224	93
1953	432	139	40
1954	430		66
1955	438		63
	428	264	106

1/ Leet et al. 1992. California's living marine resources and their utilization

1/ Forrester, 1973.

2/ "Fisheries Statistics for Oregon 1950-1953" author Harrison S. Smith

3/ Anonymous, 1955 WDF Commercial Fishing Statistical Report.

Table 5. Estimated commercial and recreational lingcod catch (mt) for northern (1916-1955) and southern areas (Eureka, Monterey and Conception), 1956 to 2002.

	Northern Area			Southern Area			
	U.S. Vancouver - Columbia			Eureka-Monterrey-Conception			Coastwide
Year	Commercial	Recreation	Total (mt)	Commercial	Recreation	Total (mt)	Total (mt)
1956	920		920	422	113	536	1,455
1957	1,000		1,000	744	114	858	1,858
1958	1,133		1,133	726	120	845	1,979
1959	1,863		1,863	638	94	732	2,594
1960	2,028		2,028	593	85	678	2,706
1961	1,875		1,875	653	70	724	2,599
1962	1,323		1,323	504	76	581	1,904
1963	938		938	514	83	597	1,534
1964	1,257		1,257	379	76	455	1,712
1965	1,538		1,538	369	100	469	2,006
1966	1,813		1,813	363	134	497	2,311
1967	1,244		1,244	426	131	557	1,800
1968	1,626		1,626	496	128	624	2,250
1969	1,148		1,148	505	98	603	1,751
1970	851		851	695		695	1,546
1971	1,009		1,009	952		952	1,961
1972	952		952	1,472		1,472	2,425
1973	1,326	76	1,402	1,615	403	2,018	3,420
1974	1,549	76	1,625	1,735	399	2,134	3,759
1975	2,019	85	2,104	1,447	429	1,876	3,981
1976	1,662	69	1,731	1,415	422	1,837	3,56[illegible]
1977	1,671	76	1,747	769	284	1,053	2,79[illegible]
1978	1,346	70	1,416	914	334	1,248	2,66[illegible]
1979	2,211	82	2,292	1,434	340	1,774	4,06[illegible]
1980	2,004	93	2,097	1,275	2,226	3,501	5,59[illegible]
1981	1,907	128	2,035	1,397	1,169	2,566	4,60[illegible]
1982	2,241	128	2,369	1,598	877	2,475	4,84[illegible]
1983	3,069	114	3,183	1,218	586	1,804	4,98[illegible]
1984	3,008	156	3,163	1,047	509	1,555	4,71[illegible]
1985	3,127	90	3,217	752	974	1,726	4,94[illegible]
1986	1,311	95	1,405	601	928	1,529	2,93[illegible]
1987	1,623	111	1,735	980	950	1,930	3,66[illegible]
1988	1,655	115	1,769	1,118	1,036	2,154	3,92[illegible]
1989	2,230	146	2,376	1,356	964	2,320	4,697
1990	1,746	123	1,869	1,187	781	1,968	3,837
1991	2,320	119	2,438	844	803	1,647	4,085
1992	1,207	185	1,392	676	792	1,468	2,860
1993	1,429	231	1,660	779	457	1,236	2,896
1994	1,215	236	1,451	691	270	962	2,412
1995	861	113	974	610	287	897	1,871
1996	1,004	121	1,125	559	376	935	2,060
1997	932	117	1,049	636	281	917	1,965
1998	152	73	225	198	267	465	690
1999	168	96	264	190	360	550	813
2000	71	80	150	71	206	277	427
2001	67	91	158	88	178	266	425
2002	94	127	221	108	524	632	852
				Average Catch			
1960's	1,479		1,479	480	98	578	2,057
1970's	1,459	76	1,513	1,245	373	1,506	3,019
1980's	2,218	117	2,335	1,134	1,022	2,156	4,491
1990-1997	1,339	156	1,495	748	506	1,254	2,748
1998-2000	110	93	204	131	307	438	642

Table 6. Estimated commercial lingcod catch (mt) by gear and INPFC area, 1981 to 2002.

U.S Vancouver INPFC Area - lingcod landings in metric tons								
Year	Hook&Line	Other	Net	Pot	Trolls	Trawls	Shrimp Trawl	Total
1981	65.3	0.0	26.6	0.0	53.5	368.8	1.3	515.5
1982	67.6	0.0	76.6	0.4	115.3	336.5	0.2	596.6
1983	36.6	0.0	119.7	0.0	201.3	820.4	18.4	1196.4
1984	63.9	0.0	131.3	3.0	201.5	1346.5	2.1	1748.3
1985	100.2	0.0	247.2	0.5	178.0	1326.2	1.5	1853.6
1986	50.3	0.0	0.0	0.0	70.8	447.8	6.1	575.0
1987	94.5	0.0	0.2	0.0	43.6	589.2	4.3	731.8
1988	69.0	0.0	0.2	0.0	74.9	478.0	0.4	622.5
1989	91.2	0.0	0.1	0.0	119.1	789.2	0.2	999.8
1990	139.9	0.0	0.0	0.0	85.0	762.4	0.5	987.8
1991	80.9	0.0	0.0	0.0	26.0	1345.2	0.3	1452.4
1992	54.6	0.0	0.0	0.0	31.4	469.6	0.1	555.7
1993	35.9	0.0	0.0	0.0	20.3	595.0	0.8	652.0
1994	34.8	0.0	0.0	0.0	21.2	472.7	1.4	530.1
1995	21.3	0.0	0.0	0.0	8.8	260.0	2.8	292.9
1996	35.2	0.0	0.0	0.0	5.8	319.5	4.7	365.2
1997	35.5	0.0	0.0	0.0	12.1	253.2	0.2	301.0
1998	8.4	0.0	0.0	0.0	2.2	39.3	0.0	49.9
1999	15.1	0.0	0.0	0.0	1.8	29.9	0.1	46.9
2000	10.5	0.0	0.0	0.0	3.3	8.1	0.0	21.9
2001	12.4	0.0	0.0	0.0	1.7	11.0	0.1	25.2
2002	10.4	0.0	0.0	0.0	1.9	29.9	0.0	42.2

Columbia INPFC Area - lingcod landings in metric tons								
Year	Hook&Line	Other	Net	Pot	Trolls	Trawls	Shrimp Trawl	Total
1981	27.2	0.8	45.5	3.5	29.2	1208.4	76.8	1391.4
1982	47.8	0.0	0.2	3.2	24.3	1497.9	71.0	1644.4
1983	37.0	0.2	10.8	2.1	31.5	1706.9	84.4	1872.9
1984	34.7	0.2	3.0	0.8	17.4	1154.2	49.1	1259.4
1985	53.8	0.0	0.0	1.4	43.3	1129.9	44.8	1273.2
1986	52.9	0.0	0.0	0.6	43.8	554.5	83.9	735.7
1987	80.7	0.1	0.0	0.7	20.3	715.8	73.9	891.5
1988	75.8	0.0	0.0	0.7	19.2	903.2	33.2	1032.1
1989	99.5	0.0	0.0	0.2	28.8	1053.8	48.2	1230.5
1990	62.4	0.0	0.0	0.1	11.6	662.5	21.7	758.3
1991	32.1	0.0	0.0	0.4	4.1	813.5	17.1	867.2
1992	55.1	0.0	0.0	0.1	8.8	571.8	15.3	651.1
1993	59.0	0.3	0.0	0.3	12.3	678.8	26.6	777.3
1994	102.4	0.0	0.0	1.0	5.8	534.5	41.5	685.2
1995	39.3	0.0	0.0	0.3	4.4	482.6	41.1	567.7
1996	48.4	0.0	0.0	0.2	5.9	555.1	28.7	638.3
1997	58.0	0.0	0.0	0.5	9.0	544.9	18.4	630.8
1998	10.7	0.0	0.0	0.3	3.0	81.3	7.1	102.4
1999	12.0	0.0	0.0	0.2	4.8	75.6	28.1	120.7
2000	7.1	0.0	0.0	0.1	6.1	20.8	14.7	48.8
2001	10.8	0.0	0.0	1.4	5.0	18.1	6.5	41.8
2002	8.4	0.0	0.0	0.9	2.9	33.4	6.2	51.8

Table 6 (continued). Estimated commercial lingcod catch (mt) by gear and INPFC area, 1981 to 2002.

Eureka INPFC Area - lingcod landings in metric tons

Year	Hook&Line	Other	Net	Pot	Trolls	Trawls	Shrimp Trawl	Total
1981	13.6	0.5	0.0	0.0	8.3	349.2	8.8	380.4
1982	15.2	2.4	0.0	0.4	12.9	510.9	12.8	554.6
1983	26.1	16.0	0.0	1.3	2.4	363.8	0.2	409.8
1984	5.2	15.4	0.0	0.2	3.4	262.8	1.0	288.0
1985	41.8	9.0	0.1	0.9	1.2	183.4	1.6	238.0
1986	81.6	16.7	0.0	1.8	8.5	95.1	3.5	207.2
1987	104.0	11.7	0.0	0.3	0.5	203.9	1.1	321.5
1988	106.8	22.1	0.0	0.3	0.3	179.7	3.1	312.3
1989	175.4	18.9	0.0	1.5	1.1	188.6	3.7	389.2
1990	173.6	8.8	0.0	0.3	4.1	231.6	3.4	421.8
1991	65.5	1.3	0.0	0.0	0.0	139.9	5.9	212.6
1992	59.3	1.8	0.0	0.1	0.0	105.0	3.7	169.9
1993	40.6	1.0	0.2	0.1	0.3	153.3	1.8	197.3
1994	53.8	0.7	0.3	0.2	0.2	160.3	12.5	228.0
1995	90.8	1.5	0.7	0.2	0.2	132.9	5.8	232.1
1996	73.9	0.0	0.0	0.2	2.8	118.0	8.5	203.4
1997	109.1	0.0	0.1	0.2	0.1	149.4	5.1	264.0
1998	40.4	0.2	0.0	0.2	0.6	56.8	1.0	99.2
1999	43.2	0.2	0.0	0.3	1.1	56.6	3.8	105.2
2000	21.7	0.0	0.0	0.4	0.3	19.6	0.5	42.5
2001	32.5	0.0	0.0	0.3	0.2	19.7	0.3	53.0
2002	38.3	0.0	0.0	1.1	0.1	23.5	0.1	63.1

Monterey INPFC Area - lingcod landings in metric tons

Year	Hook&Line	Other	Net	Pot	Trolls	Trawls	Shrimp Trawl	Total
1981	38.2	5.4	8.8	2.7	21.2	771.5	0.3	848.1
1982	22.2	16.1	49.5	1.3	14.9	737.1	0.0	841.1
1983	10.0	85.6	80.8	0.5	1.7	580.9	0.2	759.7
1984	3.4	160.0	25.6	0.0	1.0	547.3	0.0	737.3
1985	15.3	158.8	90.0	1.6	3.7	220.0	0.0	489.4
1986	52.5	91.7	90.9	2.1	0.7	128.3	0.0	366.2
1987	66.1	73.0	159.0	0.9	1.1	315.7	0.1	615.9
1988	99.1	63.5	274.4	2.8	1.4	299.3	0.0	740.5
1989	197.5	70.9	215.4	2.2	0.4	415.7	0.0	902.1
1990	153.6	48.8	176.0	1.1	8.9	318.7	0.0	707.1
1991	131.0	23.4	103.1	0.9	0.7	299.7	0.0	558.8
1992	128.4	35.2	85.5	0.7	1.0	190.6	0.0	441.4
1993	110.1	3.0	106.0	0.3	2.6	277.5	0.1	499.6
1994	84.1	3.1	72.1	0.3	12.4	224.4	0.5	396.9
1995	73.8	1.2	48.9	0.9	8.9	184.9	0.4	319.0
1996	93.1	0.5	7.6	1.2	4.8	205.6	0.9	313.7
1997	89.8	0.1	27.4	2.0	1.9	218.8	0.9	340.9
1998	30.4	0.1	3.7	8.9	0.4	35.9	0.3	79.7
1999	24.4	0.1	0.8	1.6	0.6	42.3	0.2	70.0
2000	10.3	0.0	3.3	0.2	0.4	10.7	0.2	25.1
2001	14.8	0.0	0.4	0.6	1.2	9.9	0.0	26.9
2002	18.3	0.1	0.0	0.2	0.7	15.4	0.1	34.8

Table 6 (continued). Estimated commercial lingcod catch (mt) by gear and INPFC area, 1981 to 2002.

Conception INPFC Area - lingcod landings in metric tons							Shrimp	
Year	**Hook&Line**	**Other**	**Net**	**Pot**	**Trolls**	**Trawls**	**Trawl**	**Total**
1981	5.3	0.1	10.4	0.5	1.4	149.2	1.7	168.6
1982	4.4	0.1	27.5	0.1	0.2	161.4	8.4	202.1
1983	0.9	0.5	4.8	0.0	0.1	41.9	0.3	48.5
1984	0.6	0.9	3.3	0.0	0.0	13.1	3.4	21.3
1985	1.1	3.2	9.6	0.0	0.0	10.6	0.3	24.8
1986	2.8	2.3	13.8	0.2	0.3	8.2	0.0	27.6
1987	6.2	3.3	17.1	0.2	0.7	14.9	0.0	42.4
1988	4.8	3.7	39.3	0.0	0.0	17.3	0.0	65.1
1989	4.3	4.3	34.4	0.5	0.0	21.5	0.0	65.0
1990	5.5	3.2	25.3	0.2	0.0	23.7	0.0	57.9
1991	11.0	2.9	43.8	0.1	0.0	14.7	0.0	72.5
1992	20.4	3.2	25.3	0.2	0.0	15.8	0.0	64.9
1993	24.8	2.6	44.1	0.1	0.0	10.0	0.0	81.6
1994	18.4	0.6	21.6	1.5	0.2	21.3	2.6	66.2
1995	27.8	0.4	8.1	3.1	0.2	17.0	2.2	58.8
1996	24.1	0.6	4.8	6.7	0.2	5.1	0.6	42.1
1997	17.4	0.0	2.4	5.2	0.1	5.1	0.4	30.6
1998	10.2	0.0	1.4	2.9	0.1	3.4	0.8	18.8
1999	10.3	0.0	0.4	2.1	0.0	1.5	0.2	14.5
2000	2.9	0.0	0.0	0.6	0.0	0.1	0.1	3.7
2001	5.8	0.0	0.3	1.2	0.0	0.8	0.1	8.2
2002	8.4	0.0	0.1	1.4	0.1	0.1	0.0	10.1

Table 6a. Estimates of lingcod discard, live and dead, in the recreational fishery by State.

MRFSS estimates of % lingcod catch (#'s of fish) that was discarded dead (B1 catches)

YEAR	SOUTHERN CALIFORNIA	NORTHERN CALIFORNIA	OREGON	WASHINGTON	ALL SUBREGIONS
1980	2%	36%	37%	40%	21%
1981	11%	23%	18%	140%	31%
1982	12%	10%	14%	126%	23%
1983	13%	7%	43%	57%	19%
1984	8%	6%	7%	33%	8%
1985	18%	6%	8%	45%	10%
1986	5%	12%	17%	150%	13%
1987	25%	16%	18%	106%	23%
1988	60%	44%	3%	1100%	45%
1989	5%	24%	2%	100%	17%
1993	50%	12%	na	na	9%
1994	13%	6%	na	na	3%
1995	14%	6%	na	na	4%
1996	0%	12%	na	na	8%
1997	0%	1%	na	na	1%
1998	0%	9%	na	na	6%
1999	0%	7%	na	na	5%
2000	0%	10%	na	na	6%
2001	0%	14%	na	na	7%
2002	20%	5%	na	na	14%
2003	0%	0%	na	na	7%

MRFSS estimates of % lingcod catch (#'s of fish) that was discarded live (B2 catches)

YEAR	SOUTHERN CALIFORNIA	NORTHERN CALIFORNIA	OREGON	WASHINGTON	SUBREGIONS
1980	6%	4%	0%	0%	5%
1981	35%	7%	4%	37%	12%
1982	16%	14%	6%	23%	12%
1983	31%	12%	17%	10%	14%
1984	27%	13%	0%	22%	13%
1985	59%	10%	0%	9%	16%
1986	162%	35%	0%	0%	59%
1987	107%	38%	2%	29%	46%
1988	122%	39%	3%	0%	52%
1989	70%	39%	2%	0%	38%
1993	117%	57%	57%	na	52%
1994	88%	61%	41%	na	45%
1995	157%	65%	58%	na	60%
1996	400%	46%	83%	na	68%
1997	75%	78%	477%	na	163%
1998	250%	81%	767%	na	220%
1999	378%	73%	76%	na	89%
2000	1867%	428%	253%	na	397%
2001	1733%	590%	147%	na	514%
2002	1224%	271%	95%	57%	374%
2003	3100%	167%	200%		387%

Note: the 2002 Washington estimate is derived from data collected by WDFW.

Table 7. Commercial fishery lingcod age composition used in the northern (LCN) model.

Fishery	Year	Tot. No.Fish	Female Proportion-at-age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Com	1979	694	0.000	0.003	0.004	0.015	0.031	0.052	0.094	0.207	0.236	0.145	0.050	0.018	0.017	0.017	0.030	0.031	0.006	0.000	0.000	0.000
Com	1980	1853	0.000	0.004	0.019	0.029	0.051	0.113	0.120	0.128	0.134	0.087	0.049	0.038	0.025	0.015	0.015	0.008	0.006	0.002	0.000	0.001
Com	1981	1325	0.000	0.007	0.053	0.070	0.067	0.059	0.073	0.073	0.085	0.119	0.050	0.013	0.012	0.006	0.009	0.000	0.000	0.000	0.000	0.000
Com	1982	469	0.000	0.013	0.039	0.093	0.124	0.160	0.136	0.067	0.037	0.052	0.054	0.010	0.030	0.000	0.009	0.009	0.000	0.001	0.000	0.000
Com	1983	443	0.000	0.019	0.110	0.137	0.161	0.085	0.052	0.044	0.021	0.018	0.037	0.039	0.020	0.014	0.011	0.008	0.014	0.005	0.003	0.003
Com	1984	339	0.000	0.000	0.036	0.121	0.206	0.196	0.080	0.048	0.022	0.016	0.010	0.018	0.013	0.001	0.001	0.001	0.001	0.000	0.000	0.000
Com	1985	312	0.000	0.000	0.002	0.040	0.101	0.235	0.285	0.078	0.077	0.040	0.016	0.009	0.016	0.000	0.008	0.000	0.000	0.000	0.000	0.000
Com	1986	663	0.000	0.003	0.026	0.069	0.106	0.147	0.160	0.156	0.084	0.054	0.043	0.018	0.006	0.012	0.018	0.004	0.005	0.006	0.000	0.000
Com	1987	741	0.000	0.008	0.046	0.085	0.127	0.172	0.137	0.104	0.102	0.041	0.015	0.005	0.001	0.003	0.001	0.003	0.004	0.000	0.001	0.000
Com	1988	821	0.000	0.031	0.144	0.064	0.097	0.101	0.079	0.094	0.058	0.045	0.022	0.013	0.007	0.000	0.000	0.000	0.000	0.005	0.003	0.000
Com	1989	786	0.000	0.004	0.120	0.309	0.161	0.075	0.048	0.024	0.022	0.017	0.008	0.000	0.008	0.000	0.001	0.000	0.000	0.000	0.001	0.000
Com	1990	887	0.000	0.013	0.041	0.179	0.167	0.088	0.072	0.049	0.032	0.021	0.036	0.004	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1991	999	0.000	0.034	0.082	0.119	0.199	0.157	0.099	0.057	0.032	0.028	0.011	0.013	0.006	0.000	0.007	0.000	0.001	0.002	0.000	0.000
Com	1992	1140	0.000	0.175	0.142	0.119	0.085	0.071	0.083	0.042	0.026	0.010	0.015	0.009	0.000	0.004	0.008	0.001	0.000	0.000	0.000	0.000
Com	1993	1022	0.000	0.116	0.173	0.100	0.102	0.071	0.135	0.032	0.010	0.073	0.004	0.015	0.006	0.002	0.005	0.000	0.001	0.000	0.000	0.000
Com	1994	1034	0.000	0.107	0.308	0.194	0.095	0.039	0.019	0.025	0.011	0.006	0.002	0.003	0.001	0.001	0.004	0.000	0.000	0.000	0.000	0.000
Com	1995	1093	0.000	0.021	0.187	0.347	0.144	0.055	0.018	0.004	0.007	0.003	0.003	0.002	0.000	0.000	0.001	0.006	0.000	0.000	0.000	0.000
Com	1996	820	0.000	0.058	0.124	0.266	0.276	0.058	0.043	0.027	0.012	0.008	0.008	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000
Com	1997	673	0.000	0.028	0.165	0.200	0.159	0.135	0.041	0.032	0.020	0.033	0.024	0.001	0.002	0.003	0.008	0.002	0.000	0.002	0.000	0.000
Com	1998	706	0.000	0.023	0.224	0.269	0.155	0.081	0.041	0.018	0.007	0.004	0.001	0.001	0.003	0.000	0.001	0.000	0.001	0.000	0.000	0.000
Com	1999	750	0.000	0.011	0.087	0.247	0.223	0.105	0.064	0.049	0.027	0.007	0.002	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Com	2000	310	0.000	0.003	0.057	0.136	0.273	0.147	0.064	0.035	0.030	0.015	0.004	0.009	0.005	0.000	0.003	0.000	0.000	0.000	0.000	0.000
Com	2001	548	0.000	0.031	0.079	0.151	0.142	0.155	0.099	0.027	0.026	0.015	0.003	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2002	694	0.000	0.021	0.135	0.138	0.098	0.091	0.060	0.050	0.022	0.026	0.004	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-age																			
Com	1979	694	0.000	0.001	0.003	0.005	0.018	0.007	0.008	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1980	1853	0.000	0.000	0.009	0.014	0.031	0.053	0.018	0.016	0.009	0.001	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1981	1325	0.000	0.001	0.010	0.045	0.048	0.060	0.064	0.050	0.020	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1982	469	0.000	0.004	0.013	0.016	0.044	0.025	0.032	0.019	0.010	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1983	443	0.000	0.005	0.034	0.061	0.077	0.015	0.002	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1984	339	0.000	0.000	0.003	0.030	0.034	0.094	0.052	0.003	0.006	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1985	312	0.000	0.000	0.000	0.016	0.015	0.015	0.044	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1986	663	0.000	0.005	0.005	0.013	0.019	0.025	0.004	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1987	741	0.000	0.007	0.020	0.008	0.044	0.033	0.023	0.006	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1988	821	0.000	0.020	0.050	0.050	0.033	0.008	0.005	0.004	0.004	0.030	0.008	0.016	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000
Com	1989	786	0.000	0.001	0.066	0.076	0.024	0.019	0.010	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1990	887	0.000	0.006	0.041	0.106	0.066	0.026	0.026	0.004	0.013	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1991	999	0.000	0.027	0.018	0.032	0.029	0.018	0.015	0.008	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1992	1140	0.000	0.074	0.072	0.017	0.013	0.014	0.005	0.008	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1993	1022	0.000	0.050	0.051	0.040	0.006	0.002	0.004	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1994	1034	0.000	0.024	0.091	0.047	0.013	0.002	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1995	1093	0.000	0.009	0.052	0.107	0.028	0.002	0.002	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1996	820	0.000	0.011	0.038	0.025	0.018	0.011	0.000	0.003	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1997	673	0.000	0.014	0.068	0.022	0.023	0.011	0.006	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1998	706	0.000	0.005	0.064	0.045	0.018	0.019	0.013	0.003	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1999	750	0.000	0.005	0.032	0.046	0.041	0.015	0.021	0.007	0.004	0.003	0.002	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000
Com	2000	310	0.000	0.000	0.013	0.023	0.107	0.054	0.010	0.009	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2001	548	0.000	0.014	0.015	0.069	0.062	0.048	0.028	0.017	0.011	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2002	694	0.000	0.031	0.069	0.069	0.062	0.018	0.044	0.015	0.015	0.013	0.007	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 8. Recreational fishery lingcod age composition used in the northern (LCN) model.

Fishery	Year	Tot. No.Fish	Female Proportion-at-age 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Rec	1980	226	0.000	0.004	0.022	0.022	0.018	0.031	0.049	0.009	0.013	0.013	0.009	0.000	0.004	0.013	0.004	0.000	0.000	0.000	0.000	0.000
Rec	1986	341	0.000	0.003	0.015	0.056	0.062	0.053	0.062	0.062	0.050	0.032	0.026	0.018	0.012	0.009	0.009	0.003	0.006	0.006	0.003	0.000
Rec	1987	274	0.000	0.018	0.018	0.062	0.077	0.036	0.033	0.036	0.018	0.015	0.004	0.000	0.007	0.004	0.004	0.000	0.000	0.000	0.000	0.004
Rec	1988	250	0.004	0.044	0.112	0.044	0.024	0.008	0.004	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1989	227	0.000	0.013	0.044	0.062	0.040	0.031	0.040	0.013	0.013	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1990	207	0.005	0.019	0.029	0.068	0.063	0.034	0.010	0.000	0.010	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1991	247	0.000	0.004	0.065	0.040	0.032	0.077	0.057	0.012	0.028	0.012	0.012	0.016	0.012	0.004	0.016	0.008	0.016	0.000	0.000	0.000
Rec	1992	499	0.000	0.048	0.070	0.068	0.048	0.044	0.030	0.024	0.014	0.010	0.004	0.006	0.004	0.002	0.002	0.000	0.000	0.000	0.000	0.000
Rec	1993	530	0.002	0.049	0.096	0.081	0.049	0.038	0.023	0.015	0.006	0.008	0.002	0.002	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.000
Rec	1994	449	0.000	0.009	0.076	0.114	0.085	0.085	0.024	0.011	0.007	0.009	0.009	0.004	0.011	0.000	0.000	0.002	0.002	0.000	0.000	0.000
Rec	1995	643	0.000	0.005	0.042	0.096	0.106	0.059	0.058	0.019	0.012	0.006	0.005	0.002	0.000	0.002	0.002	0.000	0.002	0.000	0.000	0.000
Rec	1996	461	0.000	0.007	0.098	0.143	0.117	0.069	0.048	0.015	0.013	0.007	0.004	0.002	0.000	0.002	0.004	0.000	0.000	0.000	0.000	0.000
Rec	1997	446	0.000	0.007	0.087	0.108	0.092	0.085	0.029	0.020	0.009	0.004	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1998	416	0.002	0.007	0.067	0.147	0.127	0.079	0.067	0.024	0.019	0.002	0.002	0.007	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1999	609	0.000	0.000	0.053	0.138	0.149	0.085	0.053	0.033	0.011	0.003	0.003	0.002	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Rec	2000	610	0.000	0.002	0.036	0.110	0.159	0.098	0.079	0.028	0.011	0.005	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2001	961	0.000	0.000	0.019	0.087	0.149	0.134	0.083	0.040	0.020	0.011	0.007	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2002	1098	0.000	0.001	0.054	0.160	0.147	0.095	0.074	0.036	0.015	0.015	0.011	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-age																			
Rec	1980	226	0.000	0.009	0.080	0.146	0.173	0.142	0.137	0.049	0.040	0.009	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1986	341	0.000	0.006	0.053	0.100	0.059	0.041	0.053	0.067	0.044	0.029	0.018	0.021	0.006	0.006	0.006	0.003	0.000	0.003	0.003	0.000
Rec	1987	274	0.000	0.091	0.113	0.109	0.109	0.073	0.073	0.044	0.015	0.015	0.000	0.015	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1988	250	0.000	0.216	0.372	0.080	0.056	0.020	0.004	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1989	227	0.000	0.044	0.194	0.220	0.123	0.057	0.035	0.031	0.018	0.009	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1990	207	0.000	0.034	0.135	0.242	0.237	0.072	0.019	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000
Rec	1991	247	0.000	0.028	0.113	0.109	0.069	0.126	0.028	0.065	0.012	0.012	0.012	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.004	0.000
Rec	1992	499	0.002	0.072	0.166	0.124	0.092	0.080	0.052	0.014	0.012	0.004	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1993	530	0.000	0.070	0.230	0.138	0.075	0.038	0.025	0.021	0.004	0.013	0.011	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1994	449	0.002	0.024	0.151	0.156	0.078	0.049	0.029	0.027	0.013	0.004	0.011	0.002	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1995	643	0.000	0.014	0.082	0.221	0.134	0.075	0.023	0.012	0.011	0.006	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.003	0.000
Rec	1996	461	0.000	0.007	0.087	0.111	0.121	0.078	0.028	0.024	0.002	0.002	0.007	0.000	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Rec	1997	446	0.000	0.013	0.099	0.173	0.110	0.067	0.056	0.004	0.013	0.007	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1998	416	0.000	0.010	0.058	0.120	0.127	0.065	0.041	0.022	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1999	609	0.000	0.000	0.048	0.128	0.123	0.087	0.043	0.021	0.010	0.000	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2000	610	0.000	0.002	0.034	0.077	0.148	0.108	0.054	0.026	0.007	0.003	0.003	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2001	961	0.000	0.002	0.016	0.083	0.106	0.114	0.058	0.034	0.020	0.009	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2002	1098	0.000	0.000	0.028	0.100	0.118	0.066	0.045	0.020	0.006	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 9. NMFS Trawl Survey and WDFW Cape Flattery survey age composition used in the northern (LCN) model.

Survey	Year	Tot. No.Fish	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Female Proportion-at-age																			
NMFS	1992	74	0.068	0.149	0.149	0.135	0.014	0.054	0.014	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000
NMFS	1995	208	0.091	0.101	0.207	0.130	0.058	0.043	0.019	0.005	0.005	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	1998	367	0.114	0.101	0.120	0.112	0.109	0.090	0.049	0.014	0.003	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	2001	563	0.108	0.206	0.121	0.036	0.021	0.027	0.027	0.025	0.016	0.012	0.004	0.002	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-age																			
NMFS	1992	74	0.054	0.203	0.027	0.027	0.014	0.054	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	1995	208	0.043	0.067	0.077	0.058	0.034	0.029	0.014	0.005	0.000	0.000	0.005	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000
NMFS	1998	367	0.065	0.068	0.084	0.030	0.019	0.005	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	2001	563	0.085	0.171	0.091	0.021	0.005	0.005	0.005	0.004	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Female Proportion-at-age																			
WDFW	1994	100	0.000	0.000	0.000	0.040	0.150	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1995	281	0.000	0.107	0.053	0.046	0.018	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1996	511	0.022	0.147	0.104	0.051	0.012	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1997	498	0.010	0.197	0.139	0.024	0.010	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-age																			
WDFW	1994	100	0.000	0.000	0.000	0.280	0.420	0.080	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1995	281	0.000	0.206	0.185	0.295	0.060	0.014	0.007	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1996	511	0.031	0.319	0.225	0.070	0.012	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1997	498	0.014	0.309	0.227	0.046	0.014	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table10. NMFS Trawl Survey and WDFW Cape Flattery survey size composition data (cm) used in the northern (LCN) model.

Survey	Year	Tot. No.Fish	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70
			Female Proportion-at-size (cm)																					
NMFS	1986	220	0.000	0.000	0.000	0.001	0.007	0.005	0.014	0.002	0.006	0.010	0.000	0.000	0.000	0.001	0.017	0.000	0.010	0.053	0.011	0.029	0.108	0.010
NMFS	1989	470	0.001	0.000	0.003	0.038	0.019	0.020	0.003	0.000	0.008	0.039	0.006	0.020	0.002	0.002	0.012	0.009	0.026	0.061	0.034	0.061	0.060	0.013
			Male Proportion-at-size (cm)																					
NMFS	1986	220	0.000	0.001	0.000	0.022	0.003	0.009	0.002	0.001	0.000	0.000	0.012	0.001	0.000	0.005	0.006	0.031	0.066	0.022	0.003	0.012	0.028	0.051
NMFS	1989	470	0.020	0.000	0.002	0.003	0.008	0.002	0.001	0.000	0.000	0.025	0.016	0.039	0.004	0.005	0.008	0.012	0.009	0.040	0.043	0.039	0.012	0.003
			Female Proportion-at-size (cm)																					
WDFW	1986	484	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.006	0.006	0.004	0.008	0.008	0.010	0.014	0.008	0.025	0.000	0.006	0.002	0.004
WDFW	1987	542	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.011	0.022	0.013	0.022	0.006	0.006	0.006	0.011	0.009	0.011	0.011	0.006	0.011	0.004	0.006
WDFW	1988	978	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.002	0.009	0.015	0.028	0.028	0.021	0.009	0.005	0.005	0.006	0.004	0.000
WDFW	1989	964	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.006	0.004	0.001	0.001	0.008	0.012	0.007	0.007	0.016	0.018	0.012	0.010	0.003
WDFW	1990	971	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.020	0.041	0.014	0.014	0.004	0.011	0.028	0.028	0.009	0.007	0.005	0.009	0.007	0.009
WDFW	1991	1017	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.017	0.024	0.010	0.010	0.013	0.025	0.036	0.029	0.013	0.007	0.005	0.011	0.003	0.004
WDFW	1992	1003	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.015	0.027	0.038	0.011	0.008	0.014	0.034	0.024	0.021	0.013	0.017	0.009	0.005	0.003	0.005
WDFW	1993		0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.015	0.024	0.040	0.030	0.012	0.013	0.019	0.025	0.026	0.012	0.005	0.006	0.003	0.003	0.003
			Male Proportion-at-size (cm)																					
WDFW	1986	484	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.029	0.017	0.045	0.056	0.089	0.085	0.066	0.103	0.058	0.074	0.074	0.029	0.029	0.019
WDFW	1987	542	0.000	0.000	0.000	0.000	0.000	0.006	0.020	0.042	0.046	0.031	0.015	0.018	0.054	0.066	0.055	0.089	0.083	0.089	0.057	0.042	0.031	0.028
WDFW	1988	978	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.017	0.045	0.102	0.137	0.131	0.072	0.043	0.049	0.044	0.049	0.040	0.021	0.021
WDFW	1989	964	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.004	0.015	0.017	0.015	0.015	0.032	0.058	0.141	0.150	0.150	0.103	0.054	0.025	0.025	0.022
WDFW	1990	971	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.024	0.037	0.039	0.020	0.019	0.036	0.050	0.044	0.025	0.062	0.080	0.115	0.071	0.051	0.016
WDFW	1991	1017	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.017	0.060	0.052	0.026	0.045	0.085	0.102	0.076	0.043	0.043	0.040	0.033	0.048	0.034	0.033
WDFW	1992	1003	0.000	0.000	0.001	0.000	0.000	0.011	0.028	0.080	0.103	0.060	0.029	0.044	0.074	0.077	0.067	0.039	0.027	0.021	0.022	0.013	0.013	0.012
WDFW	1993		0.000	0.000	0.000	0.000	0.000	0.002	0.027	0.084	0.114	0.107	0.062	0.059	0.069	0.076	0.047	0.032	0.017	0.022	0.014	0.007	0.003	0.003

Survey	Year	Tot. No.Fish	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
			Female Proportion-at-size (cm)																			
NMFS	1986	220	0.012	0.050	0.033	0.096	0.023	0.026	0.013	0.026	0.026	0.012	0.001	0.026	0.000	0.007	0.013	0.000	0.000	0.000	0.000	0.006
NMFS	1989	470	0.027	0.014	0.007	0.015	0.010	0.011	0.017	0.003	0.017	0.006	0.014	0.023	0.005	0.001	0.006	0.002	0.003	0.005	0.000	0.003
			Male Proportion-at-size (cm)																			
NMFS	1986	220	0.022	0.010	0.001	0.012	0.028	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	1989	470	0.018	0.052	0.000	0.003	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Female Proportion-at-size (cm)																			
WDFW	1986	484	0.002	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1987	542	0.007	0.006	0.000	0.002	0.000	0.004	0.000	0.000	0.000	0.002	0.002	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1988	978	0.004	0.006	0.005	0.006	0.002	0.003	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
WDFW	1989	964	0.002	0.002	0.002	0.003	0.001	0.003	0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001
WDFW	1990	971	0.014	0.012	0.014	0.004	0.002	0.000	0.002	0.000	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1991	1017	0.004	0.001	0.001	0.002	0.003	0.001	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1992	1003	0.002	0.003	0.001	0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1993		0.000	0.002	0.000	0.002	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-size (cm)																			
WDFW	1986	484	0.029	0.019	0.019	0.010	0.010	0.000	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1987	542	0.013	0.015	0.002	0.009	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1988	978	0.024	0.011	0.007	0.007	0.001	0.002	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1989	964	0.016	0.017	0.004	0.004	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1990	971	0.009	0.009	0.012	0.004	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1991	1017	0.020	0.005	0.006	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1992	1003	0.011	0.009	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WDFW	1993		0.002	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 11 Commercial and Recreational fishery size composition data (cm) used in the northern (LCN) model.

Fishery	Year	Tot. No.Fish	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70
			Female Proportion-at-size (cm)																					
Com	1975	146	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.002	0.001	0.003	0.003	0.007	0.007	0.011	0.021	0.021	0.033
Com	1976	483	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.006	0.010	0.019	0.015	0.023	0.023	0.039
Com	1977	262	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1978	223	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.001	0.006	0.000	0.018	0.091	0.041	0.037	0.035	0.014	0.011
			Male Proportion-at-size (cm)																					
Com	1975	146	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.002	0.003	0.003	0.008	0.011	0.017	0.037	0.053	0.069	0.053
Com	1976	483	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.004	0.004	0.002	0.013	0.010	0.023	0.037	0.043
Com	1977	262	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1978	223	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.022	0.006	0.011	0.028	0.001	0.000	0.000
			Female Proportion-at-size (cm)																					
Rec	1981	98	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.010	0.000	0.000	0.000	0.010	0.010	0.000	0.000	0.000	0.010
Rec	1982	72	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.014	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1983	39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.026	0.000	0.051	0.000	0.000	0.026	0.000	0.000	0.000	0.026	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-size (cm)																					
Rec	1981	98	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.000	0.020	0.000	0.020	0.082	0.061	0.102	0.071	0.071	0.041	0.071	0.031	0.031	0.133
Rec	1982	72	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.014	0.014	0.000	0.014	0.069	0.069	0.097	0.097	0.111	0.083	0.014	0.069	0.042	0.069
Rec	1983	39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.026	0.051	0.000	0.026	0.000	0.000	0.051	0.000	0.128	0.103	0.051	0.128	0.026	0.103	0.000

Fishery	Year	Tot. No.Fish	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
			Female Proportion-at-size (cm)																			
Com	1975	146	0.058	0.075	0.078	0.049	0.038	0.030	0.027	0.017	0.012	0.014	0.017	0.012	0.013	0.011	0.009	0.003	0.005	0.002	0.002	0.003
Com	1976	483	0.042	0.076	0.065	0.083	0.060	0.069	0.047	0.043	0.033	0.016	0.014	0.008	0.025	0.021	0.008	0.004	0.002	0.002	0.004	0.008
Com	1977	262	0.008	0.008	0.011	0.004	0.023	0.053	0.069	0.088	0.038	0.073	0.050	0.042	0.023	0.050	0.073	0.042	0.061	0.061	0.050	0.172
Com	1978	223	0.011	0.025	0.014	0.030	0.002	0.032	0.023	0.025	0.055	0.099	0.037	0.055	0.051	0.032	0.022	0.054	0.023	0.037	0.004	0.017
			Male Proportion-at-size (cm)																			
Com	1975	146	0.052	0.033	0.022	0.016	0.009	0.008	0.002	0.002	0.002	0.002	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Com	1976	483	0.039	0.017	0.014	0.012	0.004	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1977	262	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1978	223	0.000	0.006	0.011	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Female Proportion-at-size (cm)																			
Rec	1981	98	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.010	0.000	0.000	0.000
Rec	1982	72	0.000	0.000	0.000	0.000	0.014	0.000	0.014	0.000	0.014	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1983	39	0.000	0.000	0.000	0.026	0.051	0.051	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-size (cm)																			
Rec	1981	98	0.031	0.031	0.000	0.051	0.031	0.010	0.010	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1982	72	0.014	0.028	0.028	0.000	0.000	0.028	0.000	0.014	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1983	39	0.000	0.026	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 12. Age composition of fisheries and surveys used in the southern (LCS) model.

Fishery	Year	Tot. No.Fish	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Female Proportion-at-age																			
Com	1992	289	0.000	0.138	0.289	0.091	0.041	0.041	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1993	787	0.000	0.267	0.301	0.083	0.034	0.012	0.009	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1994	538	0.000	0.088	0.241	0.135	0.041	0.047	0.017	0.005	0.023	0.001	0.011	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1995	267	0.000	0.016	0.079	0.261	0.107	0.068	0.033	0.014	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1996	302	0.000	0.028	0.226	0.138	0.097	0.104	0.019	0.005	0.004	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1997	728	0.000	0.031	0.173	0.198	0.160	0.053	0.055	0.033	0.009	0.008	0.001	0.001	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000
Com	1998	287	0.000	0.053	0.253	0.142	0.055	0.000	0.145	0.073	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2000	61	0.000	0.000	0.000	0.048	0.286	0.000	0.333	0.095	0.000	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2001	262	0.000	0.000	0.111	0.250	0.083	0.167	0.000	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2002	249	0.000	0.011	0.055	0.313	0.168	0.127	0.050	0.022	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-age																			
Com	1992	289	0.000	0.092	0.120	0.079	0.063	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1993	787	0.000	0.076	0.077	0.064	0.023	0.037	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1994	538	0.000	0.082	0.147	0.081	0.032	0.024	0.012	0.001	0.007	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1995	267	0.000	0.002	0.101	0.194	0.080	0.027	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1996	302	0.000	0.038	0.126	0.075	0.056	0.048	0.021	0.009	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1997	728	0.000	0.036	0.126	0.083	0.000	0.013	0.000	0.000	0.000	0.005	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	1998	287	0.000	0.000	0.093	0.036	0.038	0.019	0.019	0.019	0.036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2000	61	0.000	0.000	0.000	0.048	0.095	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2001	262	0.000	0.000	0.056	0.083	0.194	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Com	2002	249	0.000	0.000	0.024	0.037	0.066	0.032	0.033	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Female Proportion-at-age																			
Rec	1992	49	0.000	0.000	0.020	0.061	0.020	0.082	0.000	0.041	0.041	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1993	294	0.000	0.024	0.156	0.173	0.099	0.065	0.041	0.037	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1994	196	0.000	0.010	0.107	0.133	0.117	0.082	0.051	0.046	0.015	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1995	525	0.000	0.006	0.053	0.215	0.114	0.040	0.029	0.013	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1996	545	0.002	0.007	0.110	0.110	0.180	0.101	0.040	0.020	0.013	0.004	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1997	212	0.000	0.000	0.052	0.151	0.118	0.085	0.038	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1998	70	0.000	0.000	0.014	0.114	0.214	0.086	0.100	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2000	48	0.000	0.000	0.000	0.083	0.125	0.104	0.063	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2001	396	0.000	0.000	0.000	0.040	0.114	0.149	0.093	0.056	0.043	0.028	0.008	0.005	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2002	409	0.000	0.000	0.010	0.049	0.144	0.095	0.095	0.059	0.020	0.017	0.005	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-age																			
Rec	1992	49	0.000	0.082	0.102	0.184	0.122	0.082	0.061	0.082	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1993	294	0.000	0.020	0.136	0.116	0.054	0.031	0.014	0.007	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1994	196	0.000	0.010	0.082	0.184	0.082	0.046	0.020	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1995	525	0.002	0.010	0.091	0.261	0.080	0.055	0.013	0.008	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1996	545	0.000	0.002	0.095	0.088	0.138	0.055	0.022	0.007	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1997	212	0.000	0.000	0.075	0.222	0.123	0.104	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	1998	70	0.000	0.000	0.014	0.129	0.129	0.100	0.057	0.000	0.014	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2000	48	0.000	0.000	0.000	0.104	0.167	0.146	0.083	0.042	0.042	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2001	396	0.000	0.000	0.003	0.040	0.111	0.162	0.073	0.040	0.020	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rec	2002	409	0.000	0.000	0.017	0.071	0.178	0.115	0.081	0.032	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Survey	Year	Tot. No.Fish	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Female Proportion-at-age																			
NMFS	1995	208	0.260	0.168	0.048	0.034	0.024	0.014	0.005	0.000	0.010	0.005	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	1998	221	0.226	0.231	0.072	0.027	0.032	0.018	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	2001	197	0.183	0.274	0.056	0.005	0.036	0.010	0.010	0.010	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
			Male Proportion-at-age																			
NMFS	1995	208	0.163	0.178	0.014	0.019	0.014	0.024	0.000	0.010	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	1998	221	0.122	0.149	0.036	0.036	0.018	0.018	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NMFS	2001	197	0.157	0.157	0.061	0.005	0.010	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000

Table 13. Lingcod length, weight, and fraction mature at age data used in the northern (LCN) model.

Males					
	Length		Weight		Fraction
Age	(Cm.)	(In.)	(Kg.)	(Lbs.)	Mature
1	42.0	16.5	0.65	1.4	0.17
2	48.9	19.3	1.07	2.4	0.37
3	54.9	21.6	1.54	3.4	0.63
4	60.0	23.6	2.06	4.5	0.83
5	64.4	25.4	2.58	5.7	0.93
6	68.2	26.8	3.11	6.8	0.98
7	71.5	28.1	3.61	8.0	0.99
8	74.3	29.2	4.09	9.0	1.00
9	76.7	30.2	4.54	10.0	1.00
10	78.8	31.0	4.95	10.9	1.00
11	80.6	31.7	5.32	11.7	1.00
12	82.2	32.4	5.66	12.5	1.00
13	83.5	32.9	5.96	13.1	1.00
14	84.7	33.3	6.23	13.7	1.00
15	85.7	33.7	6.46	14.3	1.00
16	86.5	34.1	6.67	14.7	1.00
17	87.2	34.3	6.86	15.1	1.00
18	87.9	34.6	7.02	15.5	1.00
19	88.4	34.8	7.16	15.8	1.00
20	88.9	35.0	7.28	16.1	1.00

Growth Parameters:		Weight Parameters:		Maturity Parameters:	
Linf	91.816869	a	0.003953	Alpha	1.060
K	0.149260	b	3.214900	Beta	2.506
L1	41.999173				

Females					
	Length		Weight		Fraction
Age	(Cm.)	(In.)	(Kg.)	(Lbs.)	Mature
1	43.0	16.9	0.62	1.4	0.04
2	51.6	20.3	1.16	2.6	0.09
3	59.4	23.4	1.87	4.1	0.21
4	66.4	26.1	2.73	6.0	0.42
5	72.7	28.6	3.72	8.2	0.66
6	78.4	30.9	4.80	10.6	0.84
7	83.5	32.9	5.95	13.1	0.93
8	88.1	34.7	7.15	15.8	0.97
9	92.3	36.3	8.36	18.4	0.99
10	96.0	37.8	9.57	21.1	1.00
11	99.4	39.1	10.77	23.7	1.00
12	102.4	40.3	11.93	26.3	1.00
13	105.2	41.4	13.05	28.8	1.00
14	107.7	42.4	14.12	31.1	1.00
15	109.9	43.3	15.14	33.4	1.00
16	111.9	44.1	16.10	35.5	1.00
17	113.7	44.8	17.00	37.5	1.00
18	115.3	45.4	17.85	39.3	1.00
19	116.8	46.0	18.63	41.1	1.00
20	118.1	46.5	19.36	42.7	1.00

Growth Parameters:		Weight Parameters:		Maturity Parameters:	
Linf	130.18329	a	0.00176	Alpha	0.994
K	0.104103	b	3.397800	Beta	4.323
L1	42.98222				

Table 14. Lingcod biological parameters used in the northern (LCN) model.

Parameter	Male Estimate	Female Estimate
Growth[1]		
Linf	91.817	130.183
K	0.149	0.104
L1	41.999	42.982
T_0	-3.097	-2.850
n	6274	16884
Length-Weight[2]		
a	0.003953	0.001760
b	3.214900	3.397800
R sq	0.52	0.71
n	5149	12079
Maturity[3]		
Alpha	1.060	0.994
Beta	2.506	4.323
n	15	21
Natural Mortality[4]		
M	0.32	0.18
Fecundity[5]		
a		2.82406E-04
b		3.0011

[1] Growth Model: L = Linf + (L1-Linf) * exp(K * (1-Age))

[2]Length Weight Model: $W = a*L^b$

[3]Maturity Model: P = 1/(1+exp(-Alpha * (Age-Beta)))

[4]Natural Mortality: Data source: Jagielo (1994); derived from an average of values using methods of Hoenig (1983), Alverson and Carney (1975), and Pauly (1980).

Table 15. Intentionally Omitted.

Table 16. Mean length, weight and fraction of lingcod mature at age used in the LCS model. Survey data only were used for ages 1-3. Survey and fishery data were used for ages 4+.

Males						Females					
	Length		Weight		Fraction		Length		Weight		Fraction
Age	(Cm.)	(In.)	(Kg.)	(Lbs.)	Mature	Age	(Cm.)	(In.)	(Kg.)	(Lbs.)	Mature
1	34.3	13.5	0.34	0.7	0.06	1	35.1	13.8	0.31	0.7	0.04
2	43.7	17.2	0.75	1.6	0.18	2	45.6	18.0	0.76	1.7	0.11
3	51.3	20.2	1.25	2.7	0.43	3	54.7	21.5	1.41	3.1	0.29
4	57.4	22.6	1.79	3.9	0.72	4	62.5	24.6	2.23	4.9	0.55
5	62.3	24.5	2.32	5.1	0.90	5	69.3	27.3	3.16	7.0	0.79
6	66.2	26.0	2.82	6.2	0.97	6	75.2	29.6	4.17	9.2	0.92
7	69.3	27.3	3.27	7.2	0.99	7	80.2	31.6	5.20	11.5	0.97
8	71.8	28.2	3.66	8.1	1.00	8	84.6	33.3	6.24	13.7	0.99
9	73.7	29.0	3.99	8.8	1.00	9	88.4	34.8	7.24	16.0	1.00
10	75.3	29.7	4.28	9.4	1.00	10	91.7	36.1	8.20	18.1	1.00
11	76.6	30.2	4.51	10.0	1.00	11	94.6	37.2	9.09	20.0	1.00
12	77.6	30.6	4.71	10.4	1.00	12	97.0	38.2	9.92	21.9	1.00
13	78.4	30.9	4.87	10.7	1.00	13	99.2	39.0	10.68	23.5	1.00
14	79.1	31.1	5.00	11.0	1.00	14	101.0	39.8	11.37	25.1	1.00
15	79.6	31.3	5.11	11.3	1.00	15	102.6	40.4	11.99	26.4	1.00
16	80.0	31.5	5.20	11.5	1.00	16	104.0	40.9	12.55	27.7	1.00
17	80.4	31.6	5.27	11.6	1.00	17	105.2	41.4	13.04	28.8	1.00
18	80.6	31.7	5.32	11.7	1.00	18	106.2	41.8	13.48	29.7	1.00
19	80.8	31.8	5.37	11.8	1.00	19	107.1	42.2	13.87	30.6	1.00
20	81.0	31.9	5.40	11.9	1.00	20	107.9	42.5	14.22	31.3	1.00
Growth Parameters:		Weight Parameters:		Maturity Parameters:		Growth Parameters:		Weight Parameters:		Maturity Parameters:	
Linf	81.693959	a	0.003953	Alpha	1.240	Linf	112.81069	a	0.00176	Alpha	1.129
K	0.223233	b	3.214900	Beta	3.233	K	0.144902	b	3.397800	Beta	3.814
L1	34.252704					L1	35.113463				

Table 17. Lingcod biological parameters used in the southern (LCS) model.

Parameter	Male Estimate	Female Estimate
Growth[1]		
Linf	81.694	112.811
K	0.223	0.145
L1	34.253	35.113
T_0	-1.435	-1.573
n	986	1780
Length-Weight[2]		
a	0.003953	0.001760
b	3.214900	3.397800
R sq	0.52	0.71
n	5149	12079
Maturity[3]		
Alpha	1.240	1.129
Beta	3.233	3.814
R sq	0.989	0.994
Natural Mortality[4]		
M	0.32	0.18
Fecundity[5]		
a		2.82406E-04
b		3.0011

[1] Growth Model: L = Linf + (L1-Linf) * exp(K * (1-Age))

[2]Length Weight Model: $W = a*L^b$

[3]Maturity Model: P = 1/(1+exp(-Alpha * (Age-Beta)))

[4]Natural Mortality: Data source: Jagielo (1994); derived from an average of values using methods of Hoenig (1983), Alverson and Carney (1975), and Pauly (1980).

Table 18. NMFS trawl survey lingcod biomass estimates by INPFC area for combined depth strata. Note: The shallow depth strata was 50-100 fm. in 1977, and 30-100 fm. for all other years.

NMFS Trawl Survey lingcod biomass (mt) estimates for combined depth strata by INPFC

Standard analysis which includes all good perfromance hauls.

Year	Conception	Monterey	Eureka	Columbia	US Vancouver	Monterey + Eureka	CV	Columbia +US Vancouver	CV
1977	69	1,800	274	12,648	2,277	2,074	0.32	14,925	0.77
1980		671	431	8,699	1,281	1,102	0.29	9,979	0.65
1983		1,467	494	4,026	1,805	1,962	0.33	5,831	0.15
1986		611	316	1,828	988	926	0.21	2,816	0.12
1989	54	2,107	473	3,649	1,863	2,580	0.20	5,512	0.29
1992	27	484	148	3,071	1,069	632	0.24	4,140	0.49
1995	42	703	179	1,320	552	881	0.28	1,872	0.16
1998	34	651	219	2,002	1,018	871	0.27	3,020	0.26
2001	85	693	654	3,903	1,324	1,347	0.12	5,227	0.27

Including all good perfrmance hauls, but excluding tows identified as "water hauls"

Year	Conception	Monterey	Eureka	Columbia	US Vancouver	Monterey + Eureka	CV	Columbia +US Vancouver	CV
1977	74	2,368	624	12,773	2,270	2,993	0.14	15,043	0.77
1980		929	608	3,219	1,361	1,537	0.31	4,580	0.31
1983		1,523	556	4,306	1,962	2,079	0.33	6,268	0.16
1986		611	315	1,860	951	926	0.21	2,812	0.12
1989	54	2,168	540	3,933	1,922	2,708	0.20	5,856	0.30
1992	32	476	154	3,071	1,084	630	0.25	4,155	0.49
1995	46	703	199	1,329	555	901	0.27	1,884	0.16
1998	34	651	219	2,002	1,018	871	0.27	3,020	0.26
2001	85	693	654	3,903	1,324	1,347	0.12	5,227	0.27

Difference in estimated biomass (mt) by including and excluding "water hauls"

Year	Conception	Monterey	Eureka	Columbia	US Vancouver	Monterey + Eureka	Columbia +US Vancouver
1977	5	569	350	125	-7	919	118
1980	0	258	177	-5,480	81	435	-5,399
1983	0	55	61	280	157	117	437
1986	0	0	-1	33	-37	-1	-4
1989	1	61	67	284	60	128	344
1992	6	-8	6	0	15	-2	15
1995	3	0	20	9	3	20	12
1998	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0

Table 19. WDFW Cape Flattery tag survey index used in the northern (LCN) assessment. Estimates for the years 1986-1992 were obtained from Jagielo (1995).

Year	Number of Fish	Standard Deviation
1986	119700	18800
1987	208500	31800
1988	165400	19000
1989	149000	13500
1990	123800	10300
1991	114400	9500
1992	127300	11000

Table 20. Number of logbook tows used to develop trawl logbook CPUE indices in southern and northern waters.

Total number of logbook tows by PMFC Area

Year	1A	1B	1C	2A	2B	2C	2C	3A	3B	3C
1976	0	0	0	673	2783	1433	1433	3966	0	0
1977	0	0	0	447	1290	1747	1747	2051	0	0
1978	2048	9495	8702	985	1951	1638	1638	3142	0	0
1979	2472	10552	12756	1764	3007	1981	1981	5583	0	0
1980	2036	8895	7958	1137	1101	1048	1048	4479	0	0
1981	5566	19492	16002	3701	3806	1396	1396	5270	0	0
1982	2412	10345	7970	2845	5267	4503	4503	8446	0	0
1983	1494	9416	7465	2330	5324	1195	1195	4912	0	0
1984	1683	6883	7629	1657	2320	1927	1927	5644	0	0
1985	2699	8366	7142	1140	2784	2928	2928	3606	0	0
1986	2865	9941	5151	770	1432	2053	2053	5520	4338	3816
1987	3030	6630	5070	1415	5016	2765	2765	10821	3520	3287
1988	3182	6847	6209	1456	5117	7490	3751	11027	4607	4077
1989	4338	8000	5777	1431	5232	12348	6183	12492	5711	5352
1990	3622	6483	5601	1504	4786	10598	5319	9211	4491	5759
1991	3296	8931	5197	1736	6713	14917	7504	12067	5630	6460
1992	3393	10158	4210	1487	5468	14288	7190	10485	4936	5905
1993	2450	9936	4205	1827	5674	8702	8702	8491	4797	5711
1994	2662	8995	3940	1531	3888	7176	7176	7130	3674	4951
1995	2721	8688	4986	1372	3699	9378	4696	7205	3825	3230
1996	2697	9568	4968	1424	3320	9388	4699	8199	3605	2643
1997	1867	8000	4763	1717	3550	9194	4603	5706	2072	2271
1998	2673	5792	3776	2184	3228	7516	3759	4236	2066	2262
1999	3403	5258	4064	1637	2712	6026	3014	4341	1809	1841
2000	1702	3692	3278	728	2095	5423	2716	4451	2045	1638
2001	2261	3090	3078	1161	2140	6376	3195	3574	2072	1935
2002	3310	4640	3114	726	1278	4345	2176	3337	2560	1577
	69,882	208,093	153,011	39,665	90,908	154,599	96,117	169,375	61,758	62,715

Table 21. Summary of estimated Delta GLM logbook index results in the northern region, indicating: 1) sample size (# of tows), 2) the percentage of tows with lingcod present (2003 index % positive), and 3) the computed index values used in the 2003 LCN stock assessment model. The logbook index values used in the 2000 assessment are provided for comparison.

Northern Area Trawl Logbook Index

	2000 Index	2003 Index		
Year	Index Value	# of Tows	% Positive	Index Value
1976		9,615	62%	20.33
1977		6,835	52%	16.16
1978		8,369	54%	10.79
1979		12,552	58%	11.37
1980		7,676	64%	11.32
1981		11,868	63%	13.33
1982		22,719	50%	9.29
1983	335.9	12,626	51%	9.32
1984	218.3	11,818	44%	6.99
1985	296.7	12,246	36%	6.26
1986	271.6	19,212	23%	3.58
1987	287.0	28,174	31%	4.24
1988	218.1	39,808	27%	4.56
1989	201.2	53,483	25%	5.45
1990	201.1	45,443	23%	4.36
1991	157.4	60,704	22%	3.94
1992	153.8	55,370	19%	2.23
1993	102.9	42,077	28%	2.74
1994	157.6	33,995	28%	2.82
1995	40.6	36,715	21%	2.47
1996	127.3	36,543	22%	2.54
1997	123.0	31,987	21%	2.36

Table 22. Summary of estimated Delta GLM logbook index results in the southern region, indicating: 1) sample size (# of tows), 2) the percentage of tows with lingcod present (2003 index % positive), and 3) the computed index values used in the 2003 LCS stock assessment model. The logbook index values used in the 2000 assessment are provided for comparison.

Southern Area Trawl Logbook Index

	2000 Index	2003 Index		
Year	**Index Value**	**# of Tows**	**% Positive**	**Index Value**
1978	44.51	21,230	34%	5.80
1979	49.23	27,544	47%	11.75
1980	45.79	20,026	47%	9.57
1981	49.65	44,761	46%	7.29
1982	45.62	23,572	47%	7.37
1983	29.16	20,705	43%	8.88
1984	25.46	17,852	39%	7.56
1985	15.53	19,347	31%	3.56
1986	17.41	18,727	24%	3.10
1987	27.25	16,145	33%	5.42
1988	26.32	17,694	31%	5.63
1989	28.99	19,546	32%	7.30
1990	29.97	17,210	28%	6.18
1991	22.27	19,160	31%	3.75
1992	18.58	19,248	27%	3.12
1993	20.51	18,418	28%	3.84
1994	21.56	17,128	25%	3.63
1995	20.35	17,767	25%	3.87
1996	16.65	18,657	26%	3.12
1997	18.81	16,347	28%	3.30

Table 23. Recreational lingcod CPUE for boat-based fisheries using the "indirect" method on RecFIN creel data for northern California, southern California and Oregon. WDFW sport creel data was used to develop the Washington lingcod CPUE index.

Recreational lingcod catch-per-unit-effort (CPUE) for boat-based fisheries

	Southern California [1/]		Northern California [1/]		Oregon [1/]		Washington [2/]
YEAR	CPUE	SE	CPUE	SE	CPUE	SE	CPUE
1980	0.12	0.03	1.02	0.20	0.89	0.15	
1981	0.08	0.02	0.62	0.14	0.78	0.17	
1982			0.34	0.10	1.08	0.17	
1983	0.03	0.01	0.35	0.09	1.06	0.18	
1984	0.01	0.01	0.44	0.09	0.57	0.07	
1985	0.04	0.01	0.41	0.06	0.64	0.07	
1986			0.59	0.11	0.37	0.08	
1987			0.59	0.14	0.65	0.10	
1988	0.04	0.02	0.74	0.21	0.43	0.05	
1989	0.14	0.03	0.59	0.11	1.00	0.09	
1990							0.49
1991							0.47
1992							0.63
1993					1.23	0.08	0.76
1994	0.06	0.03			1.32	0.09	0.83
1995					0.77	0.10	0.53
1996	0.09	0.05	0.65	0.07	0.94	0.10	0.48
1997			0.70	0.16	1.25	0.10	0.47
1998	0.09	0.03	0.73	0.13	0.50	0.06	0.24
1999	0.12	0.03	0.52	0.06	0.59	0.06	0.37
2000	0.08	0.05	1.51	0.28	0.50	0.06	0.24
2001	0.23	0.17	0.83	0.17	1.03	0.17	0.32
2002	0.34	0.09	1.18	0.18	0.99	0.18	0.11

[1/] RecFIN creel data used in the analysis.
[2/] WDFW creel data used in the analysis.

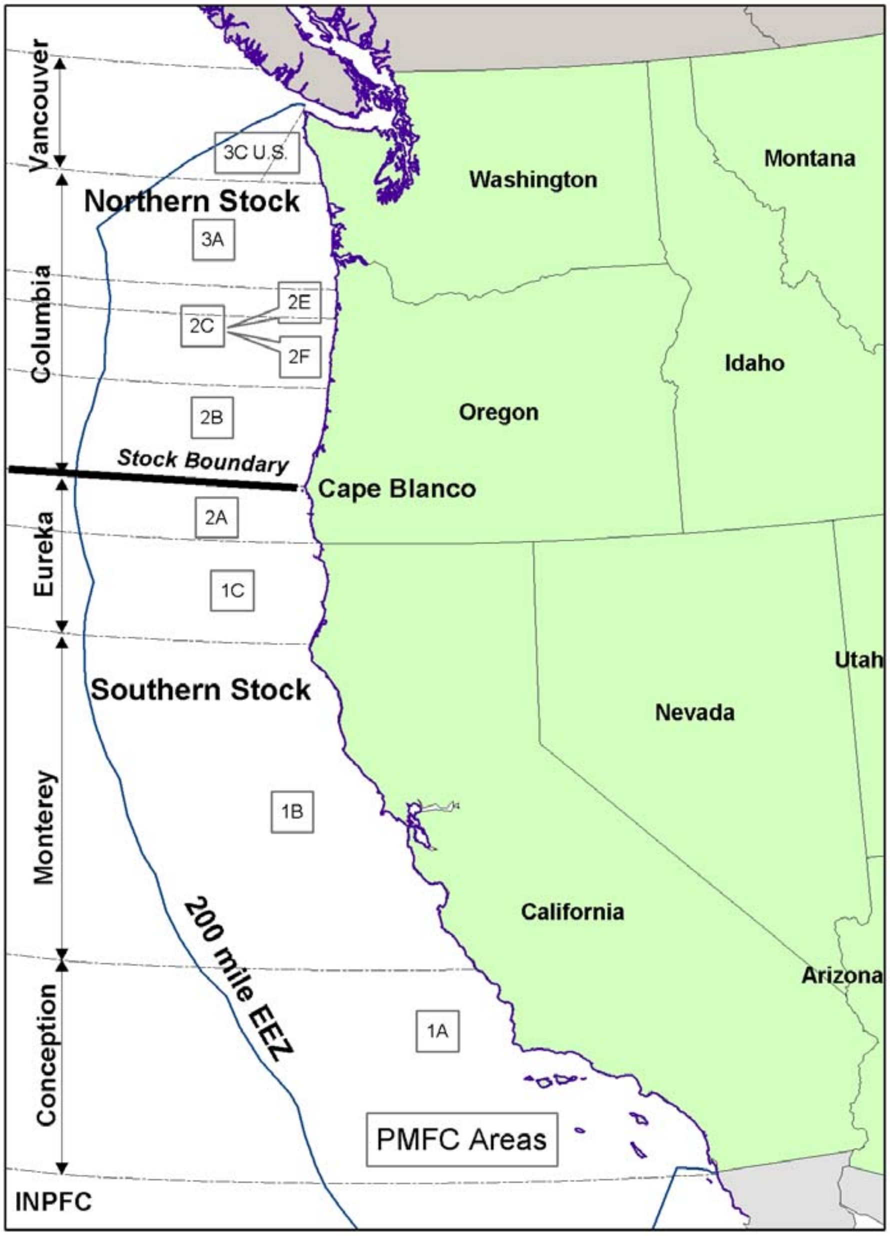


Figure 1. Lingcod stock boundaries and location of PMFC and INPFC Areas.

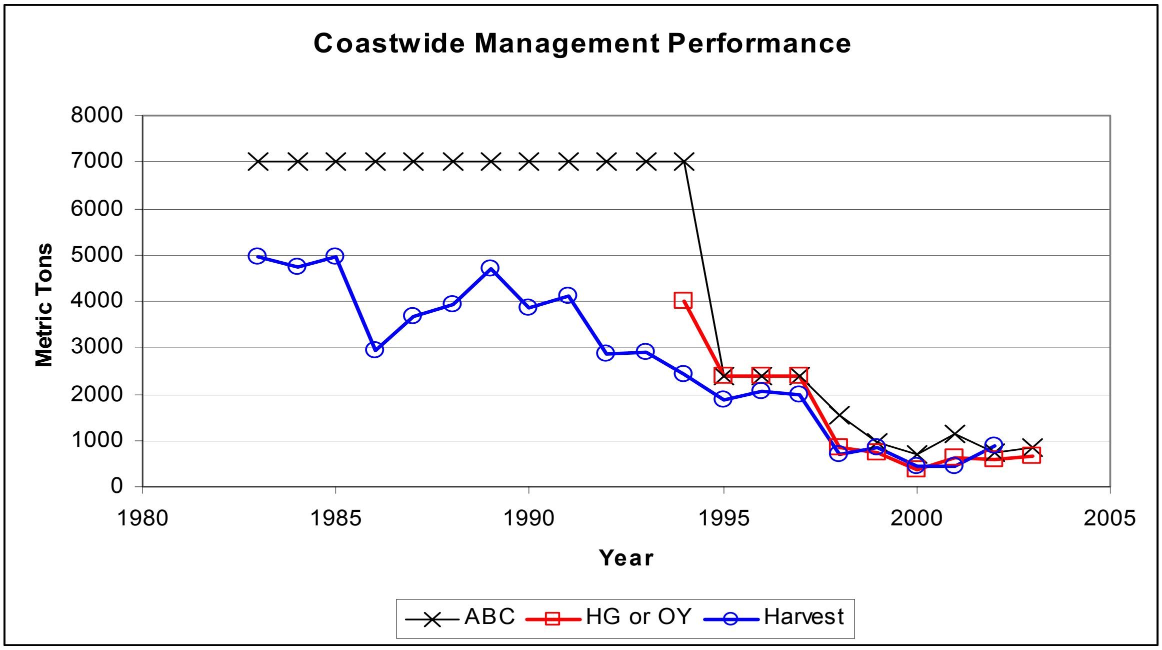


Figure 2. Comparison of lingcod ABC, OY and landings (mt) between 1983 and 2003.

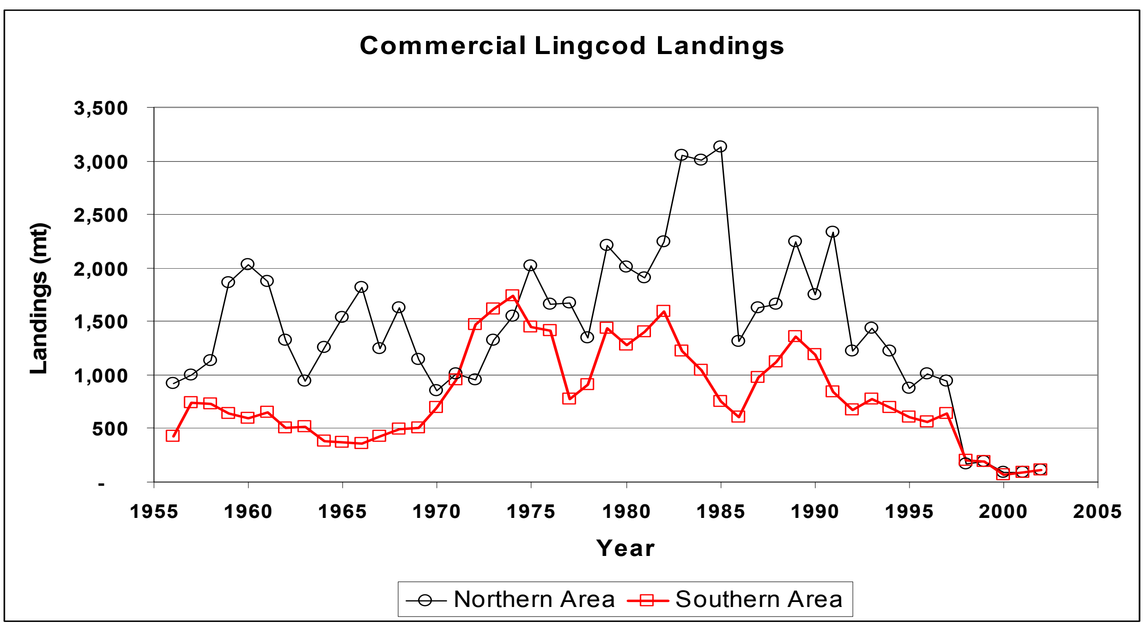


Figure 3. Comparison of commercial lingcod landings in the northern (U.S. Vancouver and Columbia) and southern (Eureka, Monterey and conception) areas.

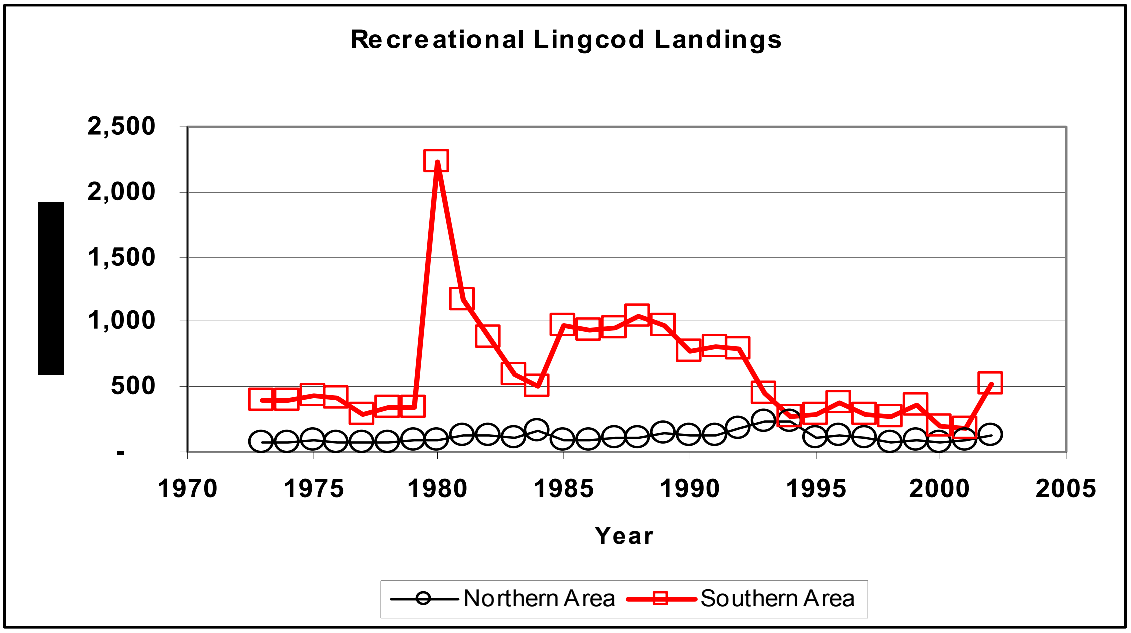


Figure 4. Comparison of recreational lingcod landings in the northern (U.S. Vancouver and Columbia) and southern (Eureka, Monterey and conception) areas.

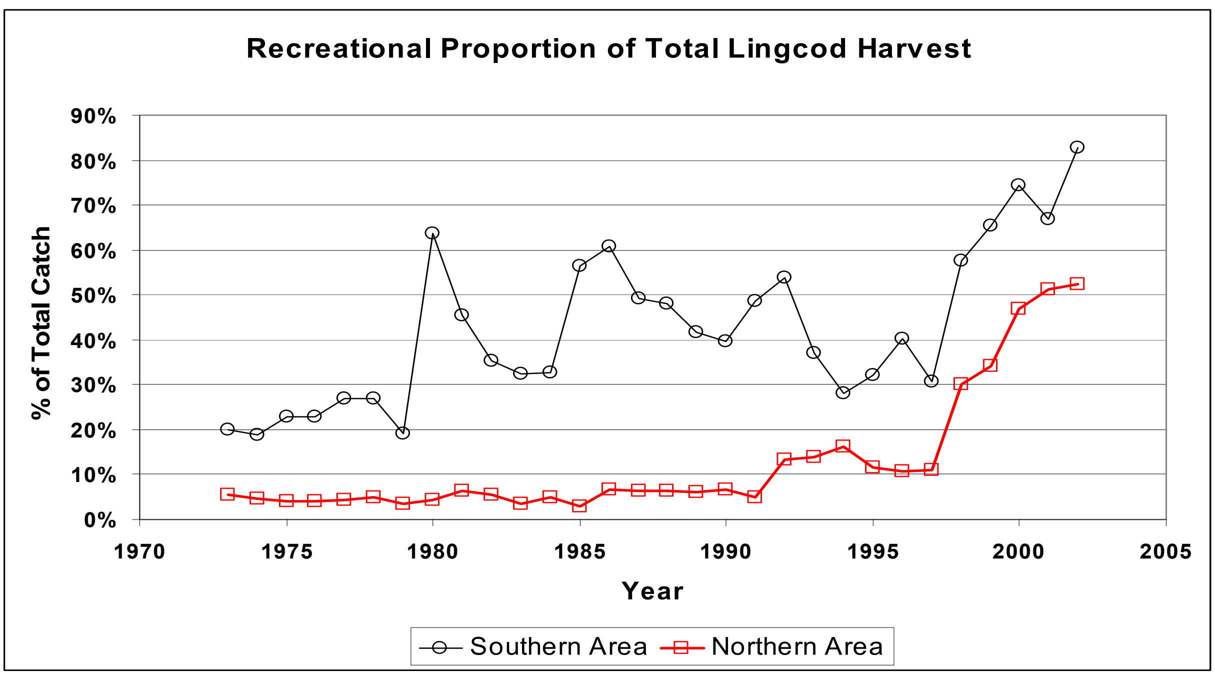


Figure 5. Recreational proportion of total lingcod harvest in the southern (INPFC Areas Eureka, Monterey and Conception) and northern areas (INPFC areas Columbia and U.S. Vancouver).

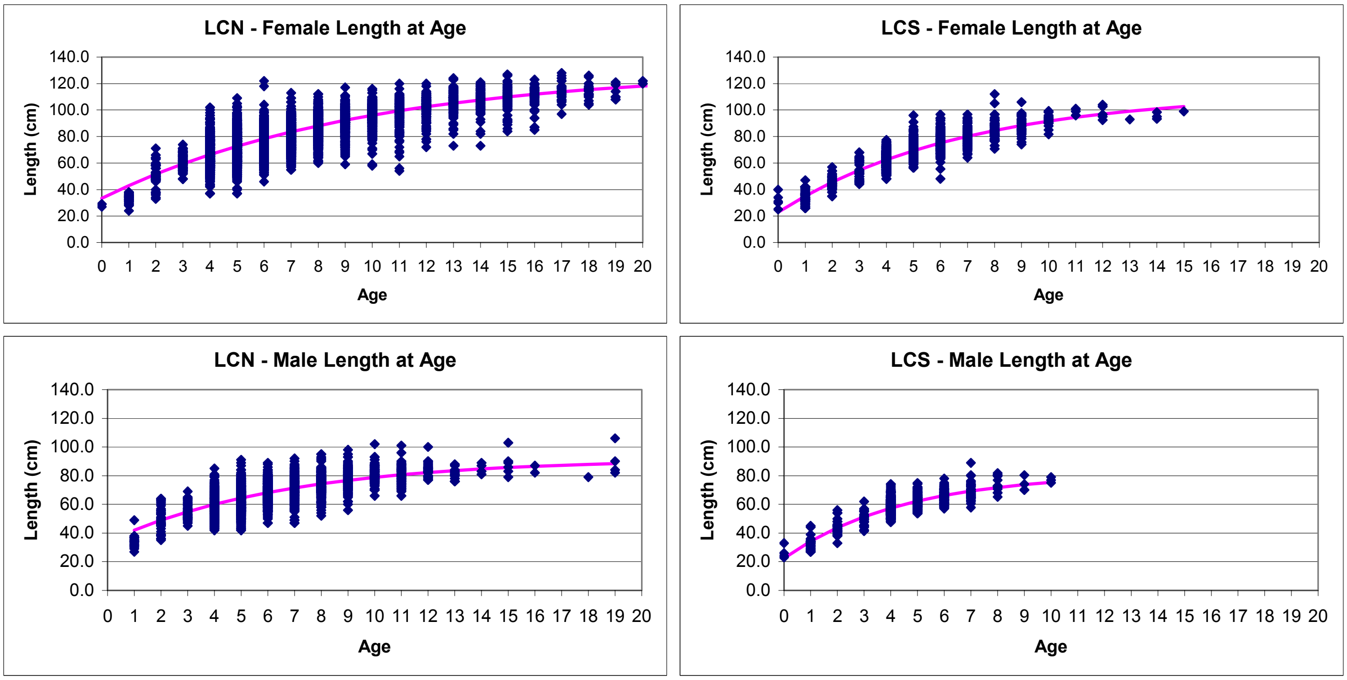


Figure 6. Length-at-age data fit to the von Bertalanffy growth model for the northern (LCN) and southern (LCS) areas. Survey data only were used for ages 1-3. Both survey and fishery data were used for ages 4+.

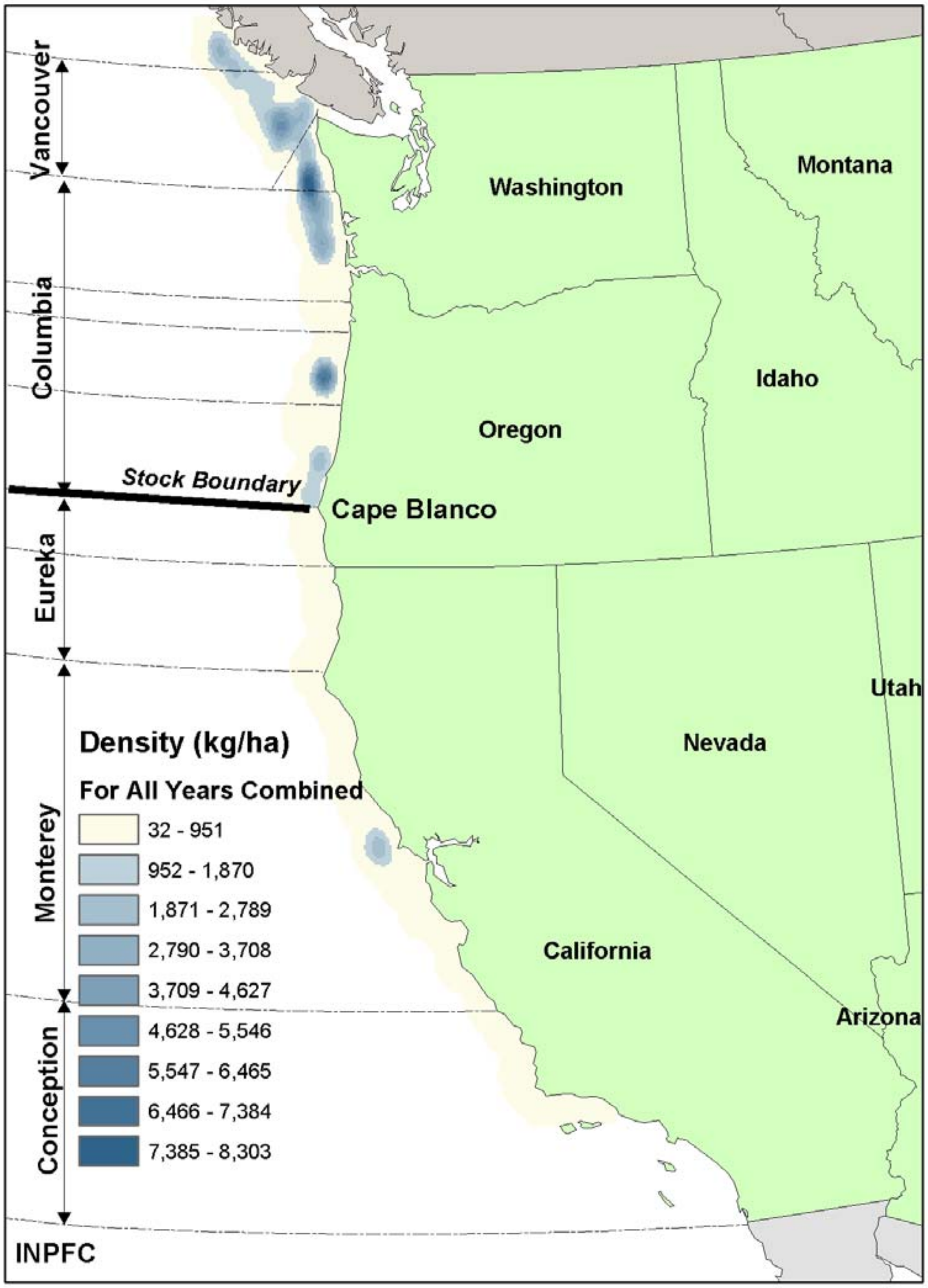


Figure 7. Coastwide distribution of lingcod (kg/ha) from the NMFS tow catches across all years and areas.

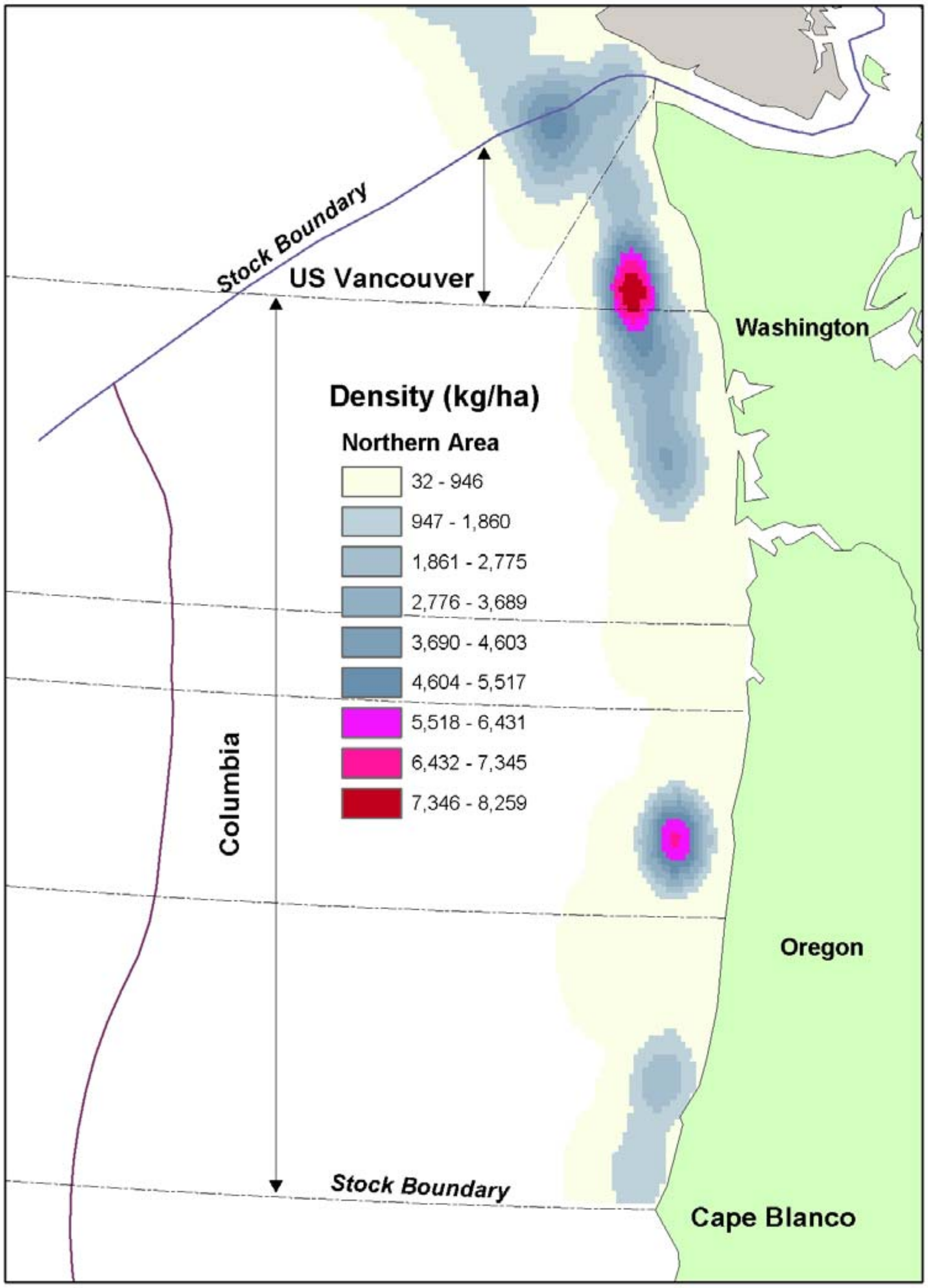


Figure 8. Northern distribution of lingcod (kg/ha) from the NMFS tow catches across all years.

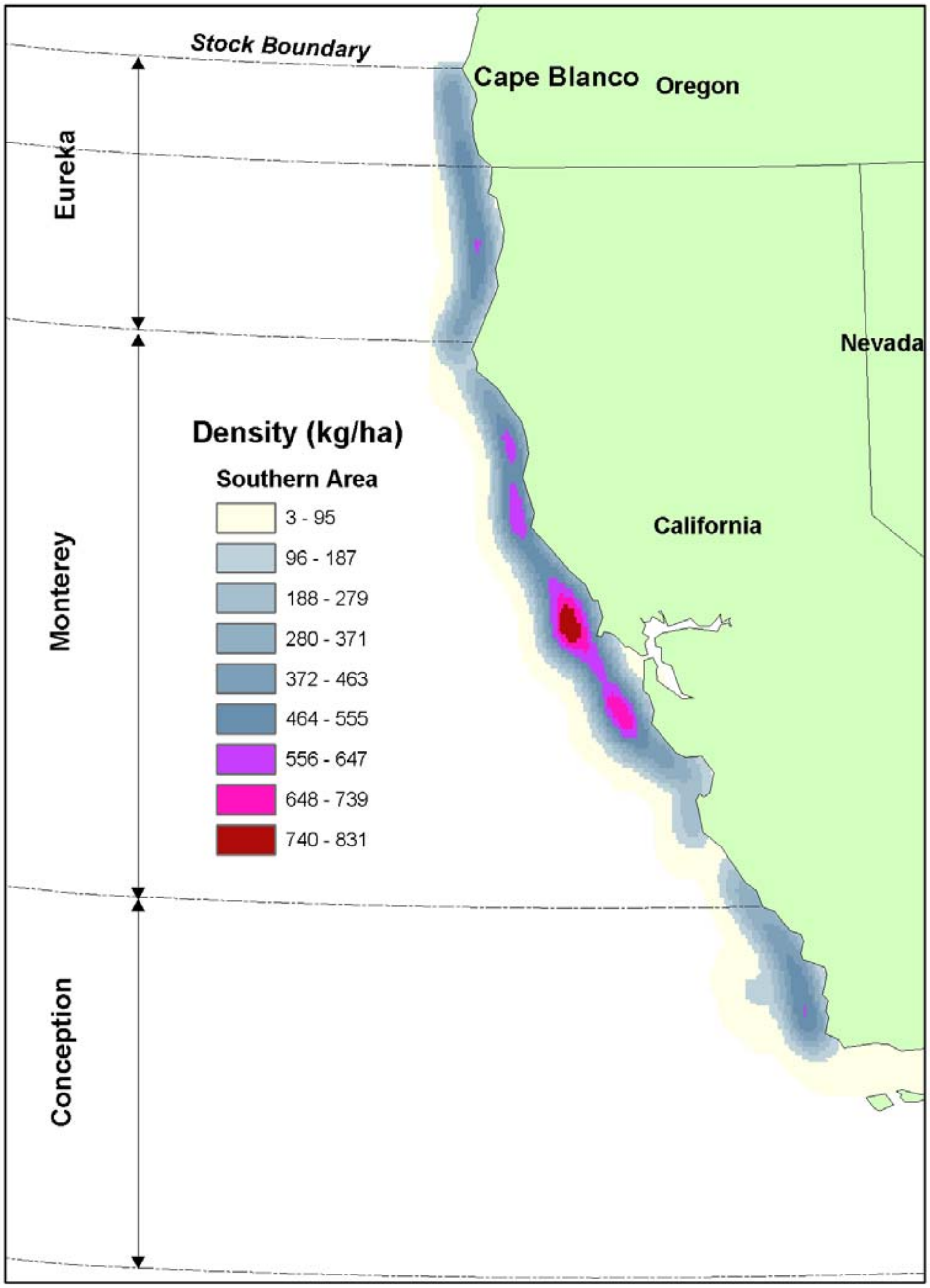


Figure 9. Southern distribution of lingcod (kg/ha) from the NMFS tow catches across all years.

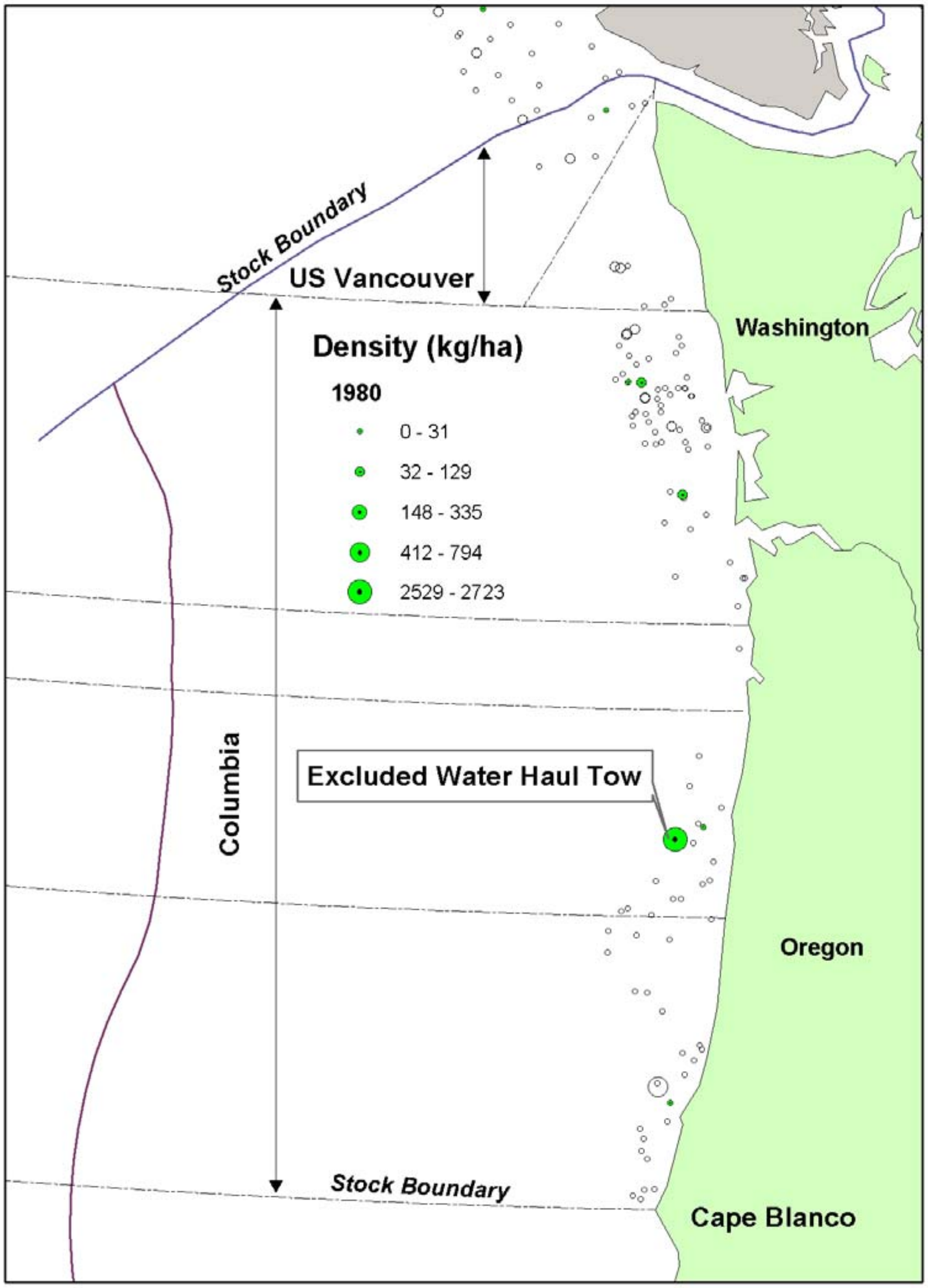


Figure 10. Location of excluded "water haul" tows (dark circles) from the 1980 NMFS Triennial Trawl Survey lingcod biomass estimate.

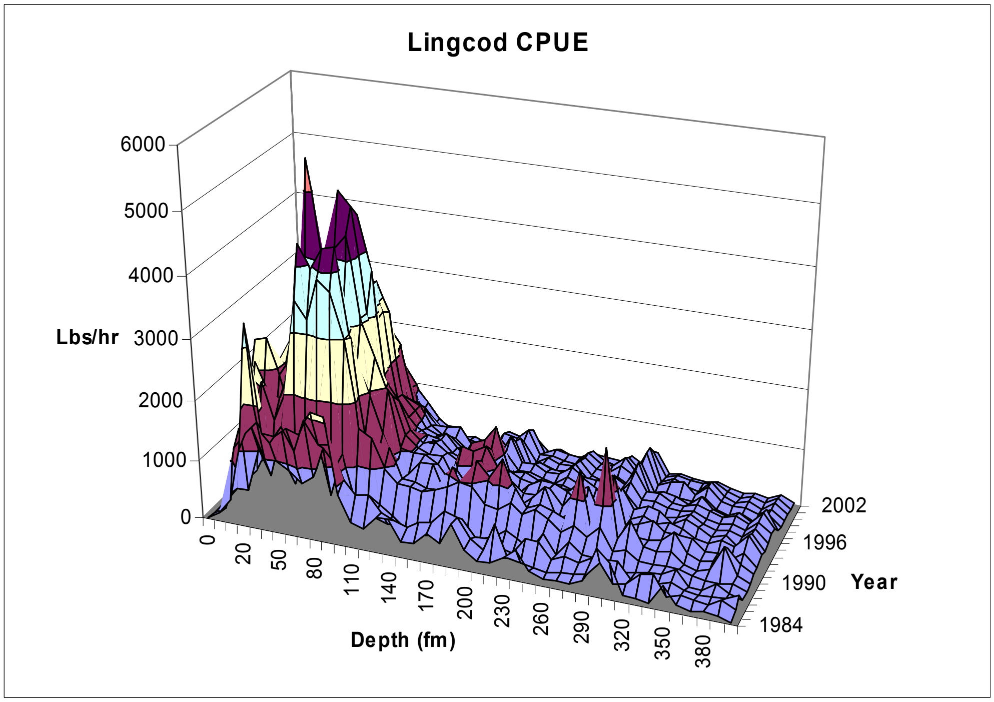


Figure 11. Mean lingcod CPUE calculated from raw data for all tows with a recorded depth.

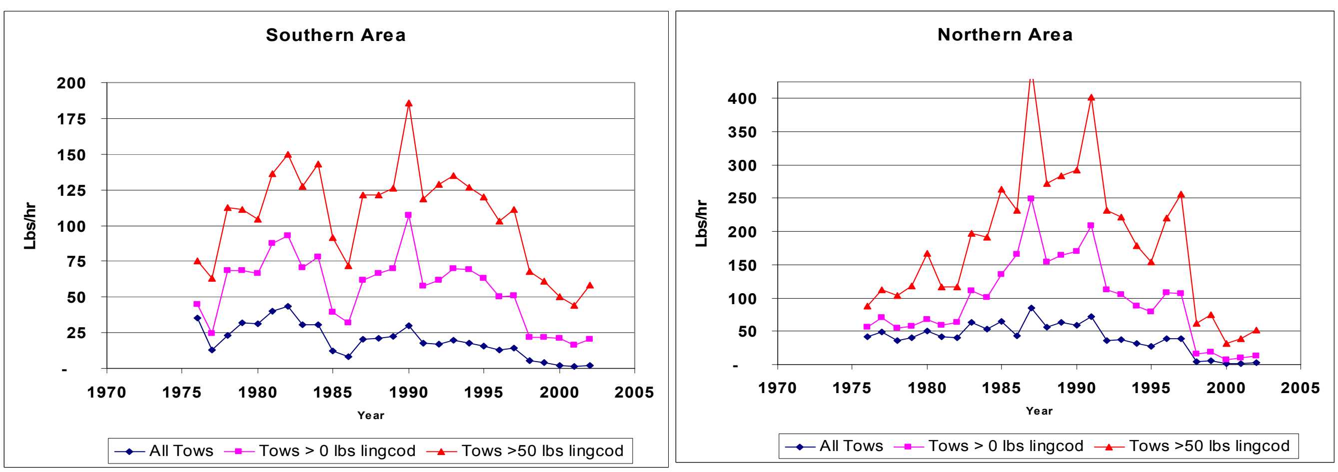
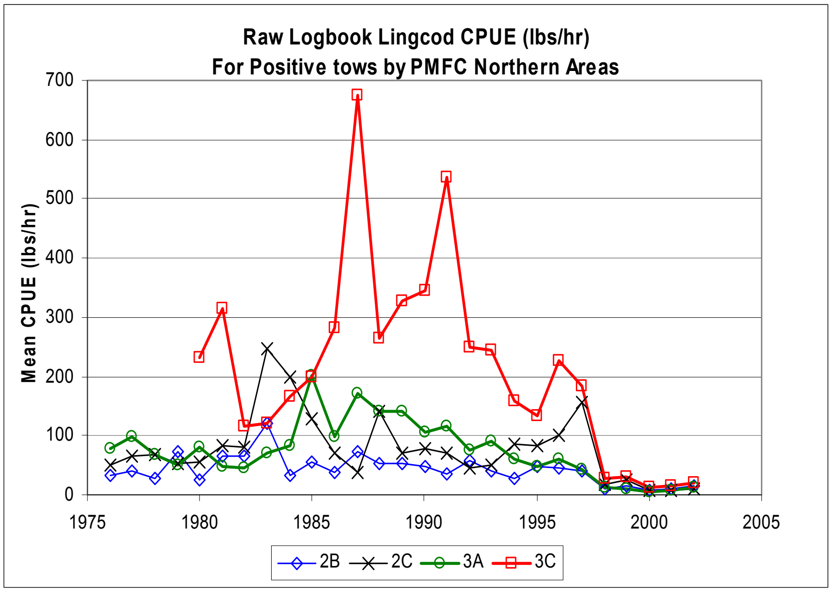


Figure 12. Mean CPUE for the southern and northern areas calculated from raw data for all tows, tows with >0 lbs lingcod catch, and tows with >50 lbs lingcod catch.



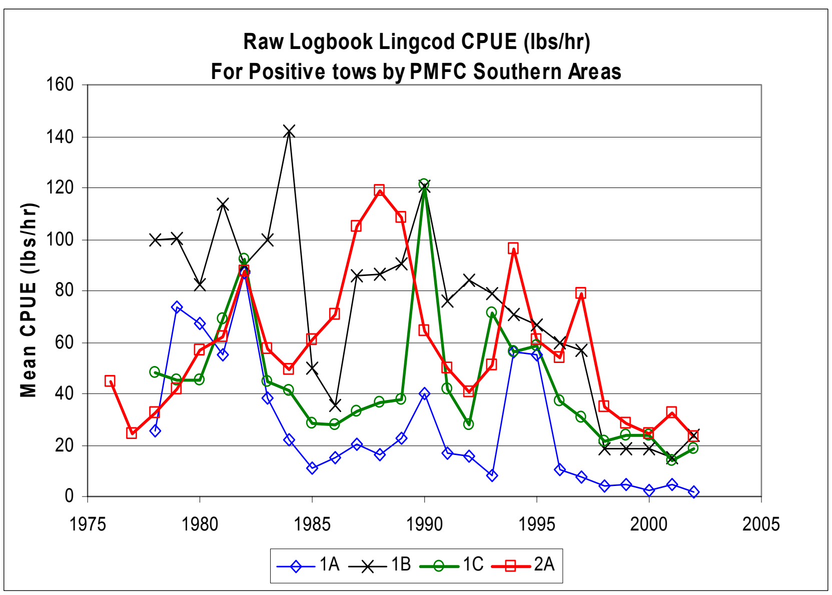


Figure 13. Mean CPUE by PMFC areas in the southern and northern areas calculated from raw data for tows with >0 lbs lingcod catch.

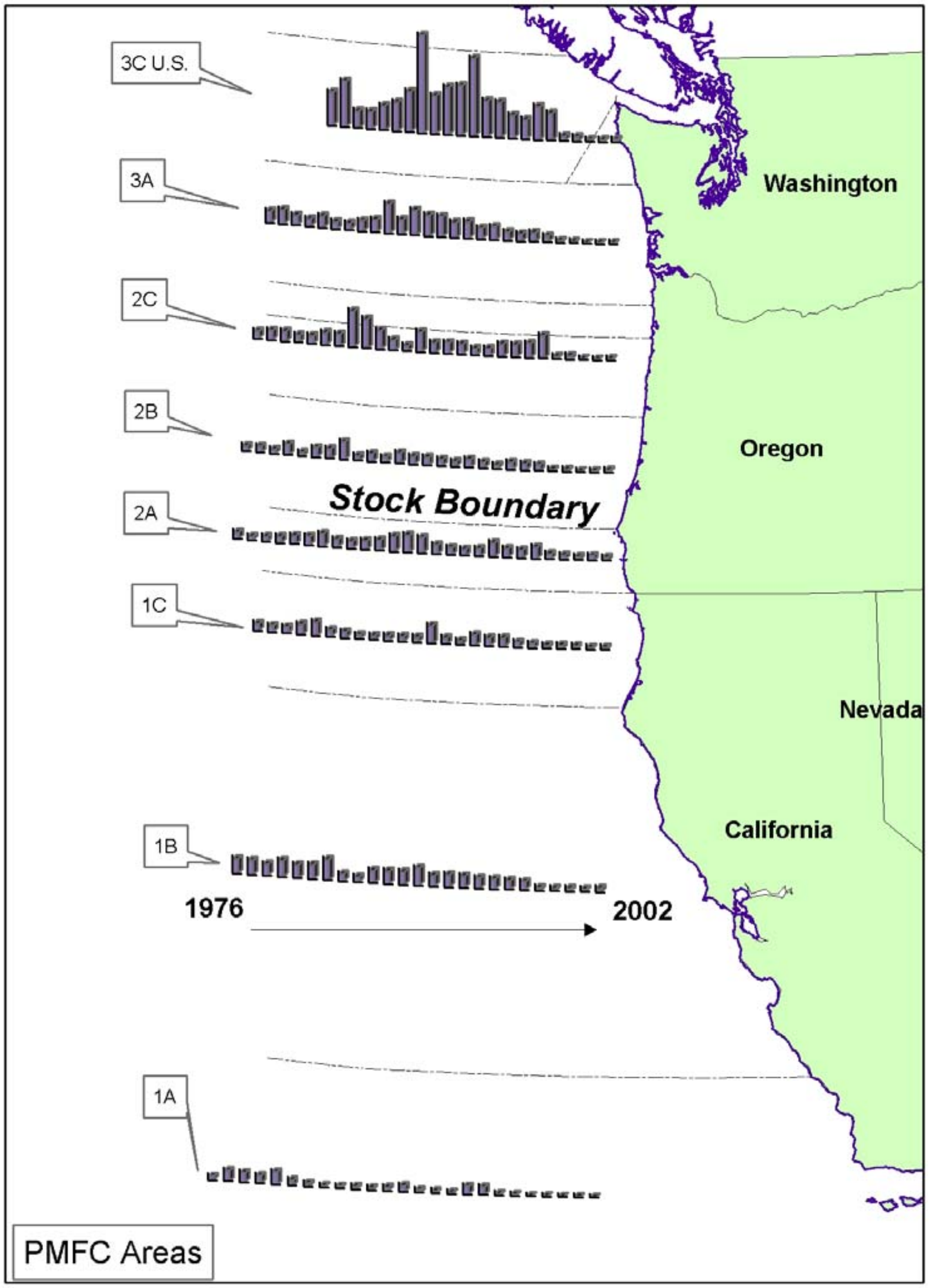


Figure 14. Time series (1976-2002) of observed lingcod trawl logbook CPUE (lbs/hr) by PMFC Area.

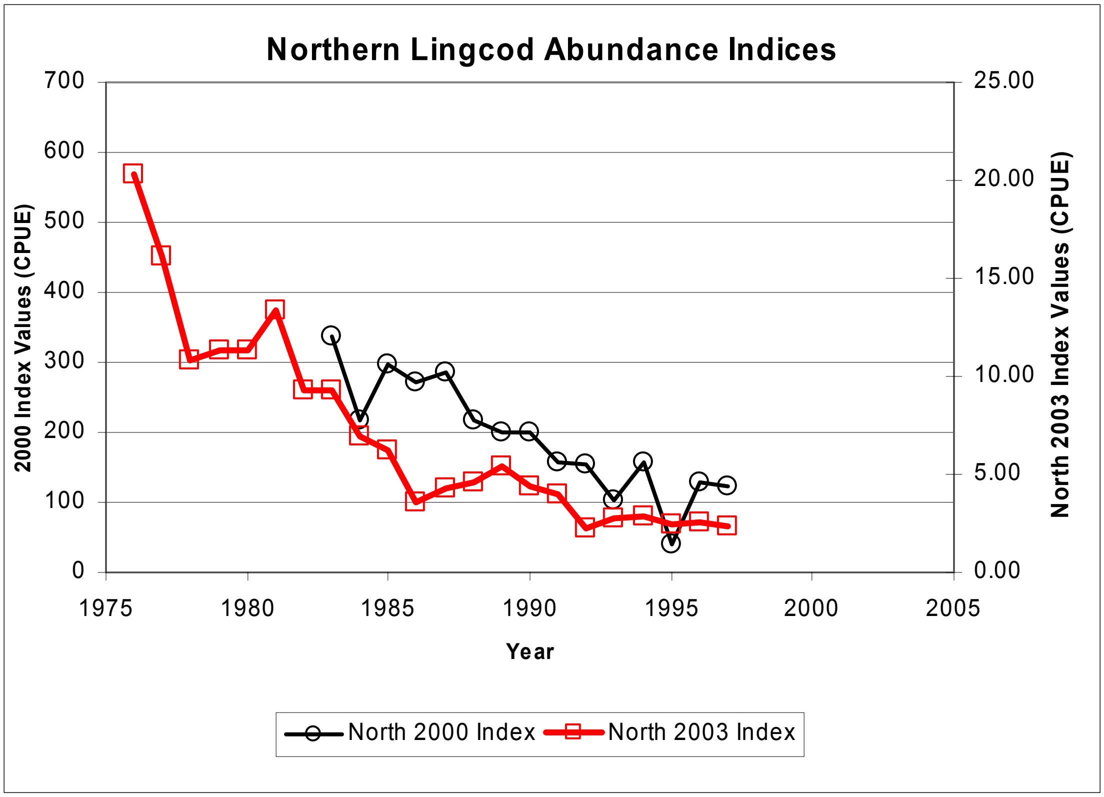


Figure 15. Comparison of the northern trawl logbook lingcod abundance trend to the northern trawl logbook index used in the 2000 lingcod stock assessment.

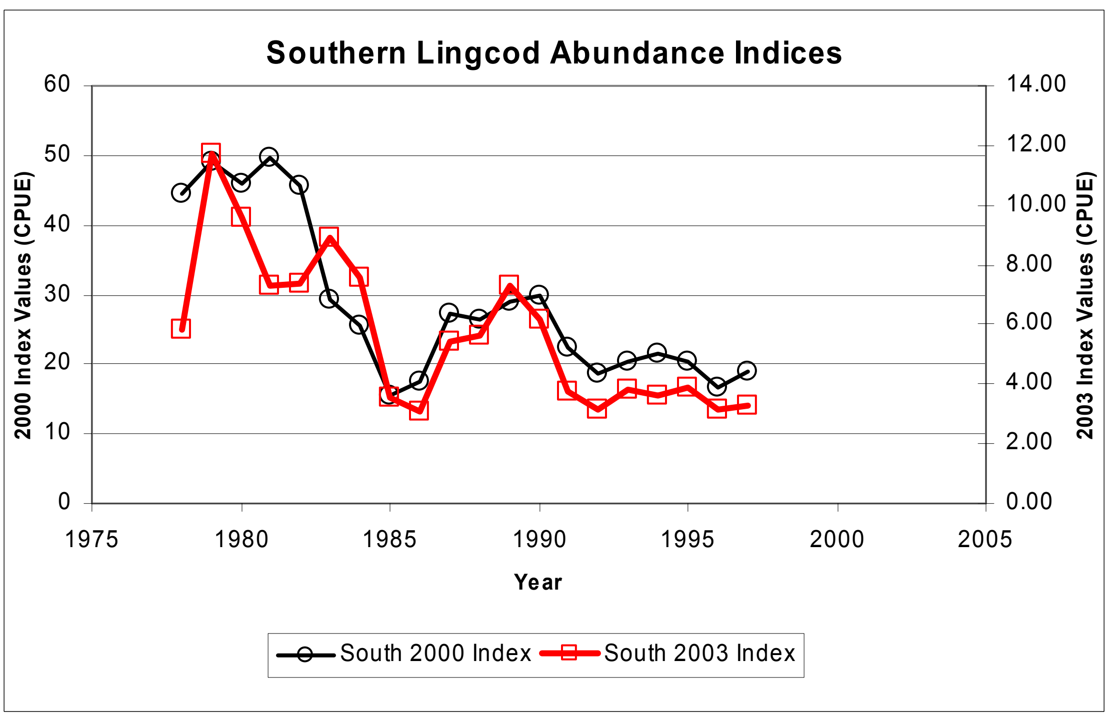


Figure 16. Comparison of the southern trawl logbook lingcod abundance trend to the southern trawl logbook index used in the 2000 lingcod stock assessment.

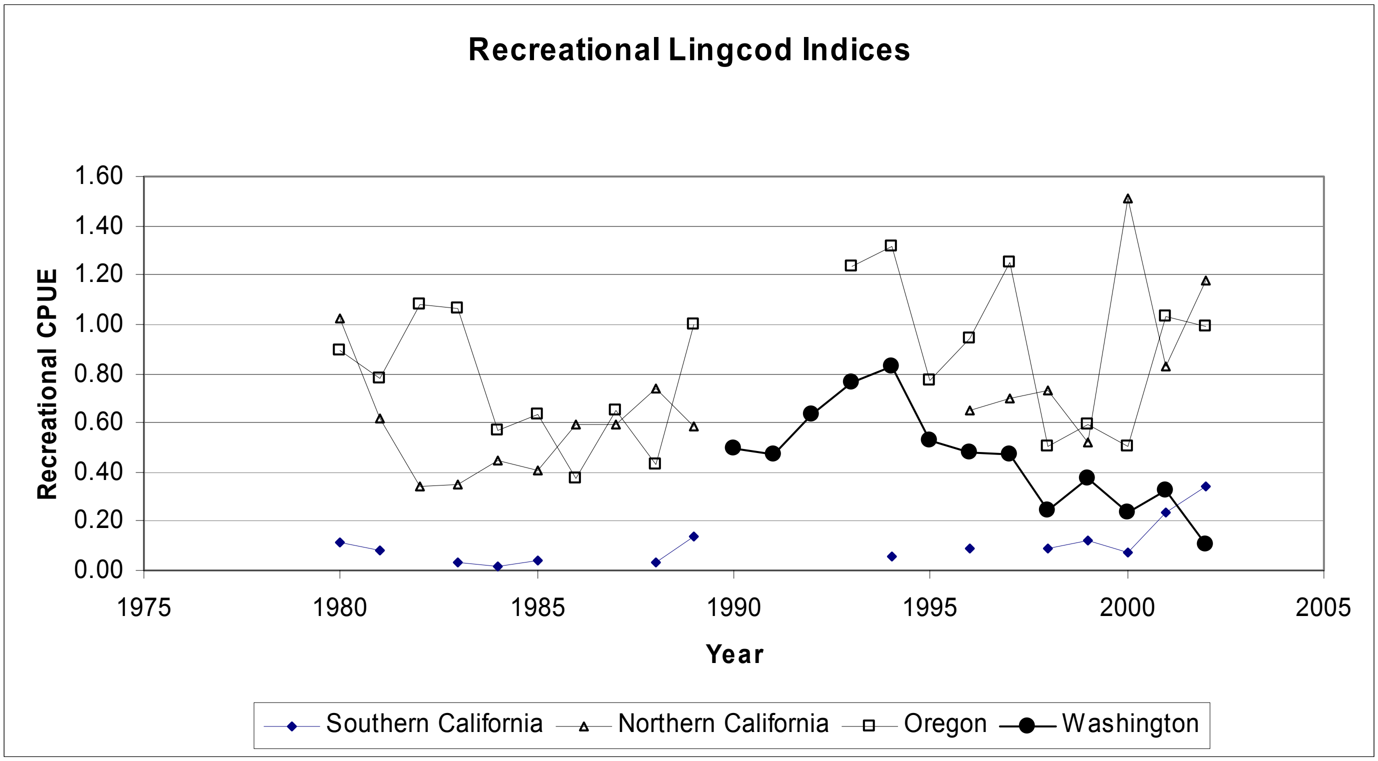


Figure 17. Candidate recreational lingcod CPUE for boat-based fisheries using the "indirect" method on RecFIN creel data for northern and southern California and Oregon and using WDFW sport creel data for the Washington index. These indices were not used in the base models.

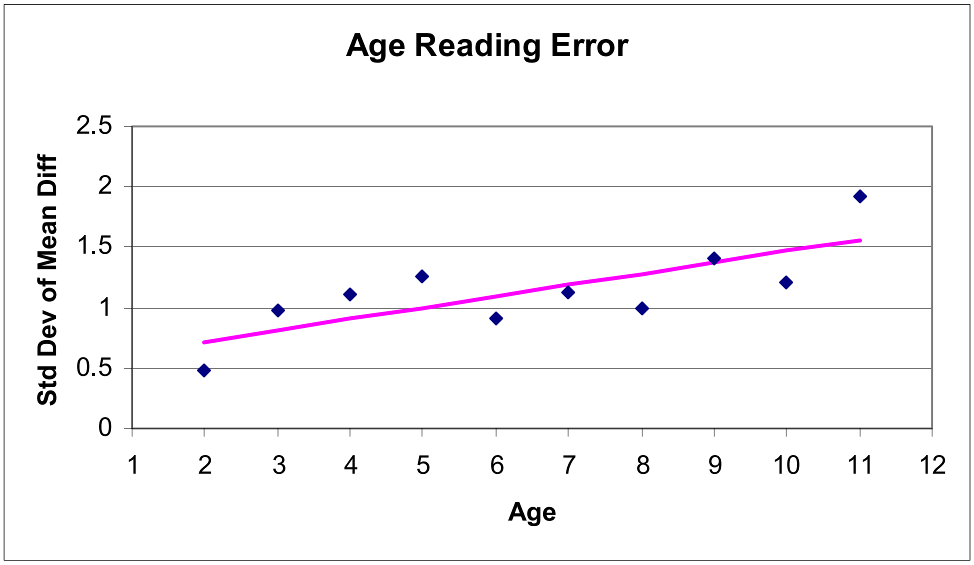


Figure 18. Between-reader (within-lab) estimates of WDFW age reading error variability.

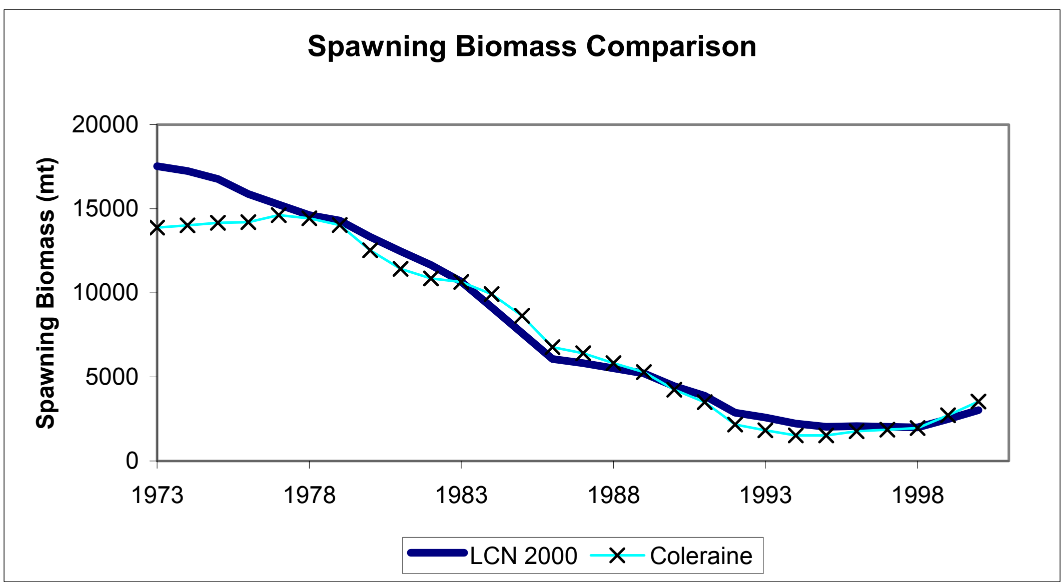


Figure 19. Comparison of LCN model estimates of spawning biomass (mt) (Jagielo et al. 2000) with Coleraine estimates of spawning biomass using the same input data.

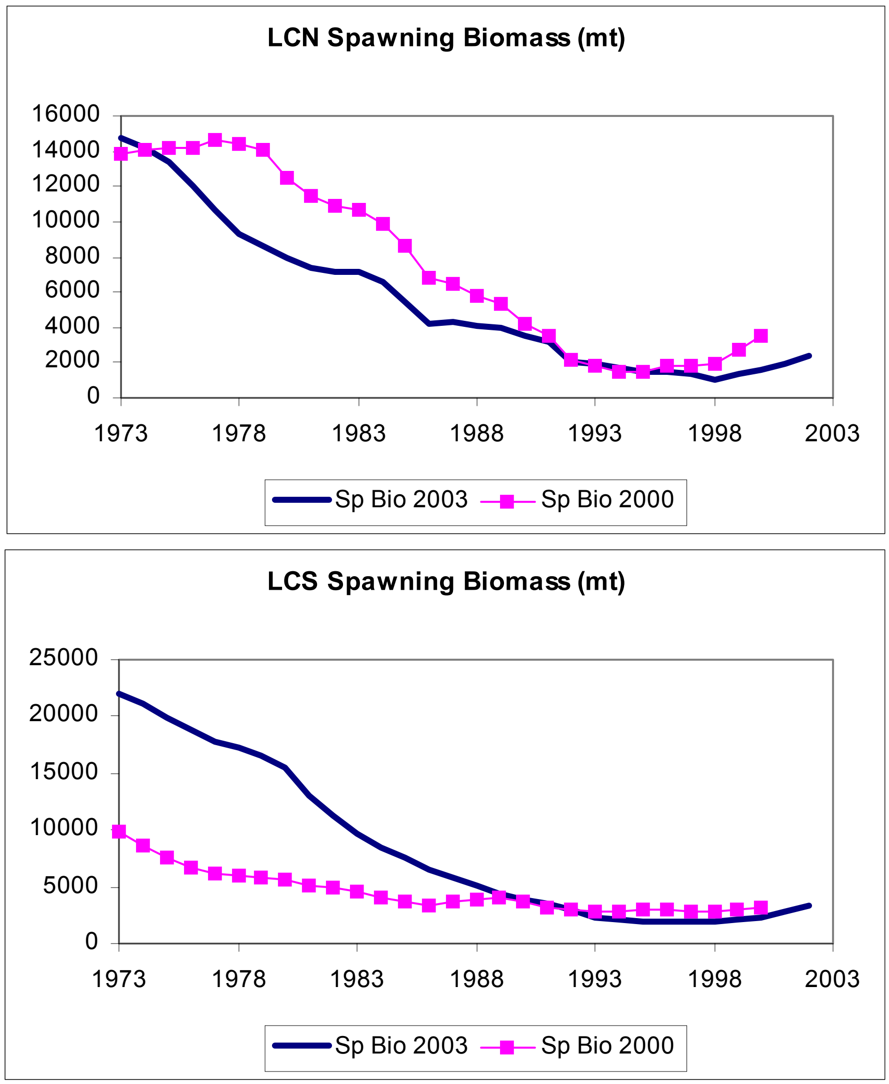


Figure 20. Comparison of LCN and LCS model estimates of spawning biomass (mt) from the 2000 assessment (Jagielo et al. 2000) with estimates of spawning biomass from the present assessment.

Appendix I. Base Model Output.
Assessment of Lingcod for the Pacific Fishery Management Council in 2003

Table of contents

Lingcod-North (LCN): US-Vancouver and Columbia INPFC Areas

Figure 4. Coleraine output for the northern area (LCN) base model: Model fits to commercial fishery catch-at-age.

Figure 5. Coleraine output for the northern area (LCN) base model: Model fits to recreational fishery catch-at-age.

Figure 6. Coleraine output for the northern area (LCN) base model: Model fits to commercial fishery catch-at-length.

Figure 7. Coleraine output for the northern area (LCN) base model: Model fits to recreational fishery catch-at-length.

Figure 8. Coleraine output for the northern area (LCN) base model: Model fits to NMFS trawl survey catch-at-age.

Figure 9. Coleraine output for the northern area (LCN) base model: Model fits to WDFW tagging survey catch-at-age.

Figure 10. Coleraine output for the northern area (LCN) base model: Model fits to NMFS trawl survey and WDFW tagging survey catch-at-length.

Figure 11a. Coleraine output for the northern area (LCN) base model: Retrospective analysis showing a comparison of base model estimates of spawning biomass with a base model configured with 1999 as the end year.

Figure 11b. Coleraine output for the northern area (LCN) base model: Historical analysis comparing spawning biomass estimates from the 2003 base model with spawning biomass estimates from the 2000 base model.

Lingcod South (LCS): Eureka, Monterey, and Conception INPFC Areas

Table 4. Coleraine input for the southern area (LCS) base model: Priors.

Table 5. Coleraine input for the southern area (LCS) base model: Likelihood and fixed parameter specifications.

Table 6. Coleraine output for the southern area (LCS) base model: Negative log likelihood values (top), parameter estimates (outlined in bold), and fixed values used in the model (shaded).

Table 6a1. Coleraine output for the northern area (LCS) base model: Standard deviation of estimated parameters under the dome shaped fishery selectivity model.

Table 6a. Coleraine output for the northern area (LCS) base model: Profile over historical exploitation rate (U_{init}).

Table 6b. Coleraine output for the northern area (LCS) base model: Profile over natural mortality rate (M).

Table 6c. Coleraine output for the northern area (LCS) base model: Profile over B-H spawner-recruit steepness (*h*).

Table 6d. Coleraine output for the northern area (LCS) base model: Profile over combinations of natural mortality rate (M) and B-H spawner-recruit steepness (*h*).

Table 6e. Coleraine output for the northern area (LCS) base model: Profile over combinations of domed and asymptotic fishery selectivity.

Figure 12a. Coleraine output for the southern area (LCS) base model: Vulnerable biomass, exploitation rate, stock recruitment, and spawning biomass.

Figure 12b. Coleraine output for the southern area (LCS) base model: Estimated selectivity for the commercial fishery, recreational fishery, and NMFS trawl survey.

Figure 13. Coleraine output for the southern area (LCS) base model: Model fits to indices of abundance; NMFS trawl survey and trawl logbook.

Figure 14. Coleraine output for the southern area (LCS) base model: Model fits to commercial fishery catch-at-age.

Figure 15. Coleraine output for the southern area (LCS) base model: Model fits to recreational fishery catch-at-age.

Figure 16. Coleraine output for the southern area (LCS) base model: Model fits to NMFS trawl survey catch-at-age.

Figure 17. Coleraine output for the southern area (LCS) base model: Historical analysis comparing spawning biomass estimates from the 2003 base model with spawning biomass estimates from the 2000 base model.

Table 1. Coleraine input file for the northern area (LCN) base model: Priors.

Priors

	Phase	Low Bound	High Bound	Prior Type (0=uniform 1=normal 2=lognormal)	Mean	CV	Seed Value
R0 (Recruitment in virgin condition)							
	1	0.1	1000000	0	0	0	1804.62
h (steepness of spawner-recruit curve)							
	-1	0.01	5	0	0.7	1	0.9
M (natural mortality)							
	-1	0.05	0.15	0	0.1	0.1	0.18
	-1	0.05	0.15	0	0.1	0.1	0.32
Log init dev prior: deviates for initial age structure: uniform or normal only							
	-5	-15	15	1	0	0.1	0
log rec dev prior (uniform or normal only)							
	2	-15	15	1	0	0.2	0
Initial R (= # 1-yr olds in yr 1/R0; unfished = 1)							
	-1	0	2	0	1	0.1	1
Initial u (exploitation rate for initial age structure; 0=unfished)							
	-1	0	0.1	0	0	0.1	0.09
	-1	0	0.1	0	0	0.1	0.09
Plus scale							
	-1	0	2	0	0	0.6	1
	-1	0	2	0	0	0.6	1
Age of full selectivity - Females							
	3	1	18	0	4	0.6	4.00
	3	1	18	0	4	0.6	4.00
Fishery age of full selectivity difference by sex (Delta)							
	3	-5	5	0	0	0.6	0
	3	-5	5	0	0	0.6	0
Fishery variance of Left side of selectivity curve (for both sexes)							
	4	-15	15	0	0	0.6	-12.1568
	4	-15	15	0	0	0.6	-15
Fishery variance of Right side of selectivity curve (for both sexes)							
	4	-15	15	0	0	0.6	14.9999
	4	-15	15	0	0	0.6	2.87946
Fishery age of full selectivity deviation by year							
	-5	-15	15	1	0	0.1	0
	-5	-15	15	1	0	0.1	0
Fishery variance of Left side selectivity by year							
	-1	-15	15	1	0	0.1	0
	-1	-15	15	1	0	0.1	0
Fishery variance of Right side selectivity by year							
	-1	-15	15	1	0	0.1	0
	-1	-15	15	1	0	0.1	0
Log q CPUE							
	1	-15	15	0	0	0.1	-6.72892
Log q CPUE error							
	-1	-5	5	0	0	0.6	0
Log q Survey							
	1	-5	5	0	0	0.2	-0.276796
	1	-5	6	0	0	0.2	4.80661
Survey age of full selectivity - Females							
	3	1	15	0	0	0.6	4.24582
	3	1	15	0	0	0.6	7.43203
Survey age of full selectivity difference by sex (Delta)							
	3	-5	5	0	0	0.6	-1.09
	3	-5	5	0	0	0.6	-5
Survey variance Left side selectivity							
	5	-15	15	0	0	0.6	-0.219137
	5	-15	15	0	0	0.6	-0.830671
Survey variance Right side selectivity							
	5	-15	15	0	0	0.6	4.5791
	5	-15	15	0	0	0.6	4.78909

Table 2. Coleraine input file for the northern area (LCN) base model: Likelihood and fixed parameter specifications.

Likelihoods (1= norm; 2 = lognorm; 3= robust norm; 4=robust lognorm; 12 = robust lognormal for proportions)

CPUE likelihood Type		
	2	
Commercial catch at age likelihood type		
	12	12
Commercial catch at length likelihood type		
	12	12
Survey likelihood type		
	2	2
Survey Index type (1=weight; 2=numbers)		
	1	2
Survey vulnerability type (1=age; 2=length)		
	1	1
Survey no-sex C@L likelihood type		
	0	0
Survey catch at length likelihood type		
	12	12
Survey catch at age likelihood type		
	12	12

Fixed Parameters

Bi-scalar of length-weight relationship		
	0.0018	0.0040
bii exponent of length-weight relationship		
	3.3978	3.2149
L-infinity of the vonBertanlanffy growth equation		
	130.1833	91.8169
k of the vonBertanlanffy growth equation		
	0.1041	0.1493
t0 of the vonBertanlanffy growth equation		
	-2.8497	-3.0970
Brody parameter		
	0.2000	0.2000
Mean length of age 1 fish		
	42.9822	41.9992
Length at oldest age		
	118.1188	88.8944
S.d. of length at age of 1-year old fish		
	2.7223	2.0968
S.d. of length at age of oldest fish		
	9.9838	7.5582

Table 3. Coleraine output file for the northern area (LCN) base model: Negative log likelihood values (top), parameter estimates (outlined in bold), and fixed values used in the model (shaded).

B0		23952
Depletion		0.29
	No. of Parameters:	**51**
Likelihoods	**AIC:**	**-14946**
Trawl Logbook CPUE		4.7
Com Catch-At-Age		-1955.8
Rec Catch-At-Age		-1567.0
Com Catch-At-Length		-810.3
Rec Catch-At-Length		-626.4
NMFS Trawl Survey		2.9
WDFW Tag Survey		1.7
NMFS Survey Catch-At-Age		-318.1
WDFW Survey Catch-At-Age		-353.2
NMFS Survey Catch-At-Length		-318.9
WDFW Survey Catch-At-Length		-1606.4
		0
		0
Penalties: B-H Recruitment		22.6
	Total Likelihood:	**-7524.2**
Parameters		
R0		1805
h		0.9
M Females		0.18
M Males		0.32
Rinit		1
Uinit Females		0.09
Uinit Males		0.09
Init Plus Grp Resid Females		1
Init Plus Grp Resid Males		1
Selectivity - Full Com		4.00
Selectivity - Full Rec		4.00
Selectivity - Left Side Com		-12.16
Selectivity - Left Side Rec		-15.00
Selectivity - Right Side Com		15.00
Selectivity - Right Side Rec		2.88
Selectivity - Full - Yr Error Com		0
Selectivity - Full - Yr Error Rec		0
Selectivity - Left - Yr Error Com		0
Selectivity - Left - Yr Error Rec		0
Selectivity - Right - Yr Error Com		0
Selectivity - Right - Yr Error Rec		0
Trawl Logbook CPUE - log(q)		-6.73
Trawl Logbook CPUE - q Yr Error		0.00
Trawl Logbook CPUE q		0.00
NMFS Trawl Survey q		-0.28
WDFW Tag Survey q		4.81
Selectivity - Full NMFS Survey		4.25
Selectivity - Full WDFW Survey		7.43
Selectivity - Left NMFS Survey		-0.22
Selectivity - Left WDFW Survey		-0.83
Selectivity - Right NMFS Survey		4.58
Selectivity - Right WDFW Survey		4.79
Log Initial Age Comp Dev		0.00
Log Rec Dev		-0.2891

Table 3a.1. Coleraine output for the northern area (LCN) base model. Standard deviation of estimated parameters under the dome shaped fishery selectivity model.

index	name	value	std dev
1	R0	1.8046e+003	5.6175e+001
2	log_RecDev	-2.8907e-001	1.7899e-001
3	log_RecDev	-3.1635e-001	1.9415e-001
4	log_RecDev	-1.3456e-001	1.7700e-001
5	log_RecDev	-2.0427e-001	1.9747e-001
6	log_RecDev	-2.2905e-001	1.9279e-001
7	log_RecDev	-1.5507e-001	1.8728e-001
8	log_RecDev	-1.4527e-001	1.8877e-001
9	log_RecDev	4.2838e-001	1.6512e-001
10	log_RecDev	-8.9725e-002	1.7300e-001
11	log_RecDev	3.5796e-002	1.9356e-001
12	log_RecDev	-3.8628e-001	1.5556e-001
13	log_RecDev	-8.7539e-002	1.6889e-001
14	log_RecDev	-5.6214e-002	1.8895e-001
15	log_RecDev	7.6997e-001	8.4586e-002
16	log_RecDev	-1.9187e-001	1.4136e-001
17	log_RecDev	-4.5506e-001	1.5797e-001
18	log_RecDev	-2.1885e-001	1.2306e-001
19	log_RecDev	1.2543e-002	1.1650e-001
20	log_RecDev	6.7353e-002	1.0712e-001
21	log_RecDev	4.3182e-002	1.1598e-001
22	log_RecDev	-2.0990e-001	1.6596e-001
23	log_RecDev	7.1103e-002	1.3459e-001
24	log_RecDev	2.8221e-001	1.4720e-001
25	log_RecDev	1.6941e-001	1.5865e-001
26	log_RecDev	-6.2276e-002	1.6827e-001
27	log_RecDev	3.9475e-002	1.7187e-001
28	log_RecDev	2.3747e-001	1.8825e-001
29	log_RecDev	8.4688e-002	2.1109e-001
30	log_RecDev	2.8128e-003	2.0038e-001
31	log_RecDev	0.0000e+000	2.0000e-001
32	log_RecDev	0.0000e+000	2.0000e-001
33	Sfullest	4.0000e+000	2.0585e-003
34	Sfullest	4.0008e+000	6.0985e-005
35	Sfulldelta	2.2791e-003	3.6505e-001
36	Sfulldelta	-7.5684e-004	1.2916e-004
37	log_varLest	-1.2369e+001	3.2042e+002
38	log_varLest	-1.5000e+001	4.3806e-002
39	log_varRest	1.5000e+001	3.8942e-001
40	log_varRest	2.8795e+000	4.8134e-001
41	log_qCPUE	-6.7289e+000	5.2017e-002
42	log_qsurvey	-2.7680e-001	1.5135e-001
43	log_qsurvey	4.8066e+000	7.6105e-002
44	surveySfullest	4.2458e+000	4.2222e-001
45	surveySfullest	7.4320e+000	1.4611e-001
46	surveySfulldeltaest	-1.0930e+000	2.2191e-001
47	surveySfulldeltaest	-5.0000e+000	1.2529e-005
48	log_surveyvarL	-2.1914e-001	6.3816e-001
49	log_surveyvarL	-8.3067e-001	2.8254e-001
50	log_surveyvarR	4.5791e+000	1.3811e+000
51	log_surveyvarR	4.7891e+000	1.2618e+000
52	Ro_mcmc	1.8046e+003	5.6175e+001

Table 3a. Coleraine output for the northern area (LCN) base model: Profile over historical exploitation rate (U_{init}); Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold. Note: Runs 4 and 5 did not fully converge.

B0	26853	27556	28072	28079	29503
Depletion	0.16	0.15	0.14	0.13	0.12
	RUN1	**RUN2**	**RUN3**	**RUN4**	**RUN5**
Input File	nu1out.txt	nu2out.txt	nu3out.txt	nu4out.txt	nu5out.txt
No. of Parameters:	47	47	47	47	47
Likelihoods AIC:	**-14888**	**-14886**	**-14884**	**-14919**	**-14886**
Trawl Logbook CPUE	4.2	4.3	4.3	4.2	4.4
Com Catch-At-Age	-1950.1	-1951.4	-1953.6	-1962.6	-1961.4
Rec Catch-At-Age	-1566.1	-1565.5	-1564.5	-1566.3	-1565.7
Com Catch-At-Length	-809.5	-808.9	-808.7	-810.3	-808.0
Rec Catch-At-Length	-630.2	-630.4	-630.6	-629.5	-630.2
NMFS Trawl Survey	5.7	6.0	6.4	8.6	6.7
WDFW Tag Survey	5.3	5.5	5.7	5.1	5.6
NMFS Survey Catch-At-Age	-315.5	-315.4	-315.2	-349.1	-314.7
WDFW Survey Catch-At-Age	-339.2	-339.1	-339.0	-337.9	-338.7
NMFS Survey Catch-At-Length	-316.0	-316.5	-317.1	-303.4	-318.3
WDFW Survey Catch-At-Length	-1606.5	-1606.5	-1606.4	-1600.1	-1604.5
	0	0	0	0	0
	0	0	0	0	0
Penalties: B-H Recruitment	26.9	28.0	30.0	34.9	34.9
Total Likelihood:	**-7490.9**	**-7489.8**	**-7488.8**	**-7506.4**	**-7489.8**
Parameters					
R0	2023	2076	2115	2116	2223
h	0.7	0.7	0.7	0.7	0.7
M Females	0.18	0.18	0.18	0.18	0.18
M Males	0.32	0.32	0.32	0.32	0.32
Rinit	1	1	1	1	1
Uinit Females	**0.03**	**0.06**	**0.09**	**0.12**	**0.15**
Uinit Males	**0.03**	**0.06**	**0.09**	**0.12**	**0.15**
Init Plus Grp Resid Females	1	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1	1
Selectivity - Full Com	4.00	4.00	4.00	3.94	3.99
Selectivity - Full Rec	4.00	4.00	4.00	4.00	4.00
Selectivity - Left Side Com	-15.00	-15.00	-15.00	-6.28	-5.54
Selectivity - Left Side Rec	-15.00	-15.00	-15.00	-15.00	-15.00
Selectivity - Right Side Com	4.76	4.89	5.15	15.00	15.00
Selectivity - Right Side Rec	2.65	2.61	2.55	2.53	2.55
Selectivity - Full - Yr Error Com	0	0	0	0	0
Selectivity - Full - Yr Error Rec	0	0	0	0	0
Selectivity - Left - Yr Error Com	0	0	0	0	0
Selectivity - Left - Yr Error Rec	0	0	0	0	0
Selectivity - Right - Yr Error Com	0	0	0	0	0
Selectivity - Right - Yr Error Rec	0	0	0	0	0
Trawl Logbook CPUE - log(q)	-6.71	-6.71	-6.72	-6.80	-6.79
Trawl Logbook CPUE - q Yr Error	0.00	0.00	0.00	0.00	0.00
Trawl Logbook CPUE q	0.00	0.00	0.00	0.00	0.00
NMFS Trawl Survey q	-0.12	-0.11	-0.10	-0.27	-0.09
WDFW Tag Survey q	5.00	5.00	5.00	5.00	5.00
Selectivity - Full NMFS Survey	5.17	5.18	5.20	2.88	5.22
Selectivity - Full WDFW Survey	8.87	8.87	8.88	8.91	8.90
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Left WDFW Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00	4.00
Selectivity - Right WDFW Survey	3.00	3.00	3.00	3.00	3.00
Log Initial Age Comp Dev	0.00	0.00	0.00	0.00	0.00
Log Rec Dev	-0.3164	-0.3173	-0.3136	-0.3398	-0.3502

Table 3b. Coleraine output for the northern area (LCN) base model: Profile over natural mortality rate (M); Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold. Note: Runs 4 and 5 did not fully converge.

B0	37513	32531	28072	24706	23597
Depletion	0.11	0.12	0.14	0.16	0.20
	RUN1	**RUN2**	**RUN3**	**RUN4**	**RUN5**
Input File	nm1out.txt	nm2out.txt	nm3out.txt	nm4out.txt	nm5out.txt
No. of Parameters:	47	47	47	47	47
Likelihoods AIC:	**-14827**	**-14882**	**-14884**	**-14937**	**-14947**
Trawl Logbook CPUE	4.5	4.4	4.3	4.1	4.3
Com Catch-At-Age	-1955.0	-1947.6	-1953.6	-1968.2	-1975.4
Rec Catch-At-Age	-1558.7	-1564.5	-1564.5	-1563.5	-1563.4
Com Catch-At-Length	-799.4	-808.5	-808.7	-813.4	-814.2
Rec Catch-At-Length	-631.4	-630.4	-630.6	-629.0	-628.0
NMFS Trawl Survey	6.5	9.1	6.4	7.0	4.9
WDFW Tag Survey	12.3	5.9	5.7	5.5	5.3
NMFS Survey Catch-At-Age	-315.6	-361.7	-315.2	-307.7	-318.4
WDFW Survey Catch-At-Age	-348.6	-339.5	-339.0	-338.7	-339.2
NMFS Survey Catch-At-Length	-317.3	-278.9	-317.1	-335.3	-316.4
WDFW Survey Catch-At-Length	-1588.9	-1606.1	-1606.4	-1606.6	-1607.3
	0	0	0	0	0
	0	0	0	0	0
Penalties: B-H Recruitment	31.1	30.0	30.0	30.5	27.5
Total Likelihood:	**-7460.5**	**-7487.8**	**-7488.8**	**-7515.4**	**-7520.3**
Parameters					
R0	1692	1917	2115	2338	2762
h	0.7	0.7	0.7	0.7	0.7
M Females	**0.14**	**0.16**	**0.18**	**0.2**	**0.22**
M Males	**0.28**	**0.3**	**0.32**	**0.35**	**0.38**
Rinit	1	1	1	1	1
Uinit Females	0.09	0.09	0.09	0.09	0.09
Uinit Males	0.09	0.09	0.09	0.09	0.09
Init Plus Grp Resid Females	1	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1	1
Selectivity - Full Com	4.00	4.00	4.00	3.94	3.94
Selectivity - Full Rec	4.00	4.00	4.00	4.00	4.00
Selectivity - Left Side Com	-15.00	-15.00	-15.00	-5.58	-6.17
Selectivity - Left Side Rec	-15.00	-15.00	-15.00	-15.00	-15.00
Selectivity - Right Side Com	4.51	4.62	5.15	15.00	15.00
Selectivity - Right Side Rec	2.37	2.49	2.55	2.51	2.55
Selectivity - Full - Yr Error Com	0	0	0	0	0
Selectivity - Full - Yr Error Rec	0	0	0	0	0
Selectivity - Left - Yr Error Com	0	0	0	0	0
Selectivity - Left - Yr Error Rec	0	0	0	0	0
Selectivity - Right - Yr Error Com	0	0	0	0	0
Selectivity - Right - Yr Error Rec	0	0	0	0	0
Trawl Logbook CPUE - log(q)	-6.66	-6.66	-6.72	-6.79	-6.81
Trawl Logbook CPUE - q Yr Error	0.00	0.00	0.00	0.00	0.00
Trawl Logbook CPUE q	0.00	0.00	0.00	0.00	0.00
NMFS Trawl Survey q	0.06	-0.35	-0.10	0.14	-0.16
WDFW Tag Survey q	5.00	5.00	5.00	5.00	5.00
Selectivity - Full NMFS Survey	5.30	3.49	5.20	5.31	5.24
Selectivity - Full WDFW Survey	8.68	8.87	8.88	8.97	8.97
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Left WDFW Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00	4.00
Selectivity - Right WDFW Survey	3.00	3.00	3.00	3.00	3.00
Log Initial Age Comp Dev	0.00	0.00	0.00	0.00	0.00
Log Rec Dev	-0.3619	-0.3151	-0.3136	-0.3685	-0.3849

Table 3c. Coleraine output for the northern area (LCN) base model: Profile over B-H spawner-recruit steepness (h); Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold. Note: Run 5 did not fully converge.

B0	35141	31331	28072	25212	23977
Depletion	0.07	0.11	0.14	0.20	0.28
	RUN1	**RUN2**	**RUN3**	**RUN4**	**RUN5**
Input File	nh1out.txt	nh2out.txt	nh3out.txt	nh4out.txt	nh5out.txt
No. of Parameters:	47	47	47	47	47
Likelihoods AIC:	**-14783**	**-14856**	**-14884**	**-14917**	**-14931**
Trawl Logbook CPUE	4.4	4.4	4.3	4.4	5.0
Com Catch-At-Age	-1954.7	-1949.5	-1953.6	-1959.6	-1959.0
Rec Catch-At-Age	-1558.9	-1562.7	-1564.5	-1566.4	-1566.5
Com Catch-At-Length	-795.5	-806.7	-808.7	-810.6	-809.9
Rec Catch-At-Length	-632.0	-631.8	-630.6	-628.8	-628.1
NMFS Trawl Survey	12.8	8.5	6.4	4.3	3.2
WDFW Tag Survey	9.7	5.5	5.7	5.5	5.2
NMFS Survey Catch-At-Age	-315.3	-314.2	-315.2	-316.4	-317.2
WDFW Survey Catch-At-Age	-345.6	-339.2	-339.0	-339.7	-342.0
NMFS Survey Catch-At-Length	-317.6	-316.7	-317.1	-317.3	-316.6
WDFW Survey Catch-At-Length	-1589.8	-1606.0	-1606.4	-1607.0	-1608.8
	0	0	0	0	0
	0	0	0	0	0
Penalties: B-H Recruitment	43.9	33.4	30.0	26.0	22.0
Total Likelihood:	**-7438.6**	**-7474.9**	**-7488.8**	**-7505.6**	**-7512.6**
Parameters					
R0	2648	2361	2115	1900	1807
h	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
M Females	0.18	0.18	0.18	0.18	0.18
M Males	0.32	0.32	0.32	0.32	0.32
Rinit	1	1	1	1	1
Uinit Females	0.09	0.09	0.09	0.09	0.09
Uinit Males	0.09	0.09	0.09	0.09	0.09
Init Plus Grp Resid Females	1	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1	1
Selectivity - Full Com	4.00	4.00	4.00	3.95	3.87
Selectivity - Full Rec	4.00	4.00	4.00	4.00	4.00
Selectivity - Left Side Com	-15.00	-15.00	-15.00	-2.83	-4.95
Selectivity - Left Side Rec	-15.00	-15.00	-15.00	-15.00	-15.00
Selectivity - Right Side Com	4.34	4.55	5.15	15.00	15.00
Selectivity - Right Side Rec	2.32	2.43	2.55	2.69	2.81
Selectivity - Full - Yr Error Com	0	0	0	0	0
Selectivity - Full - Yr Error Rec	0	0	0	0	0
Selectivity - Left - Yr Error Com	0	0	0	0	0
Selectivity - Left - Yr Error Rec	0	0	0	0	0
Selectivity - Right - Yr Error Com	0	0	0	0	0
Selectivity - Right - Yr Error Rec	0	0	0	0	0
Trawl Logbook CPUE - log(q)	-6.72	-6.68	-6.72	-6.78	-6.74
Trawl Logbook CPUE - q Yr Error	0.00	0.00	0.00	0.00	0.00
Trawl Logbook CPUE q	0.00	0.00	0.00	0.00	0.00
NMFS Trawl Survey q	0.01	-0.12	-0.10	-0.11	-0.15
WDFW Tag Survey q	5.00	5.00	5.00	5.00	5.00
Selectivity - Full NMFS Survey	5.31	5.19	5.20	5.19	5.17
Selectivity - Full WDFW Survey	8.80	8.86	8.88	8.89	8.88
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Left WDFW Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00	4.00
Selectivity - Right WDFW Survey	3.00	3.00	3.00	3.00	3.00
Log Initial Age Comp Dev	0.00	0.00	0.00	0.00	0.00
Log Rec Dev	-0.4229	-0.3194	-0.3136	-0.3104	-0.2775

Table 3d. Coleraine output for the northern area (LCN) base model: Profile over combinations of natural mortality rate (M) and B-H spawner-recruit steepness (*h*); Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold.

B0	45025	21087	29030	30300
Depletion	0.08	0.38	0.10	0.20
	RUN9	**RUN10**	**RUN11**	**RUN12**
Input File	nhlml.txt	nhhmh.txt	nhlmh.txt	nhhml.txt
No. of Parameters:				
Likelihoods **AIC:**				
Trawl Logbook CPUE	4.2	5.7	3.9	4.4
Com Catch-At-Age	-1943.1	-1968.2	-1969.1	-1930.2
Rec Catch-At-Age	-1564.9	-1563.6	-1563.0	-1569.8
Com Catch-At-Length	-793.8	-812.6	-809.8	-804.7
Rec Catch-At-Length	-628.9	-625.3	-629.1	-628.2
NMFS Trawl Survey	6.9	3.8	10.3	3.9
WDFW Tag Survey	2.4	1.9	4.3	1.4
NMFS Survey Catch-At-Age	-309.3	-338.9	-320.5	-334.5
WDFW Survey Catch-At-Age	-358.9	-353.8	-341.7	-353.4
NMFS Survey Catch-At-Length	-329.9	-316.0	-316.7	-316.0
WDFW Survey Catch-At-Length	-1581.4	-1607.6	-1598.0	-1603.5
	0	0	0	0
	0	0	0	0
Penalties: B-H Recruitment	37.9	22.4	41.5	22.9
Total Likelihood:	**-7458.8**	**-7552.0**	**-7487.9**	**-7507.7**
Parameters				
R0	2031	2469	3398	1367
h	**0.5**	**0.9**	**0.5**	**0.9**
M Females	**0.14**	**0.22**	**0.22**	**0.14**
M Males	**0.26**	**0.38**	**0.38**	**0.26**
Rinit	1	1	1	1
Uinit Females	0.09	0.09	0.09	0.09
Uinit Males	0.09	0.09	0.09	0.09
Init Plus Grp Resid Females	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1
Selectivity - Full Com	4.00	4.00	4.00	4.00
Selectivity - Full Rec	4.00	4.00	4.00	4.00
Selectivity - Left Side Com	-15.00	-6.82	-15.00	-15.00
Selectivity - Left Side Rec	-15.00	-15.00	-15.00	-15.00
Selectivity - Right Side Com	4.14	15.00	4.75	5.11
Selectivity - Right Side Rec	2.64	2.81	2.35	3.09
Selectivity - Full - Yr Error Com	0	0	0	0
Selectivity - Full - Yr Error Rec	0	0	0	0
Selectivity - Left - Yr Error Com	0	0	0	0
Selectivity - Left - Yr Error Rec	0	0	0	0
Selectivity - Right - Yr Error Com	0	0	0	0
Selectivity - Right - Yr Error Rec	0	0	0	0
Trawl Logbook CPUE - log(q)	-6.66	-6.74	-6.79	-6.66
Trawl Logbook CPUE - q Yr Error	0.00	0.00	0.00	0.00
Trawl Logbook CPUE q	0.00	0.00	0.00	0.00
NMFS Trawl Survey q	0.60	-0.51	-0.22	-0.28
WDFW Tag Survey q	5.00	4.75	5.00	4.91
Selectivity - Full NMFS Survey	4.00	2.79	4.44	2.42
Selectivity - Full WDFW Survey	7.49	7.45	8.54	7.40
Selectivity - Left NMFS Survey	-15.00	0.01	-0.04	-0.45
Selectivity - Left WDFW Survey	-0.73	-0.82	0.58	-0.86
Selectivity - Right NMFS Survey	2.43	14.98	3.76	4.95
Selectivity - Right WDFW Survey	3.15	6.80	2.81	3.53
Log Initial Age Comp Dev	0.00	0.00	0.00	0.00
Log Rec Dev	-0.3847	-0.3245	-0.3913	-0.2312

Table 3e. Coleraine output for the northern area (LCN) base model: Profile over combinations of domed and asymptotic fishery selectivity; Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold.

B0	27761	24824	26807	25713
Depletion	0.13	0.11	0.11	0.13
	RUN3	**RUN4**	**RUN5**	**RUN6**
Input File	ndcdsin.txt	nacasin.txt	ndcasin.txt	nacdsin.txt
No. of Parameters:	51	49	50	50
Likelihoods AIC:	**-14879**	**-14857**	**-14796**	**-14877**
Trawl Logbook CPUE	4.6	6.1	5.8	5.7
Com Catch-At-Age	-1954.6	-1954.6	-1953.7	-1963.9
Rec Catch-At-Age	-1563.7	-1566.6	-1537.4	-1547.8
Com Catch-At-Length	-808.9	-813.0	-810.3	-811.4
Rec Catch-At-Length	-630.3	-617.3	-623.5	-638.3
NMFS Trawl Survey	4.4	6.7	5.6	4.9
WDFW Tag Survey	5.6	6.4	5.1	6.6
NMFS Survey Catch-At-Age	-328.3	-313.1	-314.6	-315.3
WDFW Survey Catch-At-Age	-338.9	-340.2	-337.6	-340.1
NMFS Survey Catch-At-Length	-304.5	-319.7	-317.4	-318.7
WDFW Survey Catch-At-Length	-1608.3	-1606.7	-1606.8	-1605.6
	0	0	0	0
	0	0	0	0
Penalties: B-H Recruitment	32.1	34.3	36.5	35.6
Total Likelihood:	**-7490.7**	**-7477.7**	**-7448.2**	**-7488.3**
Parameters				
R0	2092	1870	2020	1937
h	0.7	0.7	0.7	0.7
M Females	0.18	0.18	0.18	0.18
M Males	0.32	0.32	0.32	0.32
Rinit	1	1	1	1
Uinit Females	0.09	0.09	0.09	0.09
Uinit Males	0.09	0.09	0.09	0.09
Init Plus Grp Resid Females	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1
Selectivity - Full Com	4.00	4.00	4.00	4.00
Selectivity - Full Rec	4.00	4.00	3.70	4.00
Selectivity - Left Side Com	-15.00	-11.68	-9.82	-11.21
Selectivity - Left Side Rec	-15.00	-14.47	-14.47	-15.00
Selectivity - Right Side Com	**5.28**	**15.00**	**5.81**	**15.00**
Selectivity - Right Side Rec	**2.51**	**15.00**	**15.00**	**1.64**
Selectivity - Full - Yr Error Com	0	0	0	0
Selectivity - Full - Yr Error Rec	0	0	0	0
Selectivity - Left - Yr Error Com	0	0	0	0
Selectivity - Left - Yr Error Rec	0	0	0	0
Selectivity - Right - Yr Error Com	0	0	0	0
Selectivity - Right - Yr Error Rec	0	0	0	0
Trawl Logbook CPUE - log(q)	-6.72	-6.72	-6.76	-6.75
Trawl Logbook CPUE - q Yr Error	0.00	0.00	0.00	0.00
Trawl Logbook CPUE q	0.00	0.00	0.00	0.00
NMFS Trawl Survey q	-0.20	-0.04	-0.10	-0.07
WDFW Tag Survey q	5.00	5.00	5.00	5.00
Selectivity - Full NMFS Survey	5.01	5.28	5.16	5.22
Selectivity - Full WDFW Survey	8.84	8.91	8.80	8.87
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00
Selectivity - Left WDFW Survey	1.00	1.00	1.00	1.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00
Selectivity - Right WDFW Survey	3.00	3.00	3.00	3.00
Log Initial Age Comp Dev	0.00	0.00	0.00	0.00
Log Rec Dev	-0.3050	-0.3909	-0.3151	-0.2782

Figure 1. Coleraine output for the northern area (LCN) base model: Vulnerable biomass, exploitation rate, stock recruitment, and spawning biomass.

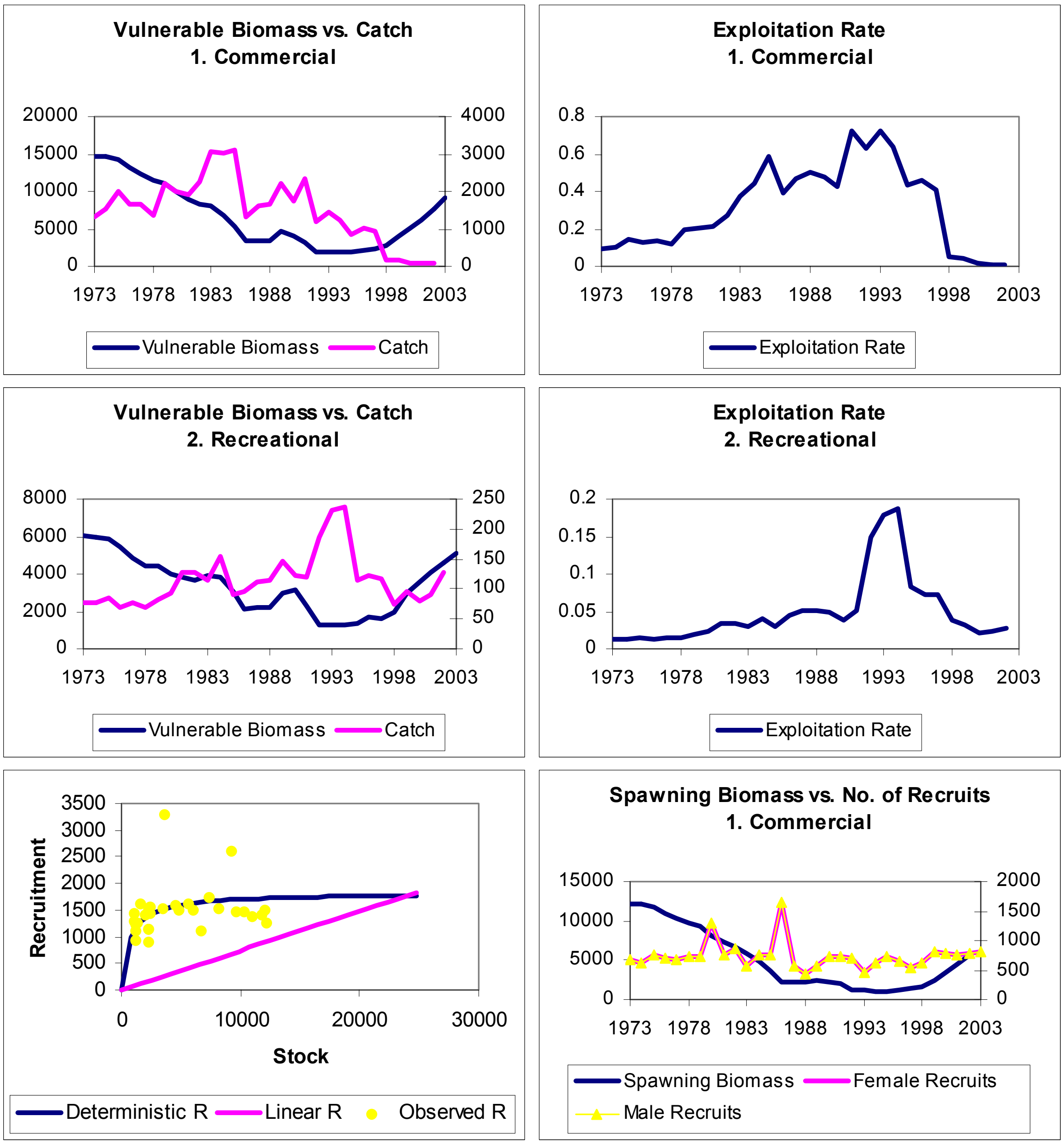


Figure 2. Coleraine output for the northern area (LCN) base model: Estimated selectivity for the commercial fishery, recreational fishery, NMFS trawl survey, and WDFW tagging survey.

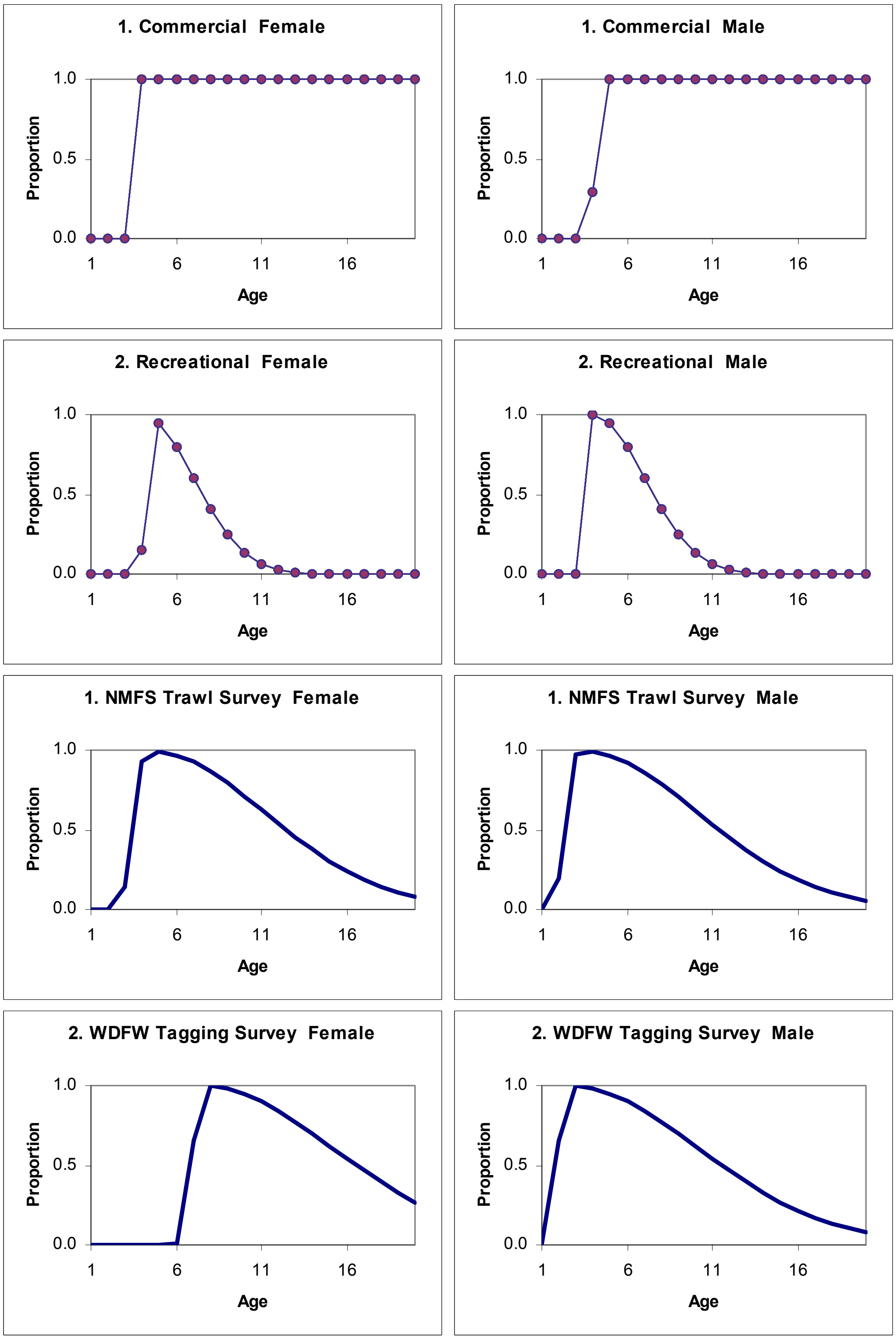


Figure 3. Coleraine output for the northern area (LCN) base model: Model fits to indices of abundance; NMFS trawl survey, WDFW tagging survey, and trawl logbook.

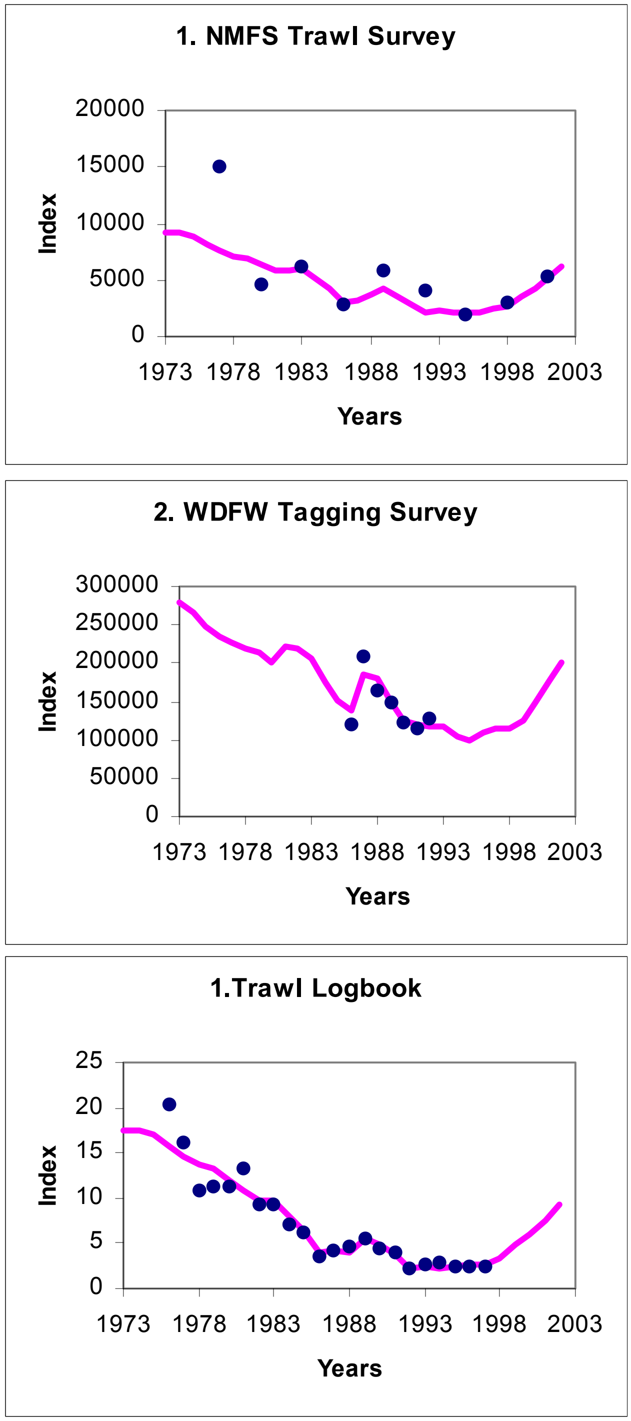


Figure 4. Coleraine output for the northern area (LCN) base model: Model fits to commercial fishery catch-at-age.

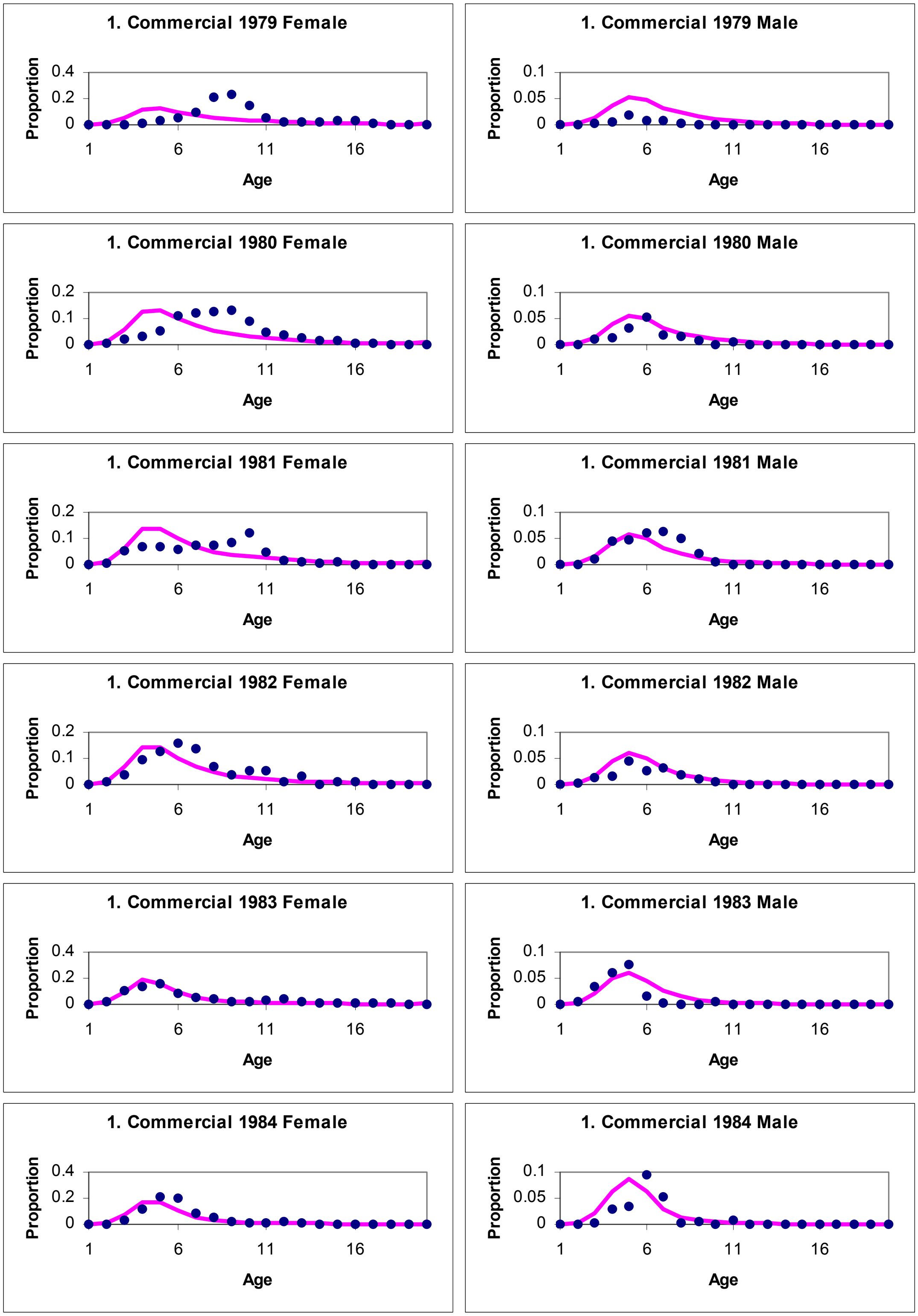


Figure 4, continued. Coleraine output for the northern area (LCN) base model: Model fits to commercial fishery catch-at-age.

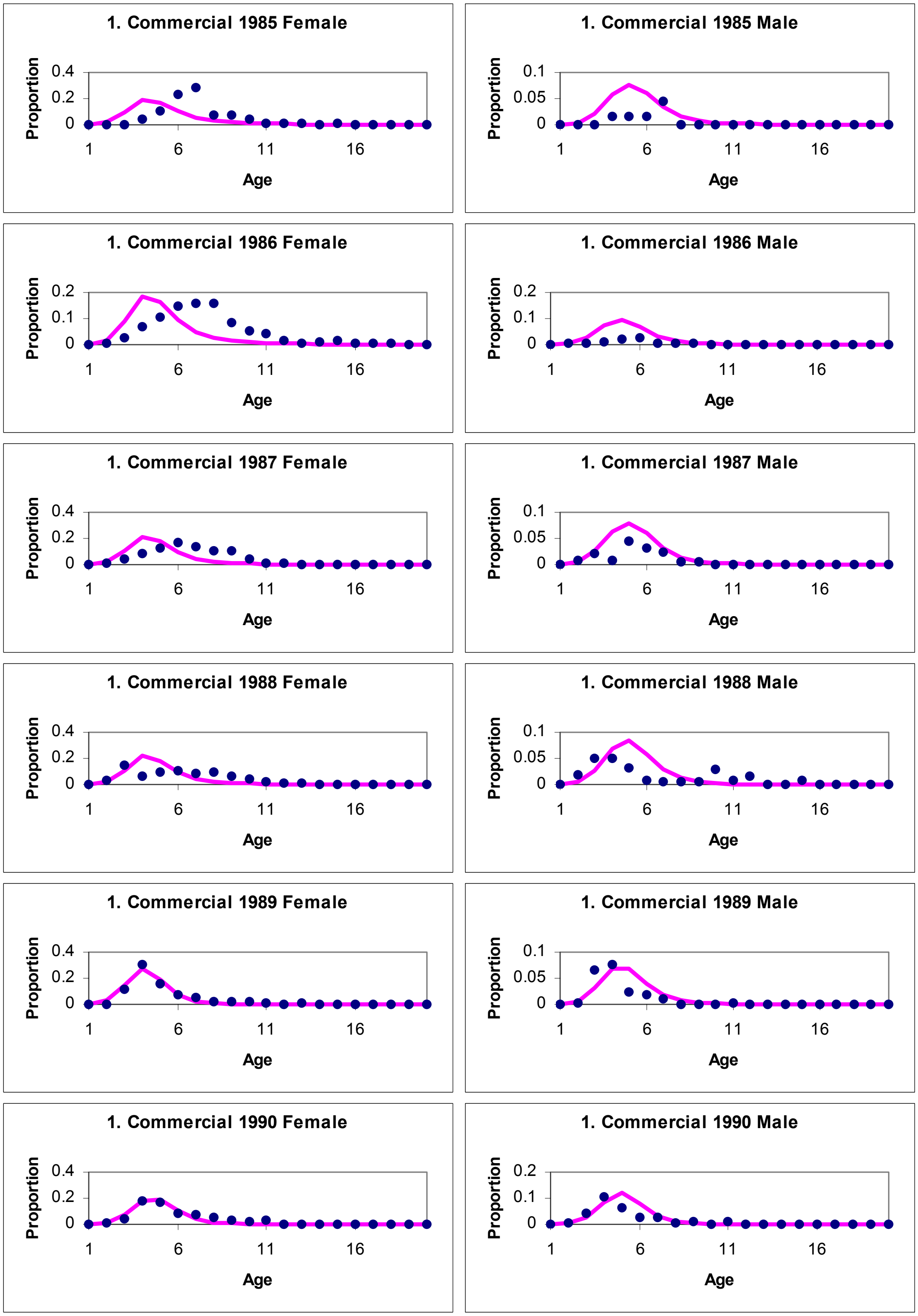


Figure 4, continued. Coleraine output for the northern area (LCN) base model: Model fits to commercial fishery catch-at-age.

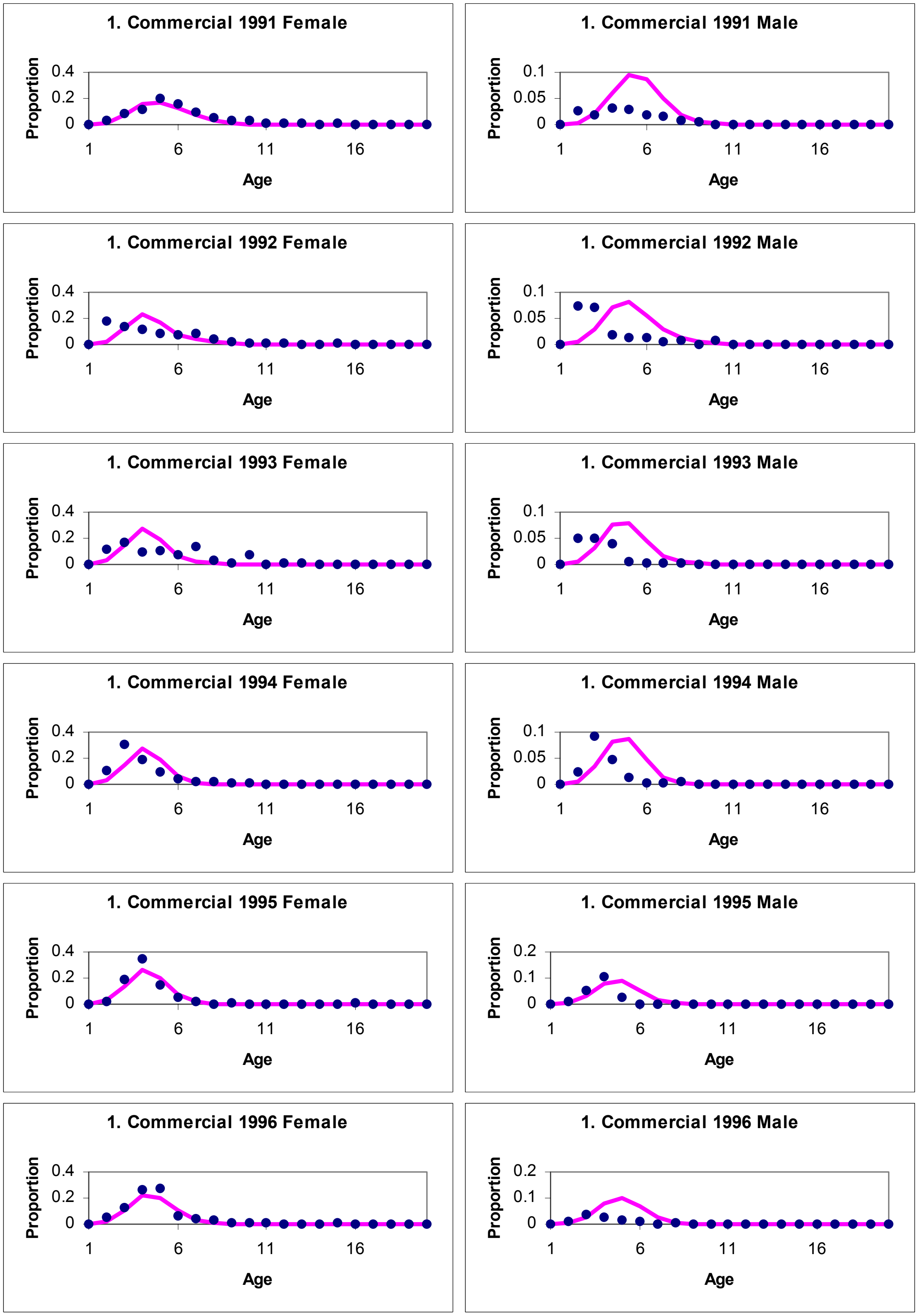


Figure 4, continued. Coleraine output for the northern area (LCN) base model: Model fits to commercial fishery catch-at-age.

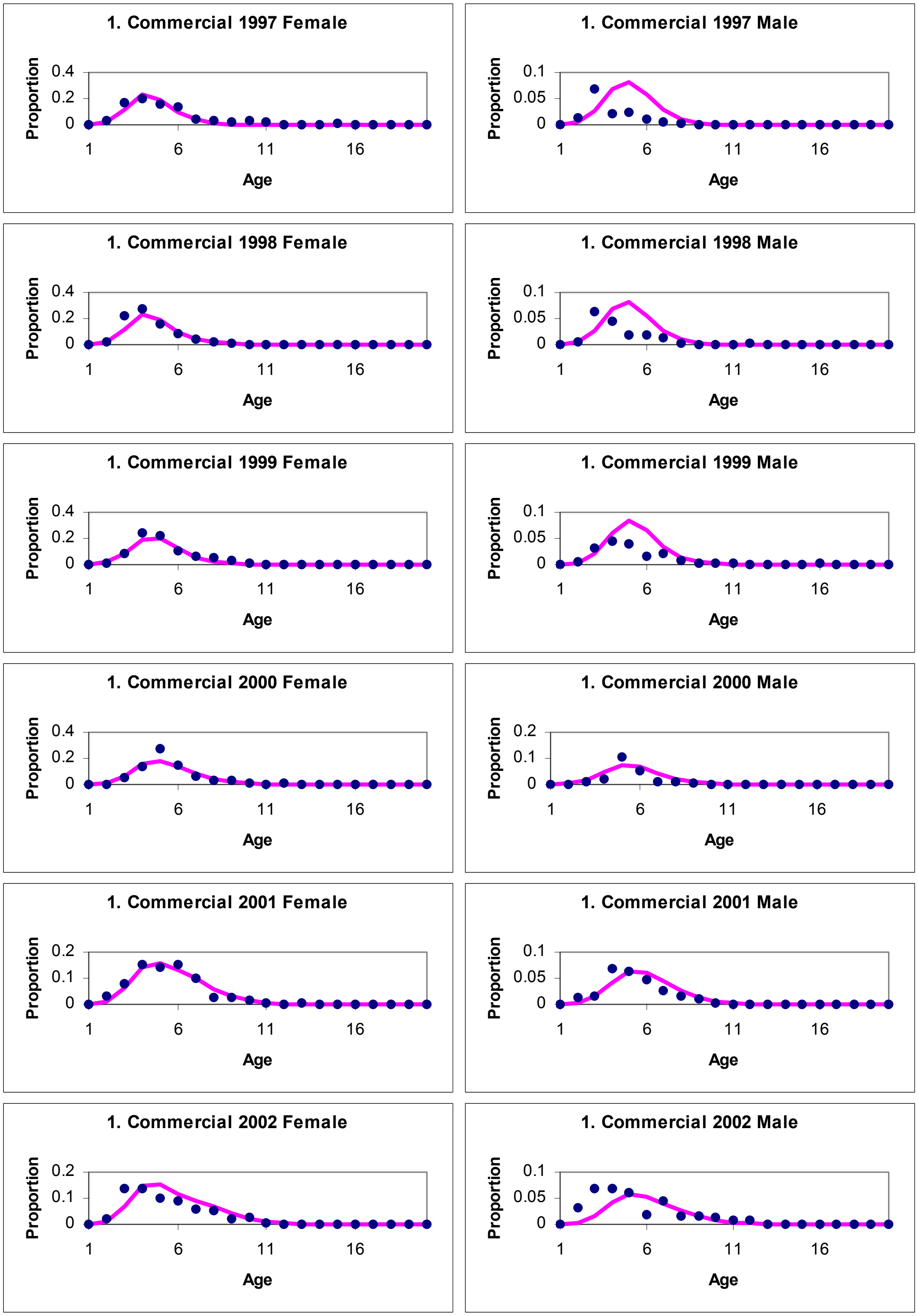


Figure 5. Coleraine output for the northern area (LCN) base model: Model fits to recreational fishery catch-at-age.

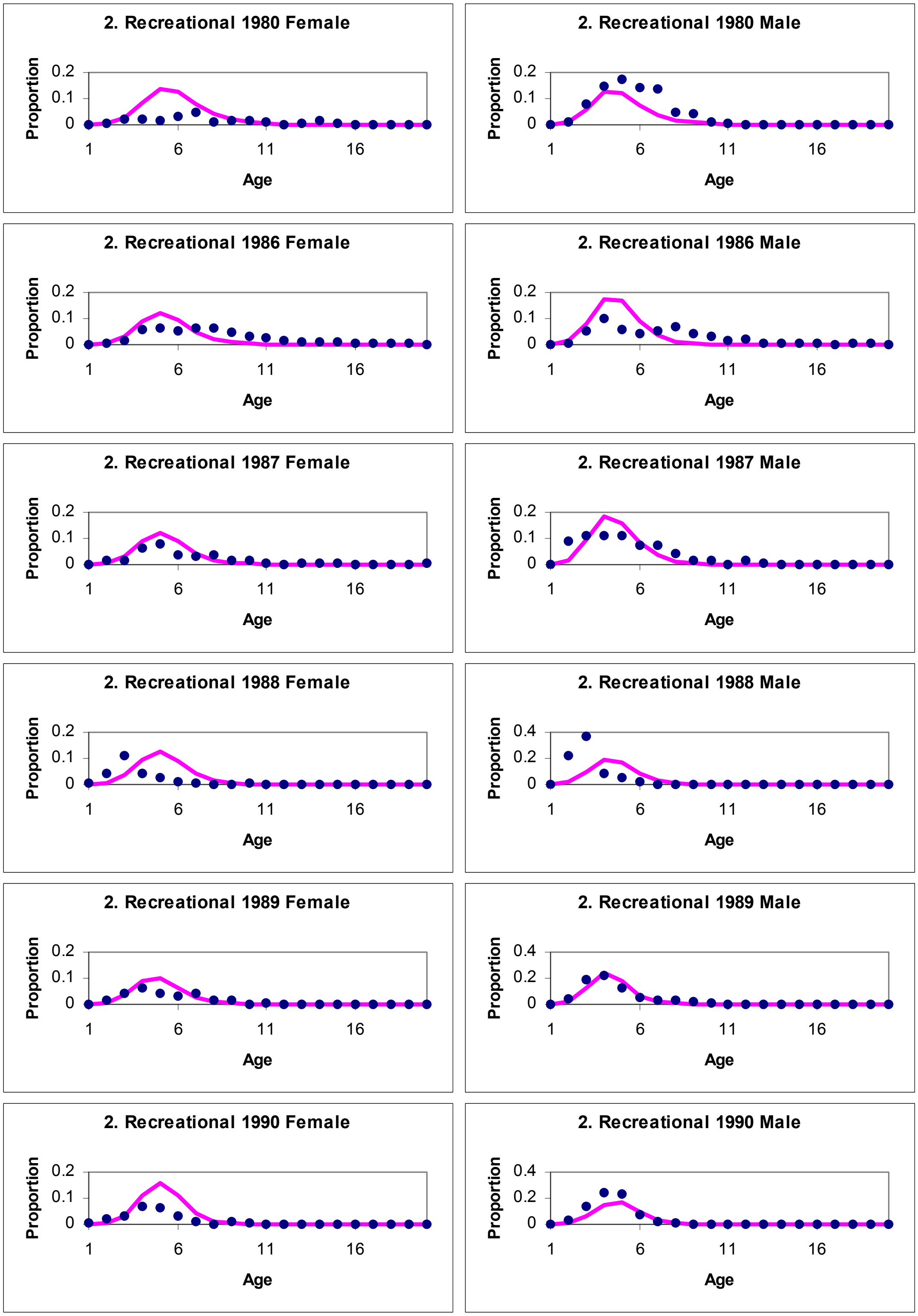


Figure 5, continued. Coleraine output for the northern area (LCN) base model: Model fits to recreational fishery catch-at-age.

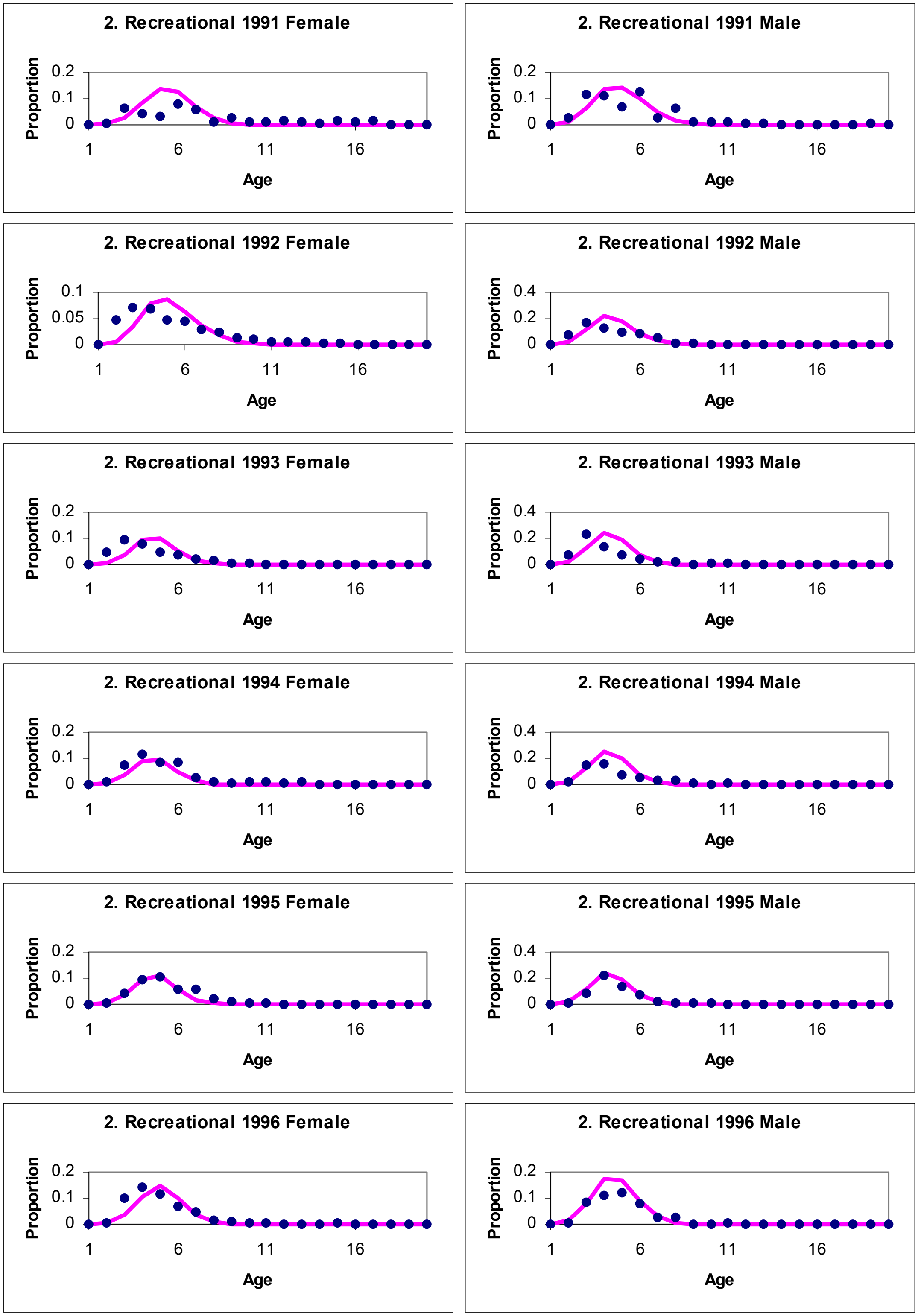


Figure 5, continued. Coleraine output for the northern area (LCN) base model: Model fits to recreational fishery catch-at-age.

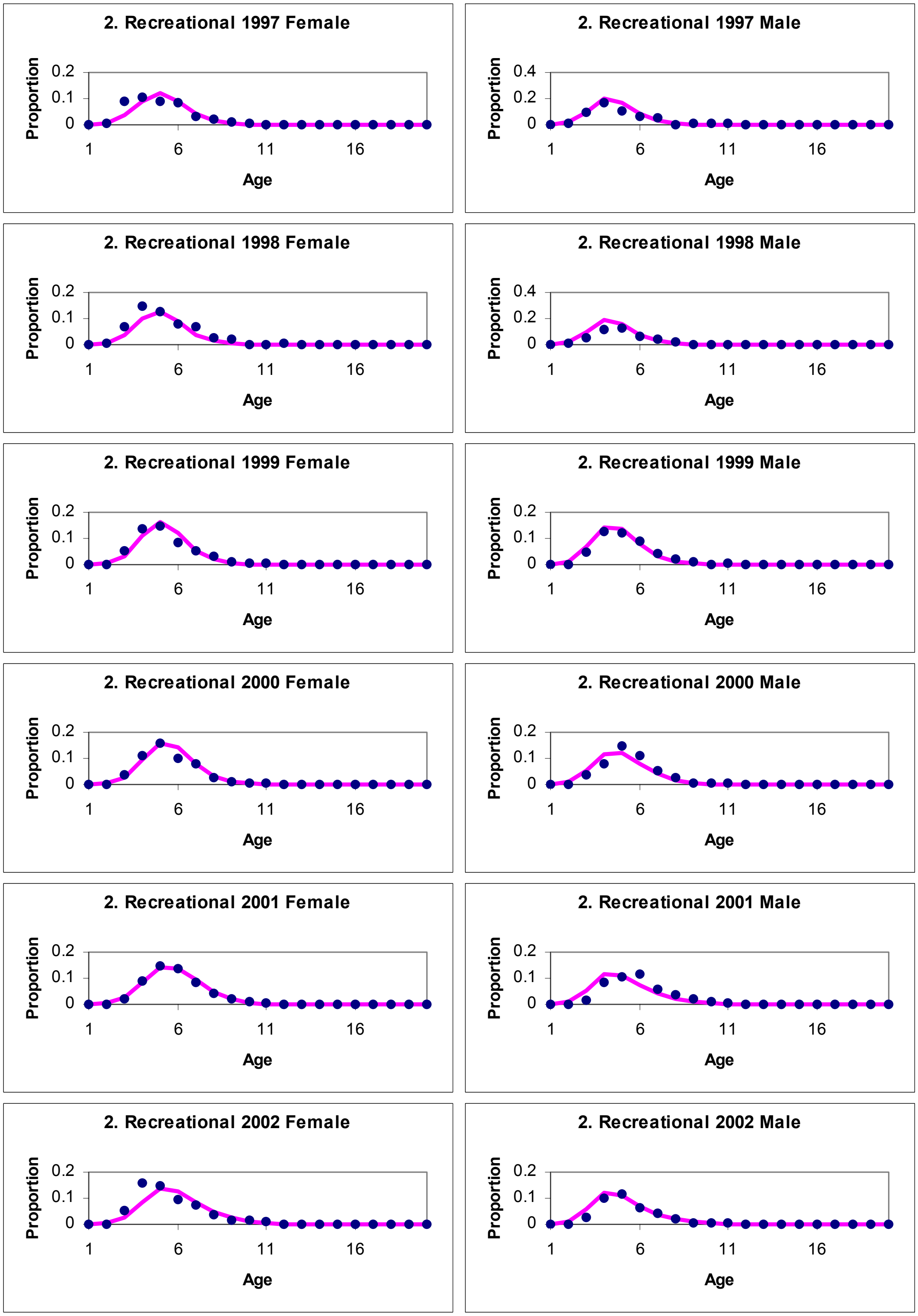


Figure 6. Coleraine output for the northern area (LCN) base model: Model fits to commercial fishery catch-at-length.

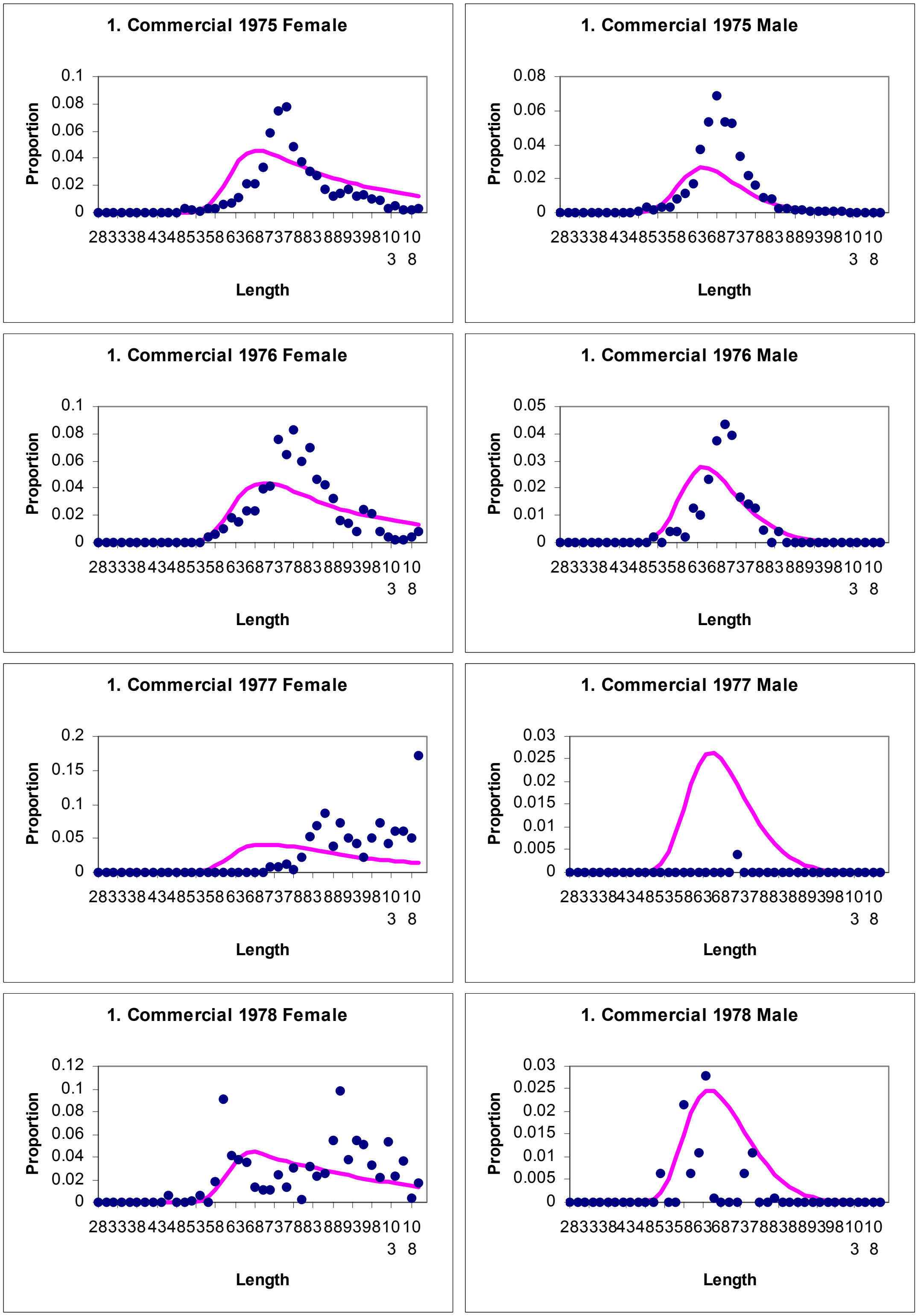


Figure 7. Coleraine output for the northern area (LCN) base model: Model fits to recreational fishery catch-at-length.

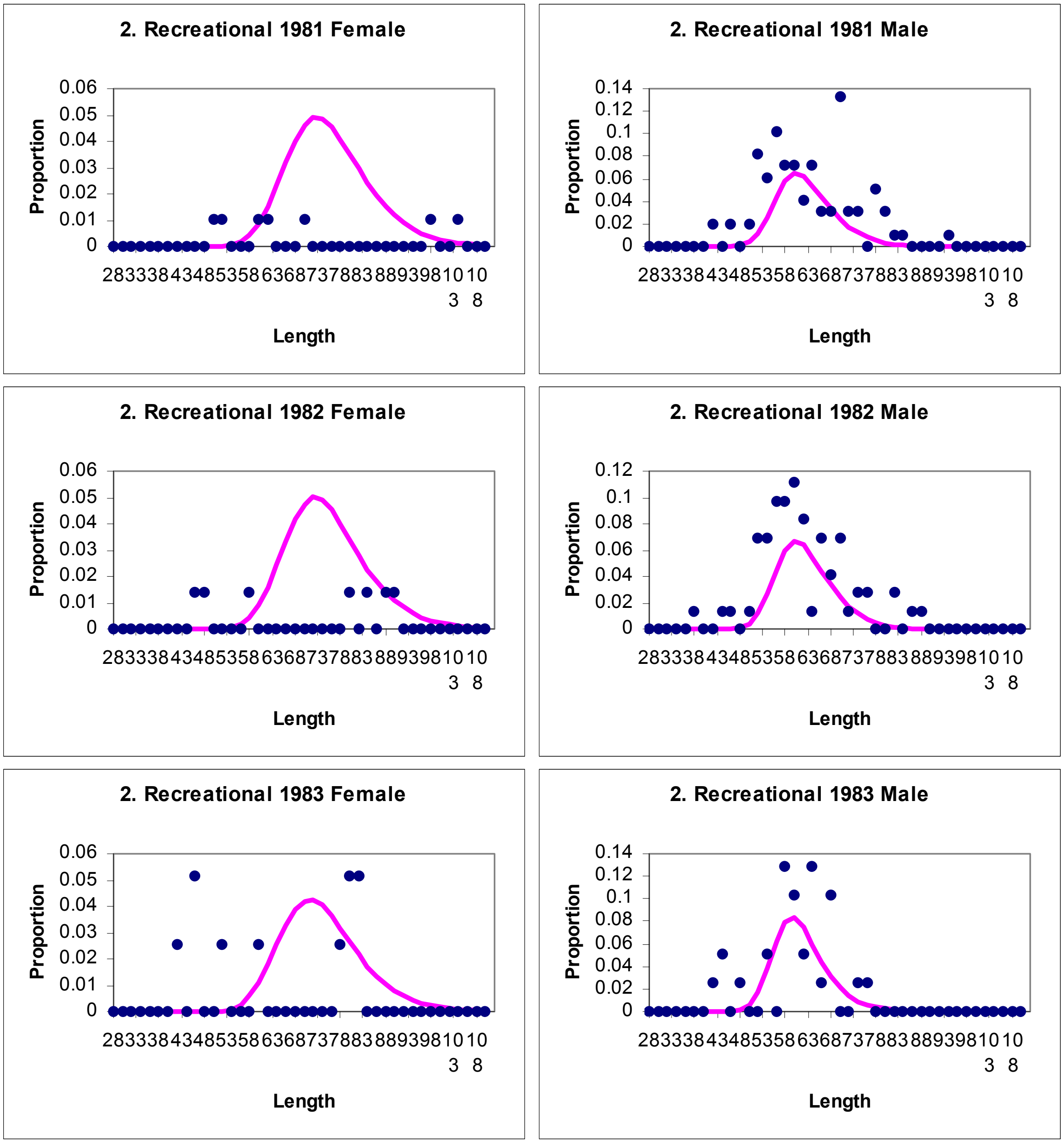


Figure 8. Coleraine output for the northern area (LCN) base model: Model fits to NMFS trawl survey catch-at-age.

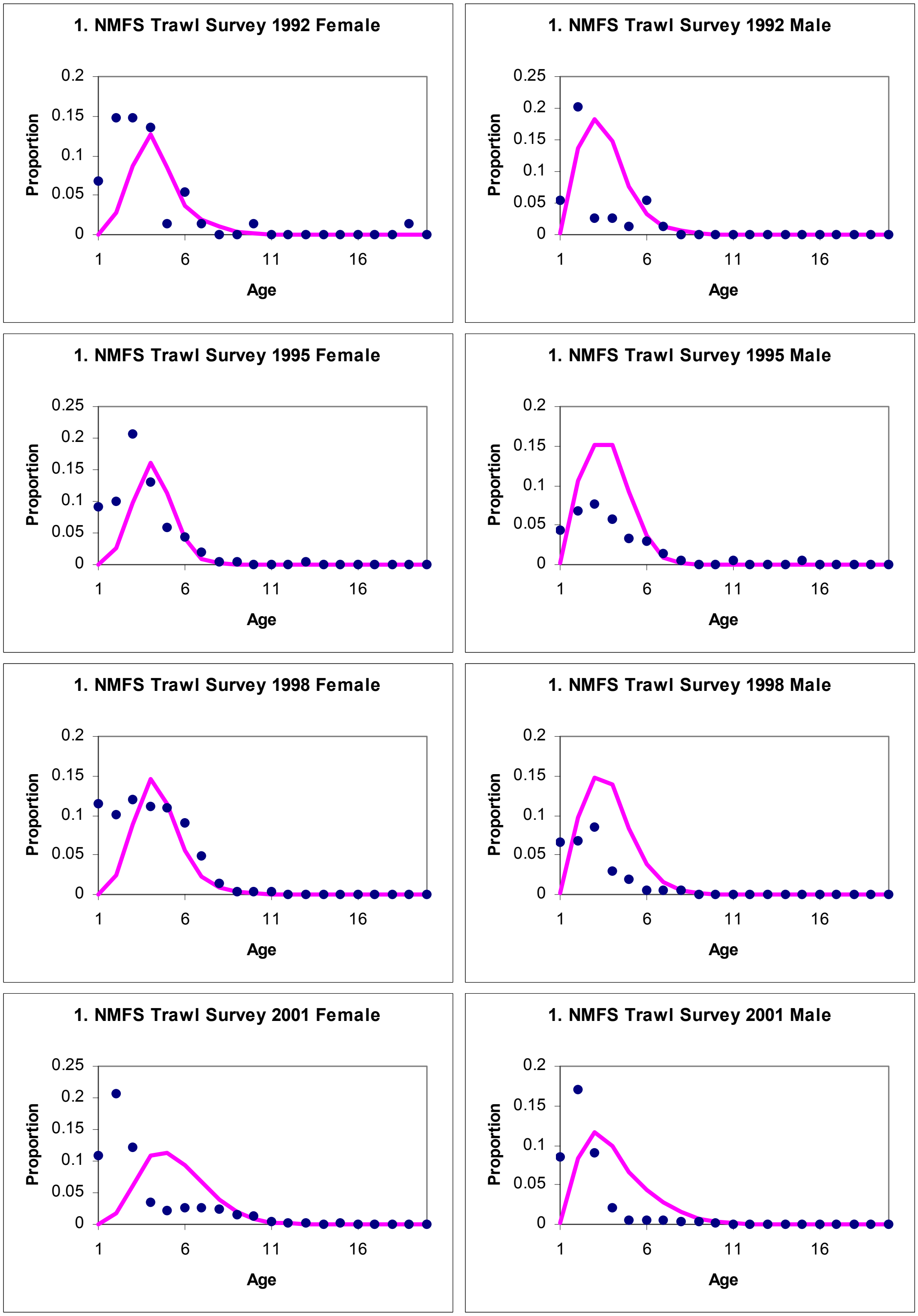


Figure 9. Coleraine output for the northern area (LCN) base model: Model fits to WDFW tagging survey catch-at-age.

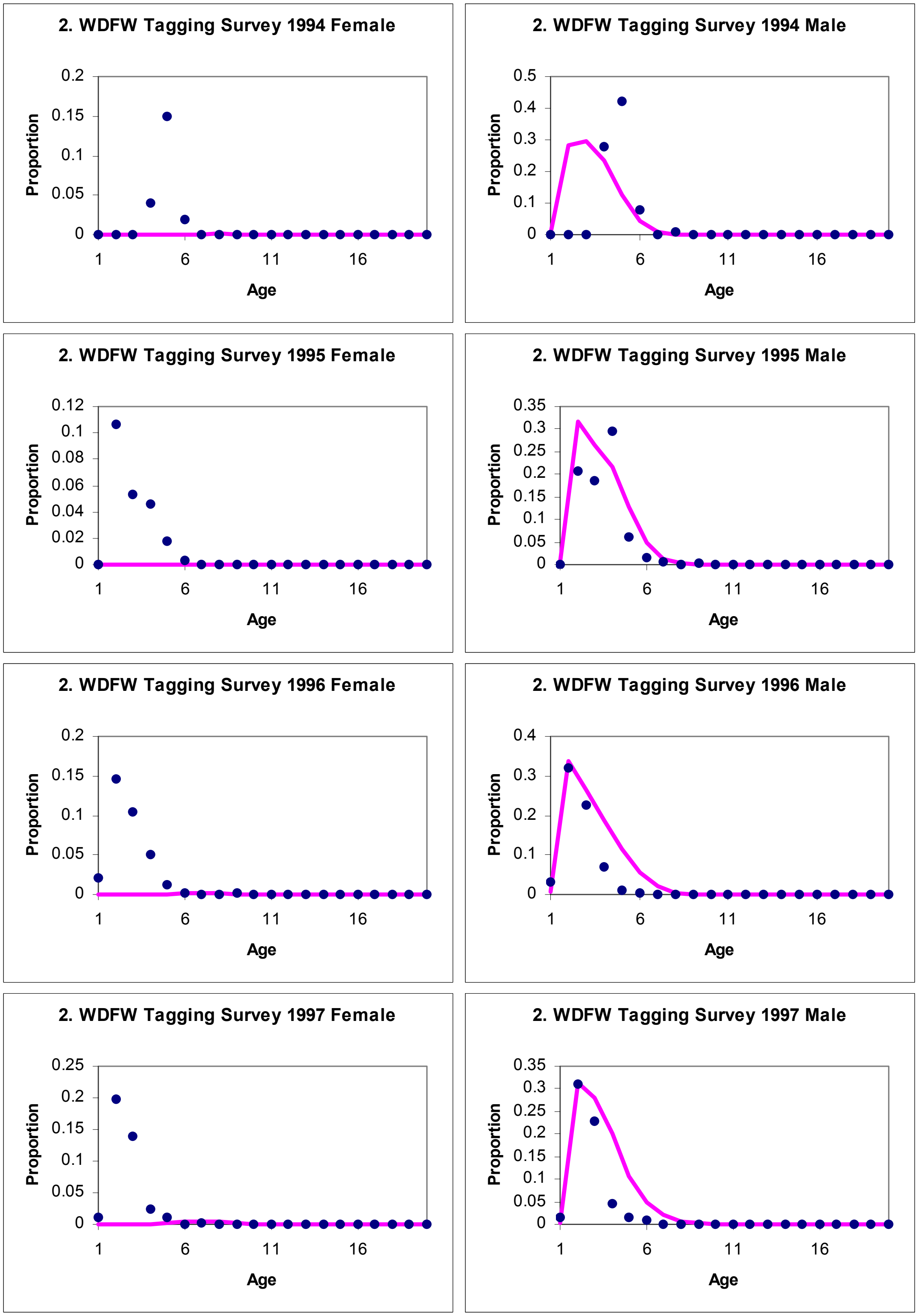


Figure 10. Coleraine output for the northern area (LCN) base model: Model fits to NMFS trawl survey and WDFW tagging survey catch-at-length.

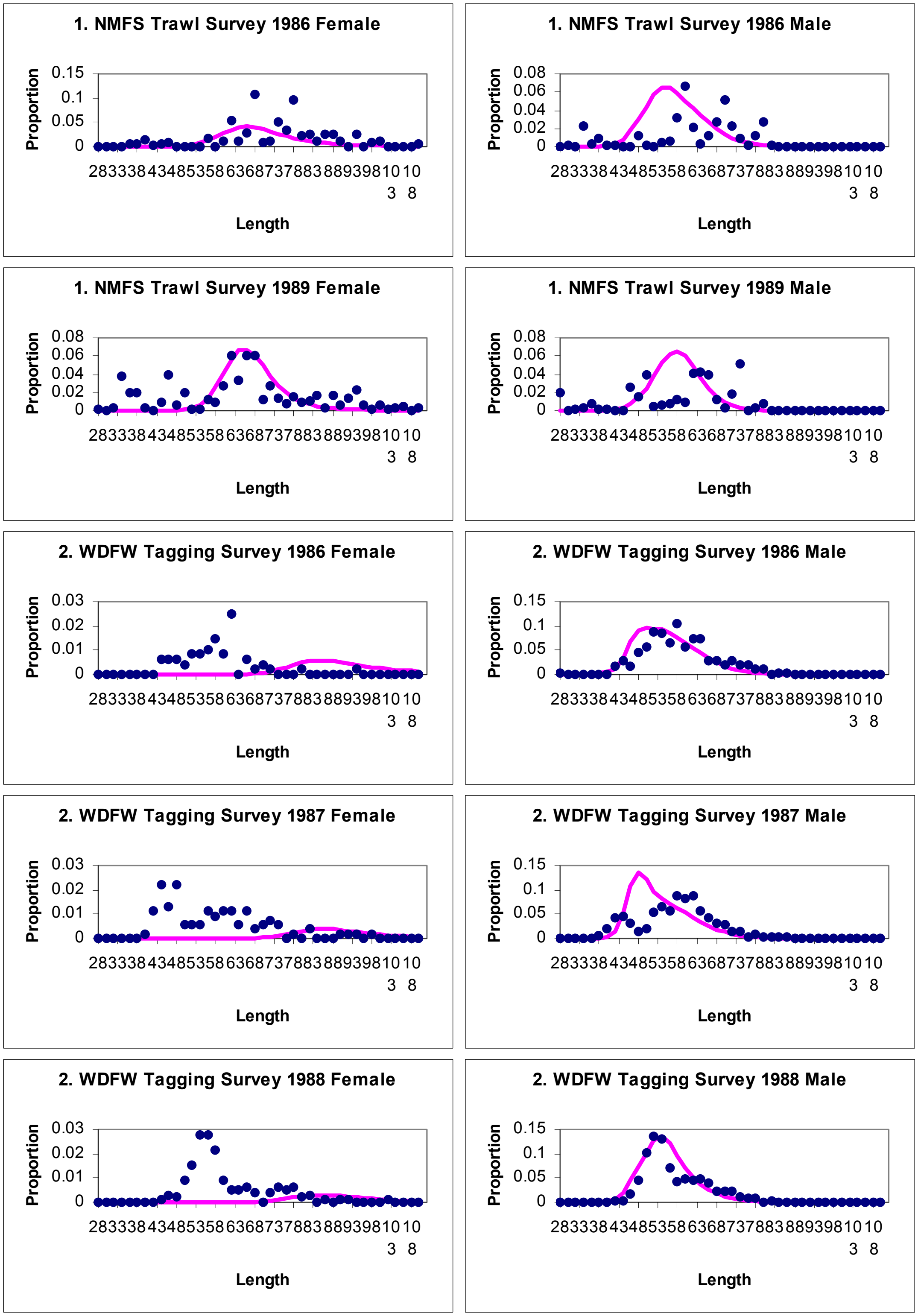


Figure 10, continued. Coleraine output for the northern area (LCN) base model: Model fits to NMFS trawl survey and WDFW tagging survey catch-at-length.

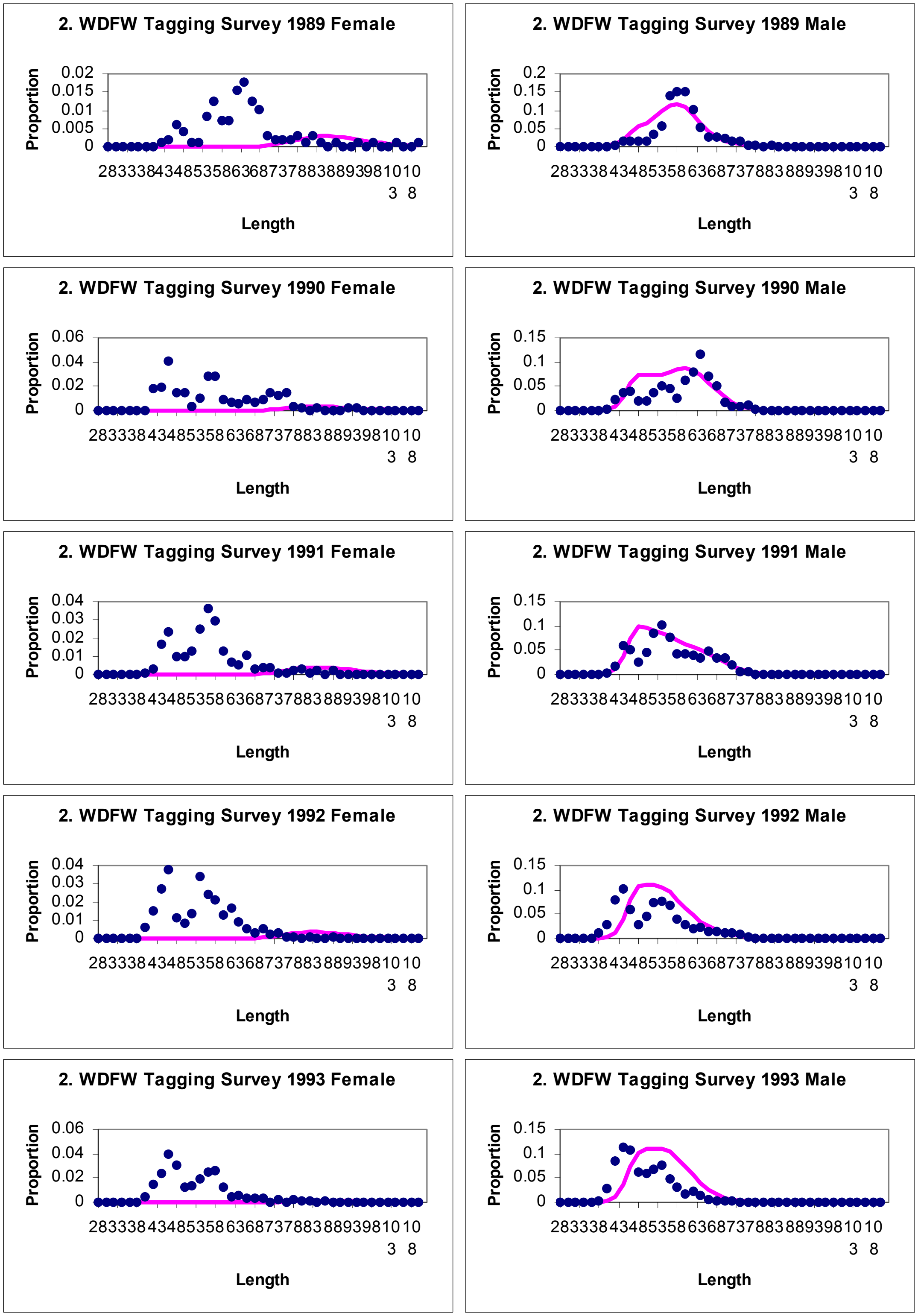


Figure 11a. Coleraine output for the northern area (LCN) base model: Retrospective analysis showing a comparison of base model estimates of spawning biomass with a base model configured with 1999 as the end year.

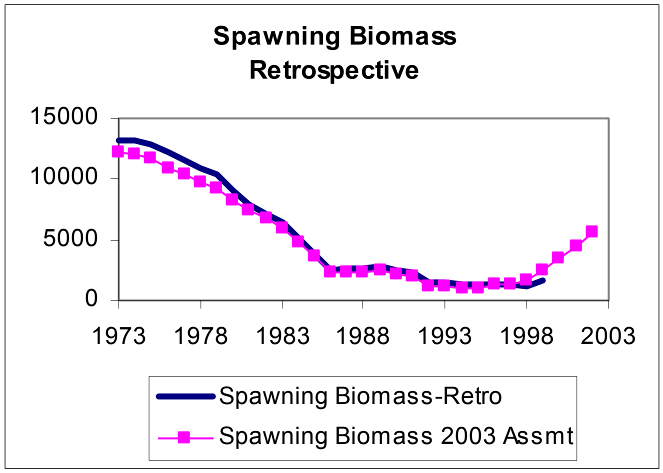


Figure 11b. Coleraine output for the northern area (LCN) base model: Historical analysis comparing spawning biomass estimates from the 2003 base model with spawning biomass estimates from the 2000 base model.

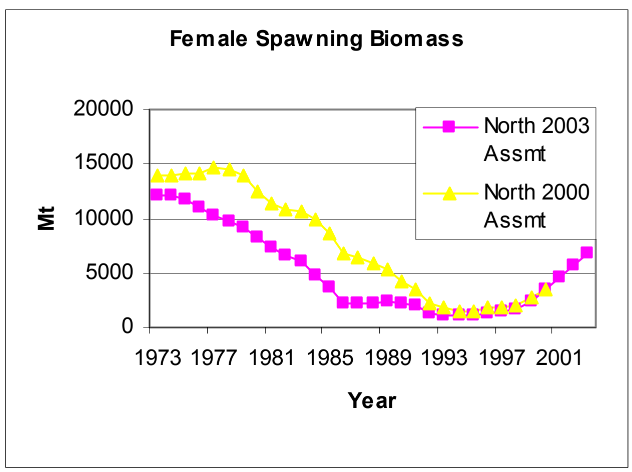


Table 4. Coleraine input for the southern area (LCS) base model: Priors.

Priors

Phase	Low Bound	High Bound	Prior Type (0=uniform, 1=normal, 2=lognormal)	Mean	CV	Seed Value
R0 (Recruitment in virgin condition)						
1	0.1	1000000	0	0	0	2100
h (steepness of spawner-recruit curve)						
-1	0.01	5	0	0.7	1	0.9
M (natural mortality)						
-1	0.05	0.5	0	0.1	0.1	0.18
-1	0.05	0.5	0	0.1	0.1	0.32
Log init dev prior: deviates for initial age structure: uniform or normal only						
-5	-15	15	1	0	0.1	0
log rec dev prior (uniform or normal only)						
2	-15	15	1	0	0.3	0
Initial R (= # 1-yr olds in yr 1/R0; unfished = 1)						
-1	0	2	0	1	0.1	1
Initial u (exploitation rate for initial age structure; 0=unfished)						
-1	0	0.25	0	0	0.1	0.07
-1	0	0.25	0	0	0.1	0.07
Plus scale						
-1	0	2	0	0	0.6	1
-1	0	2	0	0	0.6	1
Age of full selectivity - Females						
3	1	18	0	9	0.1	3.1
3	1	18	0	9	0.1	4.4
Fishery age of full selectivity difference by sex (Delta)						
4	-5	5	0	0	0.6	0
4	-5	5	0	0	0.6	0
Fishery variance of Left side of selectivity curve (for both sexes)						
4	-15	15	0	0	0.6	-2.2
4	-15	15	0	0	0.6	-1.59
Fishery variance of Right side of selectivity curve (for both sexes)						
4	-15	20	0	0	0.6	1.27
4	-15	20	0	0	0.6	4.08
Fishery age of full selectivity deviation by year						
-5	-15	15	1	0	0.1	0
-5	-15	15	1	0	0.1	0
Fishery variance of Left side selectivity by year						
-5	-15	15	1	0	0.1	0
-5	-15	15	1	0	0.1	0
Fishery variance of Right side selectivity by year						
-5	-15	15	1	0	0.1	0
-5	-15	15	1	0	0.1	0
Log q CPUE						
1	-15	15	0	0	0.1	-5
Log q CPUE error						
-1	-5	5	0	0	0.6	0
Log q Survey						
1	-5	5	0	0	0.6	-1.6
Survey age of full selectivity - Females						
-3	1	15	0	0	0.6	2
Survey age of full selectivity difference by sex (Delta)						
-3	-5	5	0	0	0.6	-0.98
Survey variance Left side selectivity						
-1	-15	15	0	0	0.6	1
Survey variance Right side selectivity						
-1	-15	15	0	0	0.6	4

Table 5. Coleraine input for the southern area (LCS) base model: Likelihood and fixed parameter specifications.

Likelihoods (1= norm; 2 = lognorm; 3= robust norm; 4=robust lognorm; 12 = robust lognormal for proportions)

CPUE likelihood Type		
	2	
Commercial catch at age likelihood type		
	12	12
Commercial catch at length likelihood type		
	0	0
Survey likelihood type		
	2	
Survey Index type (1=weight; 2=numbers)		
	1	
Survey vulnerability type (1=age; 2=length)		
	1	
Survey no-sex C@L likelihood type		
	0	
Survey catch at length likelihood type		
	0	
Survey catch at age likelihood type		
	12	

Fixed Parameters

Bi-scalar of length-weight relationship		
	0.00176	0.003953
bii exponent of length-weight relationship		
	3.3978	3.2149
L-infinity of the vonBertanlanffy growth equation		
	112.8106921	81.6939587
k of the vonBertanlanffy growth equation		
	0.144901796	0.223232852
t0 of the vonBertanlanffy growth equation		
	-1.573476868	-1.434670218
Brody parameter		
	0.2	0.2
Mean length of age 1 fish		
	35.11346278	34.25270385
Length at oldest age		
	107.8592173	81.01141723
S.d. of length at age of 1-year old fish		
	2.453914279	2.005470452
S.d. of length at age of oldest fish		
	6.611169688	12.64731616

Table 6. Coleraine output for the southern area (LCS) base model: Negative log likelihood values (top), parameter estimates (outlined in bold), and fixed values used in the model (shaded).

B0		23267
Depletion		0.16
Input File		sfinalD.txt
	No. of Parameters:	**42**
Likelihoods	**AIC:**	**-4119.35**
Trawl Logbook CPUE		7.74394
Com Catch-At-Age		-901.306
Rec Catch-At-Age		-944.034
		0
		0
NMFS Trawl Survey		11.1914
NMFS Survey Catch-At-Age		-285.437
		0
		0
Penalties: B-H Recruitment		10.1668
	Total Likelihood:	**-2101.7**
Parameters		
R0		2078.06
h		0.9
M Females		0.18
M Males		0.32
Rinit		1
Uinit Females		0.07
Uinit Males		0.07
Init Plus Grp Resid Females		1
Init Plus Grp Resid Males		1
Selectivity - Full Com		3.06415
Selectivity - Full Rec		4.3183
Selectivity - Left Side Com		-2.11419
Selectivity - Left Side Rec		-2.2295
Selectivity - Right Side Com		1.68597
Selectivity - Right Side Rec		18.6204
Selectivity - Full - Yr Error Com		0
Selectivity - Full - Yr Error Rec		0
Selectivity - Left - Yr Error Com		0
Selectivity - Left - Yr Error Rec		0
Selectivity - Right - Yr Error Com		0
Selectivity - Right - Yr Error Rec		0
Trawl Logbook CPUE - log(q)		-6.04198
Trawl Logbook CPUE - q Yr Error		0
Trawl Logbook CPUE q		0.002377
NMFS Trawl Survey q		-1.16592
Selectivity - Full NMFS Survey		2
Selectivity - Left NMFS Survey		1
Selectivity - Right NMFS Survey		4
Log Initial Age Comp Dev		0
Log Rec Dev		0.099238

Table 6a1. Coleraine output for the northern area (LCS) base model: Standard deviation of estimated parameters under the dome shaped fishery selectivity model.

index	name	value	std dev
1	R0	2.0781e+003	2.3782e+002
2	log_RecDev	9.9238e-002	3.1898e-001
3	log_RecDev	6.5530e-002	3.0707e-001
4	log_RecDev	4.2964e-002	2.9432e-001
5	log_RecDev	2.5791e-001	3.0380e-001
6	log_RecDev	3.3624e-001	2.7087e-001
7	log_RecDev	4.2634e-002	2.6969e-001
8	log_RecDev	8.8769e-002	2.7599e-001
9	log_RecDev	2.5288e-001	2.6224e-001
10	log_RecDev	3.0206e-002	2.4572e-001
11	log_RecDev	-3.8550e-001	2.4041e-001
12	log_RecDev	-5.0205e-001	2.4508e-001
13	log_RecDev	-2.6237e-001	2.5661e-001
14	log_RecDev	4.7283e-002	2.5628e-001
15	log_RecDev	1.8749e-001	2.6556e-001
16	log_RecDev	2.1493e-001	2.4760e-001
17	log_RecDev	-4.3479e-002	2.3085e-001
18	log_RecDev	-2.3003e-001	2.0221e-001
19	log_RecDev	-3.7178e-001	1.3290e-001
20	log_RecDev	-6.6480e-002	1.6114e-001
21	log_RecDev	7.0937e-002	1.6600e-001
22	log_RecDev	-5.3427e-001	2.7745e-001
23	log_RecDev	1.4631e-001	2.1832e-001
24	log_RecDev	-7.3920e-002	2.5899e-001
25	log_RecDev	1.7241e-001	2.1276e-001
26	log_RecDev	-3.2389e-001	2.2811e-001
27	log_RecDev	-2.2586e-001	2.0123e-001
28	log_RecDev	-4.4538e-001	2.3628e-001
29	log_RecDev	2.6815e-001	2.5132e-001
30	log_RecDev	1.9006e-001	2.5074e-001
31	log_RecDev	-5.7526e-006	3.0000e-001
32	log_RecDev	0.0000e+000	3.0000e-001
33	Sfullest	3.0641e+000	1.5985e-001
34	Sfullest	4.3183e+000	8.7773e-001
35	Sfulldelta	6.1139e-001	5.2049e-001
36	Sfulldelta	-5.4450e-002	1.7624e-001
37	log_varLest	-2.1142e+000	1.8501e+000
38	log_varLest	-2.2295e+000	5.3795e+000
39	log_varRest	1.6860e+000	3.3559e-001
40	log_varRest	1.8620e+001	2.5797e+003
41	log_qCPUE	-6.0420e+000	1.1102e-001
42	log_qsurvey	-1.1659e+000	8.1025e-002
43	Ro_mcmc	2.0781e+003	2.3782e+002

Table 6a. Coleraine output for the southern area (LCS) base model: Profile over historical exploitation rate (U_{init}); Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold.

B0	26826	27127	28773	29020	28216
Depletion	0.16	0.16	0.15	0.15	0.15
	RUN1	**RUN2**	**RUN3**	**RUN4**	**RUN5**
Input File	su1out.txt	su2out.txt	su3out.txt	su4out.txt	su5out.txt
No. of Parameters:	42	42	42	42	42
Likelihoods AIC:	**-4122**	**-4122**	**-4123**	**-4122**	**-4121**
Trawl Logbook CPUE	9.4	9.4	6.9	6.9	9.4
Com Catch-At-Age	-905.2	-905.1	-902.5	-902.6	-905.0
Rec Catch-At-Age	-945.7	-945.7	-944.4	-944.4	-945.7
Com Catch-At-Length	0	0	0	0	0
Rec Catch-At-Length	0	0	0	0	0
NMFS Trawl Survey	11.0	11.1	10.6	10.6	11.2
WDFW Tag Survey	0	0	0	0	0
NMFS Survey Catch-At-Age	-281.1	-281.1	-284.5	-284.5	-281.1
WDFW Survey Catch-At-Age	0	0	0	0	0
NMFS Survey Catch-At-Length	0	0	0	0	0
WDFW Survey Catch-At-Length	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Penalties: B-H Recruitment	8.4	8.5	10.6	10.6	8.6
Total Likelihood:	**-2103.0**	**-2102.9**	**-2103.3**	**-2103.2**	**-2102.6**
Parameters					
R0	2396	2423	2570	2592	2520
h	0.7	0.7	0.7	0.7	0.7
M Females	0.18	0.18	0.18	0.18	0.18
M Males	0.32	0.32	0.32	0.32	0.32
Rinit	1	1	1	1	1
Uinit Females	**0.03**	**0.05**	**0.07**	**0.09**	**0.12**
Uinit Males	**0.03**	**0.05**	**0.07**	**0.09**	**0.12**
Init Plus Grp Resid Females	1	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1	1
Selectivity - Full Com	3.00	3.00	3.12	3.12	3.00
Selectivity - Full Rec	4.38	4.38	4.41	4.41	4.38
Selectivity - Left Side Com	-15.00	-15.00	-2.19	-2.19	-15.00
Selectivity - Left Side Rec	-1.83	-1.83	-1.57	-1.57	-1.85
Selectivity - Right Side Com	2.53	2.52	1.30	1.30	2.50
Selectivity - Right Side Rec	4.22	4.22	4.13	4.13	4.21
Selectivity - Full - Yr Error Com	0	0	0	0	0
Selectivity - Full - Yr Error Rec	0	0	0	0	0
Selectivity - Left - Yr Error Com	0	0	0	0	0
Selectivity - Left - Yr Error Rec	0	0	0	0	0
Selectivity - Right - Yr Error Com	0	0	0	0	0
Selectivity - Right - Yr Error Rec	0	0	0	0	0
Trawl Logbook CPUE - log(q)	-6.2301	-6.2290	-6.0538	-6.0537	-6.2254
Trawl Logbook CPUE - q Yr Error	0	0	0	0	0
Trawl Logbook CPUE q	0.0020	0.0020	0.0023	0.0023	0.0020
NMFS Trawl Survey q	-1.2645	-1.2639	-1.2682	-1.2670	-1.2622
WDFW Tag Survey q	0	0	0	0	0
Selectivity - Full NMFS Survey	2.00	2.00	2.00	2.00	2.00
Selectivity - Full WDFW Survey	0.00	0.00	0.00	0.00	0.00
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Left WDFW Survey	0.00	0.00	0.00	0.00	0.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00	4.00
Selectivity - Right WDFW Survey	0.00	0.00	0.00	0.00	0.00
Log Initial Age Comp Dev	0	0	0	0	0
Log Rec Dev	-0.0310	-0.0297	-0.0072	-0.0057	-0.0253

Table 6b. Coleraine output for the southern area (LCS) base model: Profile over natural mortality rate (M); Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold. Note: Run 2 did not fully converge.

B0	35764	32507	28773	25842	23363
Depletion	0.15	0.14	0.15	0.16	0.17
	RUN1	**RUN2**	**RUN3**	**RUN4**	**RUN5**
Input File	sm1out.txt	sm2out.txt	sm3out.txt	sm4out.txt	sm5out.txt
No. of Parameters:	42	42	42	42	42
Likelihoods AIC:	**-4122**	**-4116**	**-4123**	**-4123**	**-4122**
Trawl Logbook CPUE	9.7	8.5	6.9	6.8	6.7
Com Catch-At-Age	-905.9	-902.4	-902.5	-902.6	-902.4
Rec Catch-At-Age	-945.8	-943.4	-944.4	-943.6	-942.6
Com Catch-At-Length	0	0	0	0	0
Rec Catch-At-Length	0	0	0	0	0
NMFS Trawl Survey	10.7	10.3	10.6	10.7	10.9
WDFW Tag Survey	0	0	0	0	0
NMFS Survey Catch-At-Age	-279.2	-281.7	-284.5	-285.5	-286.4
WDFW Survey Catch-At-Age	0	0	0	0	0
NMFS Survey Catch-At-Length	0	0	0	0	0
WDFW Survey Catch-At-Length	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Penalties: B-H Recruitment	7.7	8.6	10.6	10.7	10.7
Total Likelihood:	**-2102.9**	**-2100.1**	**-2103.3**	**-2103.4**	**-2103.1**
Parameters					
R0	1960	2298	2570	2867	3174
h	0.7	0.7	0.7	0.7	0.7
M Females	0.14	0.16	0.18	0.2	0.22
M Males	0.28	0.3	0.32	0.35	0.38
Rinit	1	1	1	1	1
Uinit Females	0.07	0.07	0.07	0.07	0.07
Uinit Males	0.07	0.07	0.07	0.07	0.07
Init Plus Grp Resid Females	1	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1	1
Selectivity - Full Com	3.00	3.07	3.12	3.13	3.15
Selectivity - Full Rec	4.39	4.33	4.41	4.41	4.42
Selectivity - Left Side Com	-15.00	-2.53	-2.19	-2.08	-1.96
Selectivity - Left Side Rec	-1.73	-2.21	-1.57	-1.61	-1.67
Selectivity - Right Side Com	2.59	1.86	1.30	1.27	1.25
Selectivity - Right Side Rec	4.09	4.18	4.13	4.23	4.40
Selectivity - Full - Yr Error Com	0	0	0	0	0
Selectivity - Full - Yr Error Rec	0	0	0	0	0
Selectivity - Left - Yr Error Com	0	0	0	0	0
Selectivity - Left - Yr Error Rec	0	0	0	0	0
Selectivity - Right - Yr Error Com	0	0	0	0	0
Selectivity - Right - Yr Error Rec	0	0	0	0	0
Trawl Logbook CPUE - log(q)	-6.2108	-6.1409	-6.0538	-6.0711	-6.0850
Trawl Logbook CPUE - q Yr Error	0	0	0	0	0
Trawl Logbook CPUE q	0.0020	0.0022	0.0023	0.0023	0.0023
NMFS Trawl Survey q	-1.2218	-1.2302	-1.2682	-1.2887	-1.3088
WDFW Tag Survey q	0	0	0	0	0
Selectivity - Full NMFS Survey	2.00	2.00	2.00	2.00	2.00
Selectivity - Full WDFW Survey	0.00	0.00	0.00	0.00	0.00
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Left WDFW Survey	0.00	0.00	0.00	0.00	0.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00	4.00
Selectivity - Right WDFW Survey	0.00	0.00	0.00	0.00	0.00
Log Initial Age Comp Dev	0	0	0	0	0
Log Rec Dev	-0.0312	-0.0305	-0.0072	-0.0003	0.0075

Table 6c. Coleraine output for the southern area (LCS) base model: Profile over B-H spawner-recruit steepness (*h*); Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold.

B0	35277	30781	28773	26006	23264
Depletion	0.15	0.15	0.15	0.16	0.16
	RUN1	**RUN2**	**RUN3**	**RUN4**	**RUN5**
Input File	sh1out.txt	sh2out.txt	sh3out.txt	sh4out.txt	sh5out.txt
No. of Parameters:	42	42	42	42	42
Likelihoods AIC:	**-4117**	**-4116**	**-4123**	**-4121**	**-4119**
Trawl Logbook CPUE	6.5	7.9	6.9	7.2	7.7
Com Catch-At-Age	-903.4	-904.6	-902.5	-901.9	-901.3
Rec Catch-At-Age	-944.4	-942.5	-944.4	-943.8	-944.0
Com Catch-At-Length	0	0	0	0	0
Rec Catch-At-Length	0	0	0	0	0
NMFS Trawl Survey	11.7	11.3	10.6	10.7	11.2
WDFW Tag Survey	0	0	0	0	0
NMFS Survey Catch-At-Age	-283.3	-280.7	-284.5	-285.0	-285.4
WDFW Survey Catch-At-Age	0	0	0	0	0
NMFS Survey Catch-At-Length	0	0	0	0	0
WDFW Survey Catch-At-Length	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Penalties: B-H Recruitment	12.4	8.3	10.6	10.4	10.2
Total Likelihood:	**-2100.5**	**-2100.2**	**-2103.3**	**-2102.4**	**-2101.7**
Parameters					
R0	3151	2749	2570	2323	2078
h	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
M Females	0.18	0.18	0.18	0.18	0.18
M Males	0.32	0.32	0.32	0.32	0.32
Rinit	1	1	1	1	1
Uinit Females	0.07	0.07	0.07	0.07	0.07
Uinit Males	0.07	0.07	0.07	0.07	0.07
Init Plus Grp Resid Females	1	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1	1
Selectivity - Full Com	3.14	3.14	3.12	3.10	3.07
Selectivity - Full Rec	4.39	4.45	4.41	4.42	4.28
Selectivity - Left Side Com	-2.41	-3.08	-2.19	-2.15	-2.11
Selectivity - Left Side Rec	-1.69	-1.58	-1.57	-1.53	-2.47
Selectivity - Right Side Com	0.97	1.78	1.30	1.46	1.68
Selectivity - Right Side Rec	3.07	3.78	4.13	4.56	12.56
Selectivity - Full - Yr Error Com	0	0	0	0	0
Selectivity - Full - Yr Error Rec	0	0	0	0	0
Selectivity - Left - Yr Error Com	0	0	0	0	0
Selectivity - Left - Yr Error Rec	0	0	0	0	0
Selectivity - Right - Yr Error Com	0	0	0	0	0
Selectivity - Right - Yr Error Rec	0	0	0	0	0
Trawl Logbook CPUE - log(q)	-6.0647	-6.1545	-6.0538	-6.0562	-6.0418
Trawl Logbook CPUE - q Yr Error	0	0	0	0	0
Trawl Logbook CPUE q	0.0023	0.0021	0.0023	0.0023	0.0024
NMFS Trawl Survey q	-1.4176	-1.3126	-1.2682	-1.2223	-1.1659
WDFW Tag Survey q	0	0	0	0	0
Selectivity - Full NMFS Survey	2.00	2.00	2.00	2.00	2.00
Selectivity - Full WDFW Survey	0.00	0.00	0.00	0.00	0.00
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00	1.00
Selectivity - Left WDFW Survey	0.00	0.00	0.00	0.00	0.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00	4.00
Selectivity - Right WDFW Survey	0.00	0.00	0.00	0.00	0.00
Log Initial Age Comp Dev	0	0	0	0	0
Log Rec Dev	-0.0406	-0.0418	-0.0072	0.0304	0.0987

Table 6d. Coleraine output for the southern area (LCS) base model: Profile over combinations of natural mortality rate (M) and B-H spawner-recruit steepness (*h*); Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold.

B0	42274	17952	28712	29002
Depletion	0.12	0.26	0.17	0.17
	RUN10	**RUN11**	**RUN12**	**RUN13**
Input File	shlml.txt	shhmh.txt	shlmh.txt	shhml.txt
No. of Parameters:				
Likelihoods AIC:				
Trawl Logbook CPUE	8.4	10.0	6.3	10.2
Com Catch-At-Age	-907.0	-904.5	-903.5	-904.4
Rec Catch-At-Age	-941.8	-943.7	-941.9	-945.5
	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0
NMFS Trawl Survey	11.6	12.9	11.9	11.8
NMFS Survey Catch-At-Age	-277.5	-283.8	-285.3	-280.2
	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0
Penalties: B-H Recruitment	10.5	9.3	12.7	9.0
Total Likelihood:	**-2095.8**	**-2099.9**	**-2099.7**	**-2098.9**
Parameters				
R0	2316	2439	3901	1589
h	**0.5**	**0.9**	**0.5**	**0.9**
M Females	**0.14**	**0.22**	**0.22**	**0.14**
M Males	**0.26**	**0.38**	**0.38**	**0.26**
Rinit	1	1	1	1
Uinit Females	0.07	0.07	0.07	0.07
Uinit Males	0.07	0.07	0.07	0.07
Init Plus Grp Resid Females	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1
Selectivity - Full Com	3.10	3.00	3.19	3.00
Selectivity - Full Rec	4.49	4.09	4.00	4.40
Selectivity - Left Side Com	-2.52	-14.34	-2.09	-14.87
Selectivity - Left Side Rec	-1.57	-4.80	-15.00	-1.66
Selectivity - Right Side Com	1.87	2.91	0.87	2.96
Selectivity - Right Side Rec	3.92	19.38	3.19	4.45
Selectivity - Full - Yr Error Com	0.00	0.00	0.00	0.00
Selectivity - Full - Yr Error Rec	0.00	0.00	0.00	0.00
Selectivity - Left - Yr Error Com	0.00	0.00	0.00	0.00
Selectivity - Left - Yr Error Rec	0.00	0.00	0.00	0.00
Selectivity - Right - Yr Error Com	0.00	0.00	0.00	0.00
Selectivity - Right - Yr Error Rec	0.00	0.00	0.00	0.00
Trawl Logbook CPUE - log(q)	-6.1675	-6.3072	-6.0970	-6.2420
Trawl Logbook CPUE - q Yr Error	0	0	0	0
Trawl Logbook CPUE q	0.0021	0.0018	0.0022	0.0019
NMFS Trawl Survey q	-1.2643	-1.3078	-1.4636	-1.1860
Selectivity - Full NMFS Survey	2.00	2.00	2.00	2.00
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00
Log Initial Age Comp Dev	0.00	0.00	0.00	0.00
Log Rec Dev	-0.0923	0.1251	-0.0246	0.0766

Table 6e. Coleraine output for the southern area (LCS) base model: Profile over combinations of domed and asymptotic fishery selectivity; Negative log likelihood values, parameter estimates, and fixed values used in the model. Best-fit model outlined in bold.

B0	28492	22525	27620	23809
Depletion	0.16	0.16	0.12	0.18
	RUN3	**RUN4**	**RUN6**	**RUN6**
Input File	sdcdsin.txt	sacasin.txt	sdcasin.txt	sacdsin.txt
No. of Parameters:	42	40	41	41
Likelihoods AIC:	**-4135**	**-4065**	**-4068**	**-4048**
Trawl Logbook CPUE	6.8	23.4	14.2	22.0
Com Catch-At-Age	-902.7	-898.1	-890.8	-896.7
Rec Catch-At-Age	-944.4	-937.8	-931.5	-925.7
	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0
NMFS Trawl Survey	4.9	6.2	5.5	6.1
NMFS Survey Catch-At-Age	-284.4	-280.9	-285.0	-280.7
	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0
Penalties: B-H Recruitment	10.6	14.4	12.4	9.8
Total Likelihood:	**-2109.3**	**-2072.6**	**-2075.2**	**-2065.2**
Parameters				
R0	2545	2012	2467	2126
h	0.7	0.7	0.7	0.7
M Females	0.18	0.18	0.18	0.18
M Males	0.32	0.32	0.32	0.32
Rinit	1	1	1	1
Uinit Females	0.07	0.07	0.07	0.07
Uinit Males	0.07	0.07	0.07	0.07
Init Plus Grp Resid Females	1	1	1	1
Init Plus Grp Resid Males	1	1	1	1
Selectivity - Full Com	3.13	2.00	2.01	2.99
Selectivity - Full Rec	4.40	4.07	3.76	5.86
Selectivity - Left Side Com	-2.21	-14.74	-7.54	-14.96
Selectivity - Left Side Rec	-1.60	-5.37	-11.25	0.63
Selectivity - Right Side Com	**1.27**	**15.00**	**3.82**	**20.00**
Selectivity - Right Side Rec	**4.09**	**15.00**	**10.48**	**0.00**
Selectivity - Full - Yr Error Com	0.00	0.00	0.00	0.00
Selectivity - Full - Yr Error Rec	0.00	0.00	0.00	0.00
Selectivity - Left - Yr Error Com	0.00	0.00	0.00	0.00
Selectivity - Left - Yr Error Rec	0.00	0.00	0.00	0.00
Selectivity - Right - Yr Error Com	0.00	0.00	0.00	0.00
Selectivity - Right - Yr Error Rec	0.00	0.00	0.00	0.00
Trawl Logbook CPUE - log(q)	-6.0561	-6.8967	-6.6475	-7.0207
Trawl Logbook CPUE - q Yr Error	0	0	0	0
Trawl Logbook CPUE q	0.0023	0.0010	0.0013	0.0009
NMFS Trawl Survey q	-1.3135	-1.2049	-1.2125	-1.2856
Selectivity - Full NMFS Survey	2.00	2.00	2.00	2.00
Selectivity - Left NMFS Survey	1.00	1.00	1.00	1.00
Selectivity - Right NMFS Survey	4.00	4.00	4.00	4.00
Log Initial Age Comp Dev	0.00	0.00	0.00	0.00
Log Rec Dev	-0.0370	-0.1698	-0.1171	-0.1390

Figure 12a. Coleraine output for the southern area (LCS) base model: Vulnerable biomass, exploitation rate, stock recruitment, and spawning biomass.

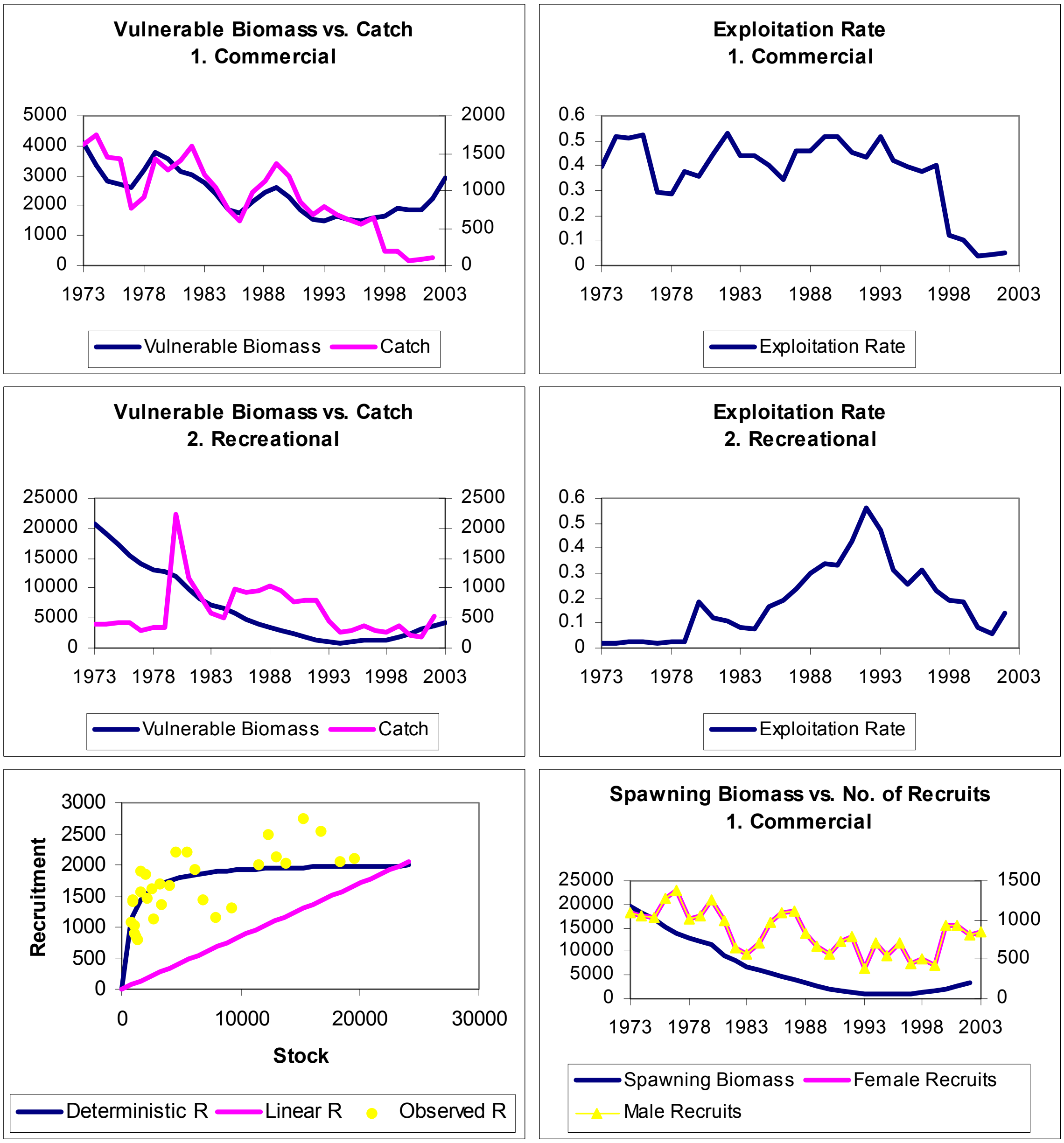


Figure 12b. Coleraine output for the southern area (LCS) base model: Estimated selectivity for the commercial fishery, recreational fishery, and NMFS trawl survey.

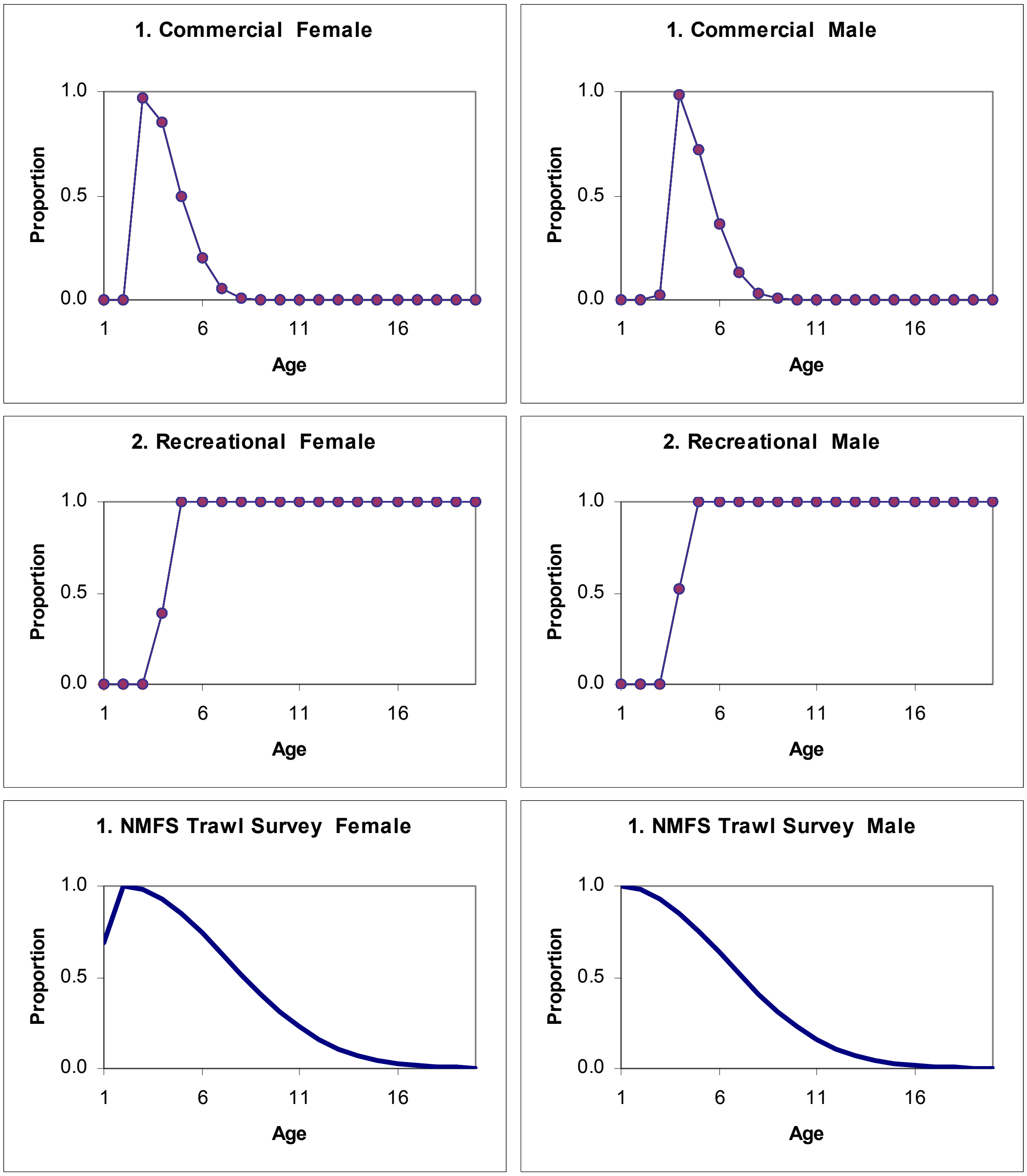
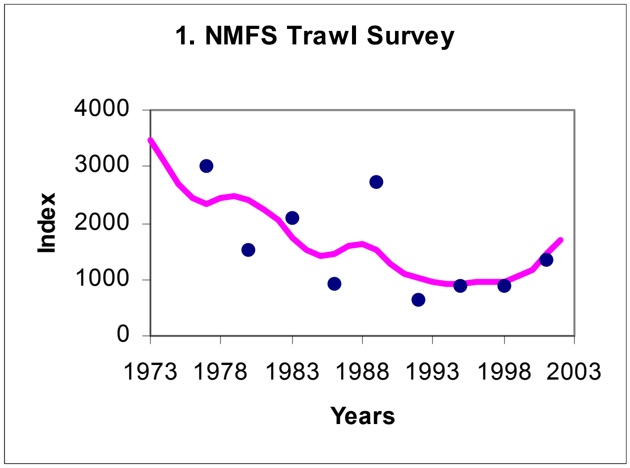


Figure 13. Coleraine output for the southern area (LCS) base model: Model fits to indices of abundance; NMFS trawl survey and trawl logbook.



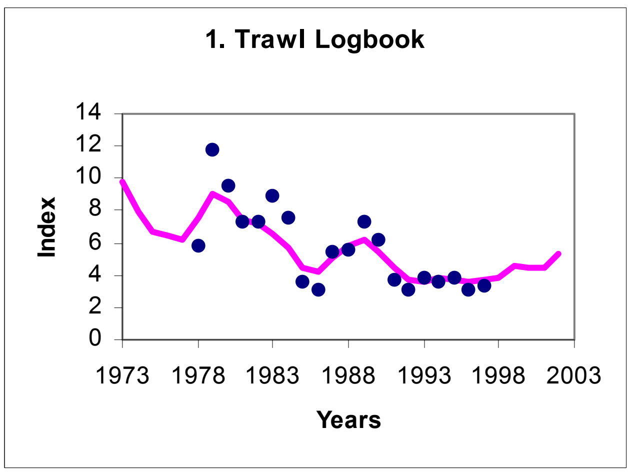


Figure 14. Coleraine output for the southern area (LCS) base model: Model fits to commercial fishery catch-at-age.

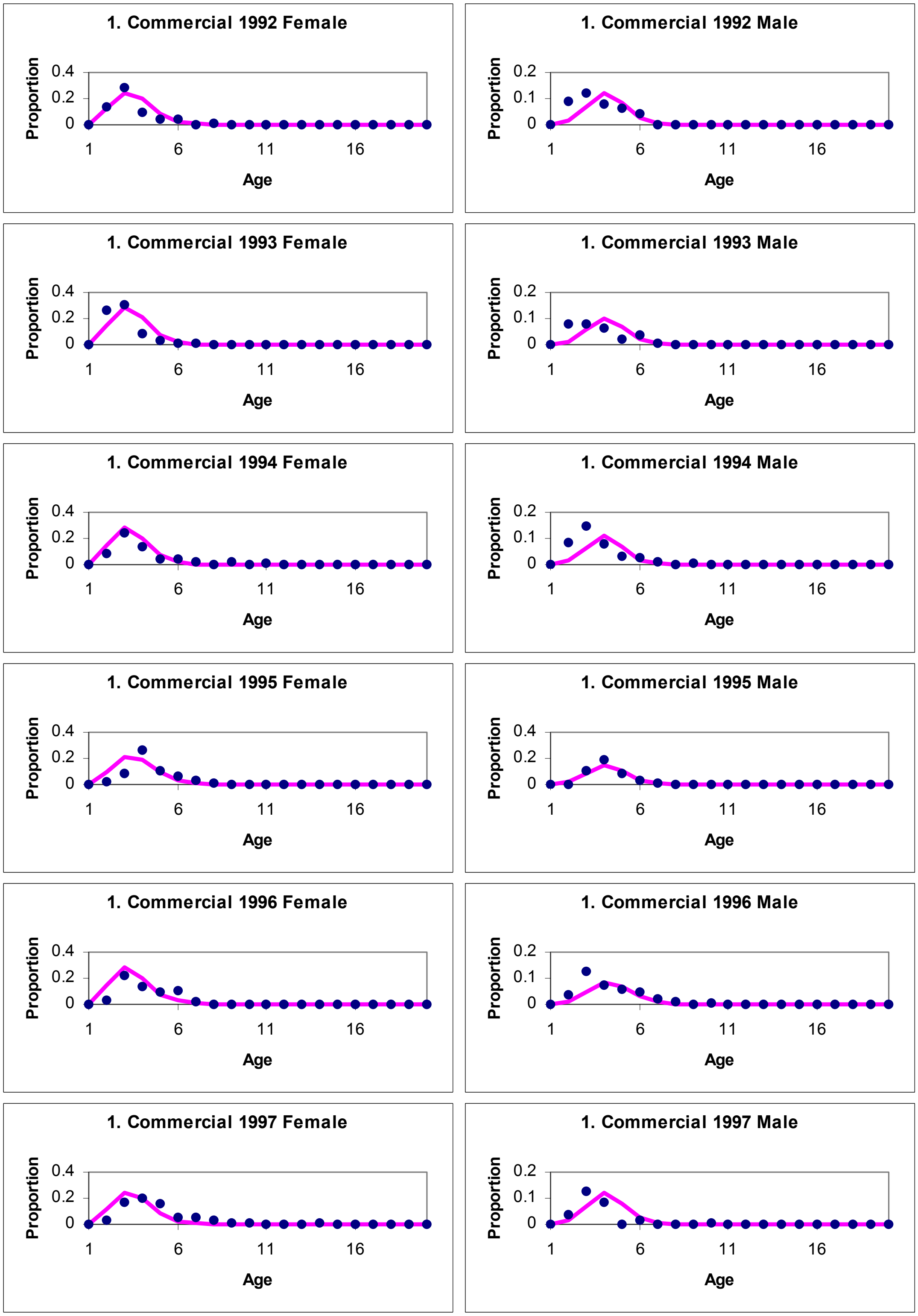


Figure 14, continued. Coleraine output for the southern area (LCS) base model: Model fits to commercial fishery catch-at-age.

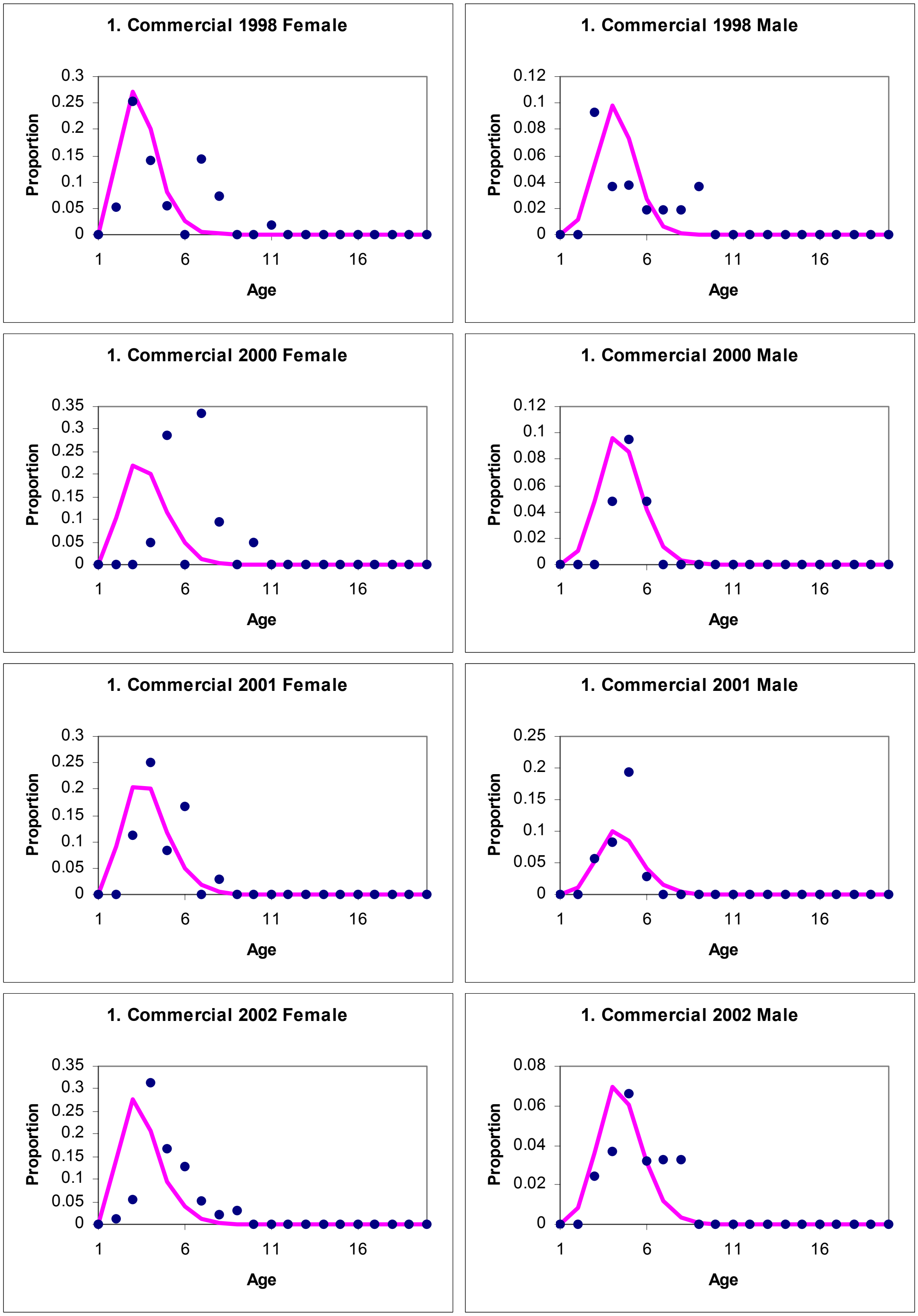


Figure 15. Coleraine output for the southern area (LCS) base model: Model fits to recreational fishery catch-at-age.

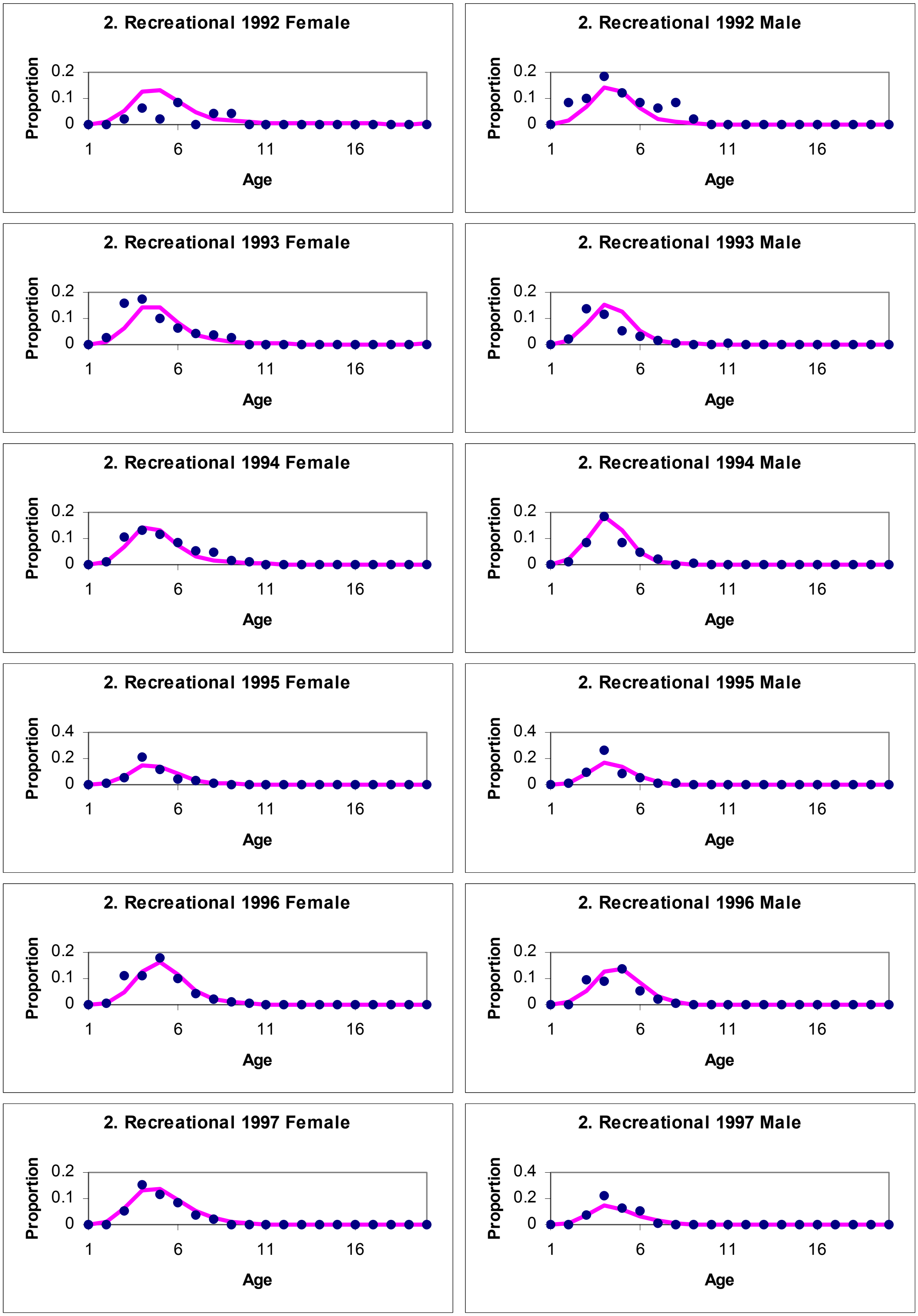


Figure 15, continued. Coleraine output for the southern area (LCS) base model: Model fits to recreational fishery catch-at-age.

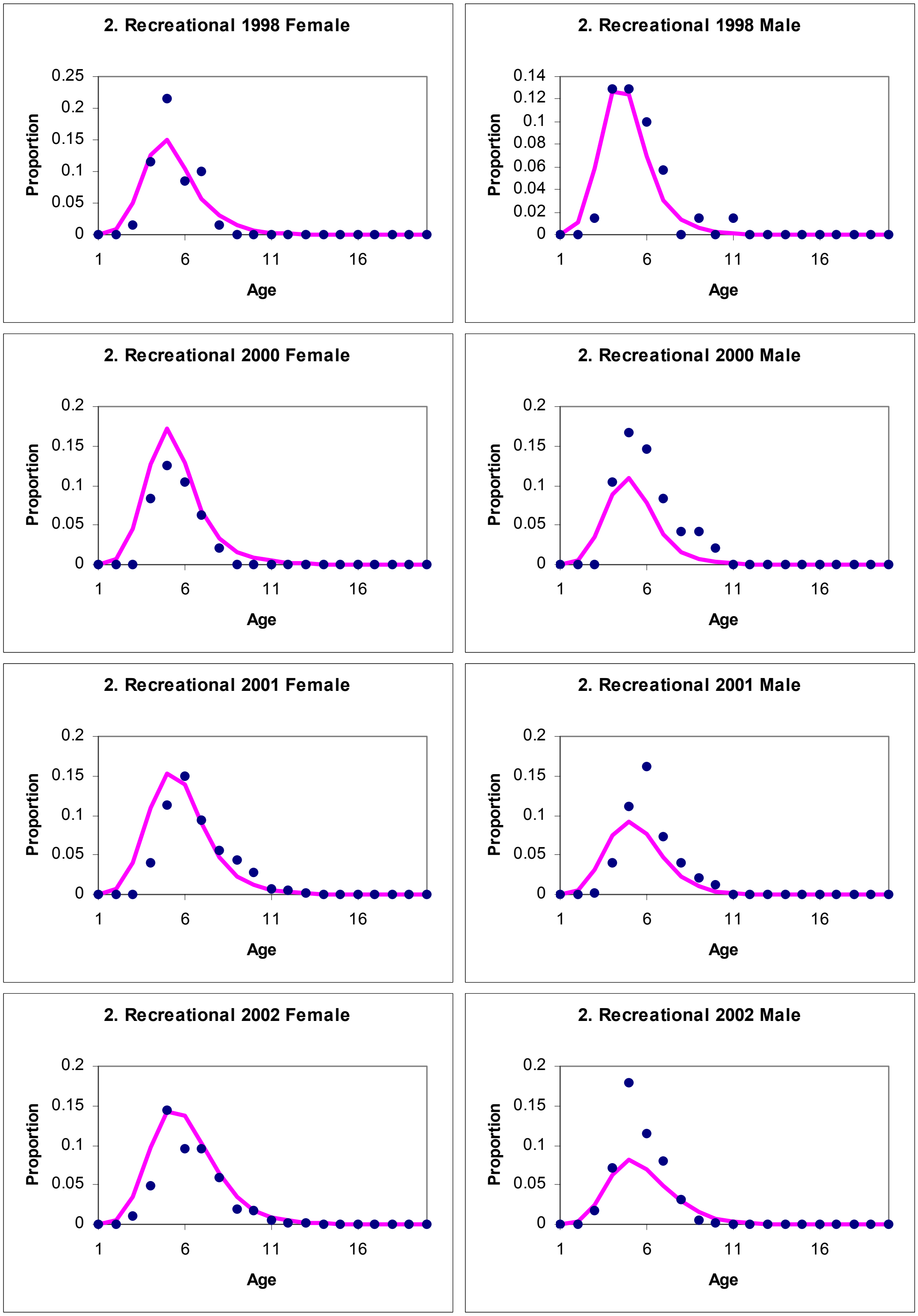


Figure 16. Coleraine output for the southern area (LCS) base model: Model fits to NMFS trawl survey catch-at-age.

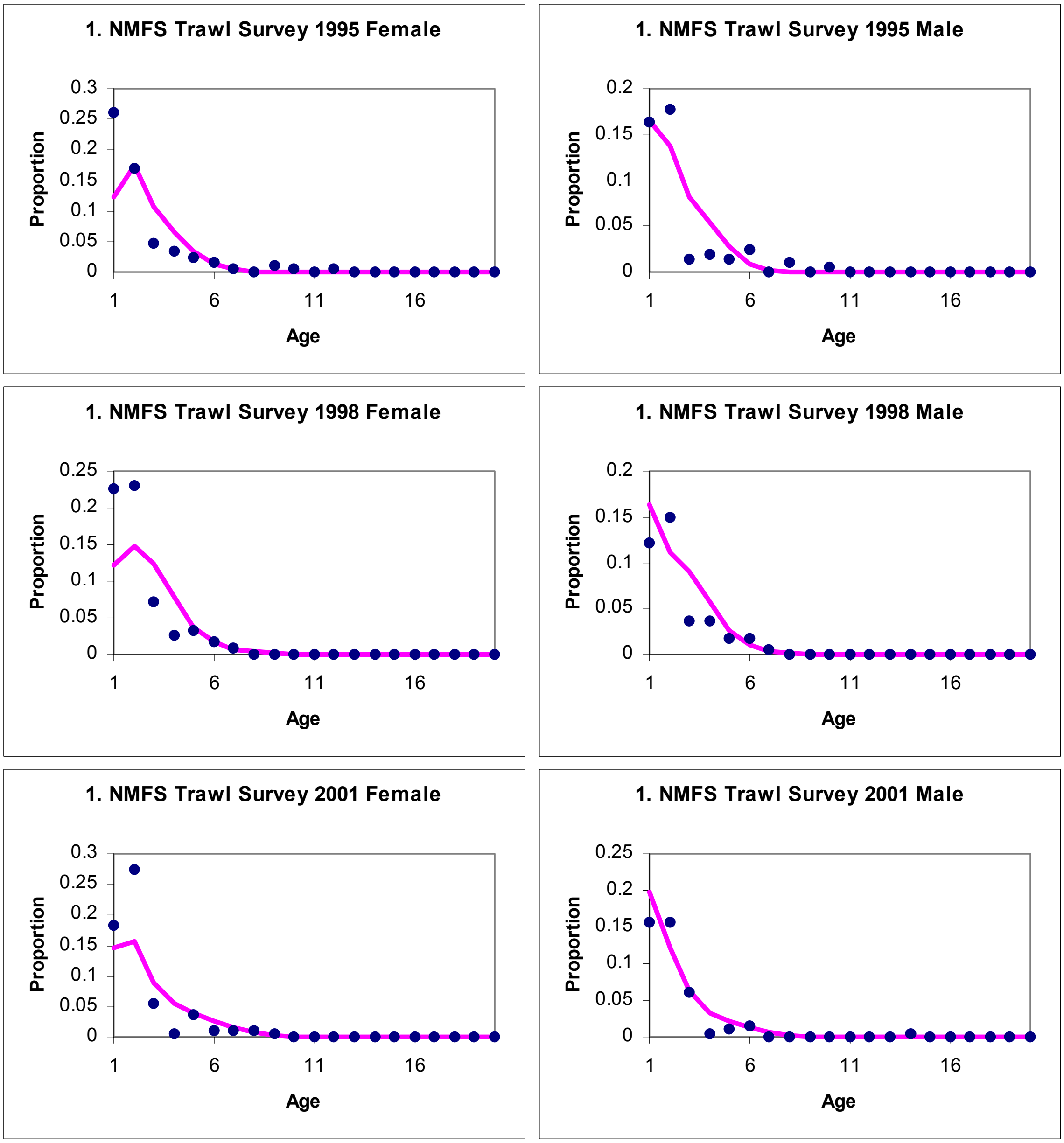
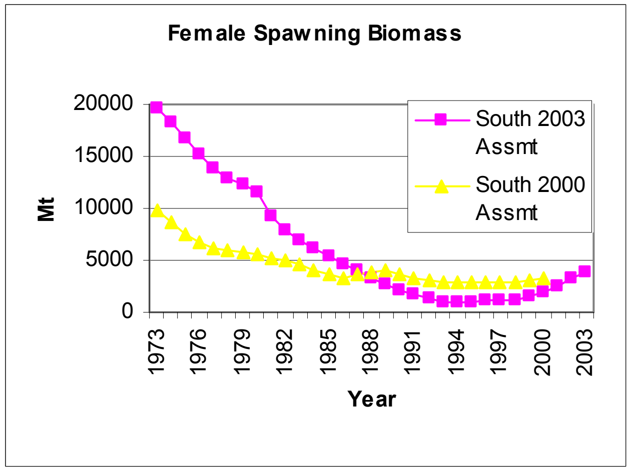


Figure 17. Coleraine output for the southern area (LCS) base model: Historical analysis comparing spawning biomass estimates from the 2003 base model with spawning biomass estimates from the 2000 base model.



Appendix II. Coastwide Lingcod Rebuilding Analysis

Assessment of Lingcod for the Pacific Fishery Management Council in 2003

Coastwide Lingcod Rebuilding Analysis

October, 2003

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History

In 1997, an assessment of lingcod prepared for the PFMC found that female spawning biomass estimates were below 25% of the unfished biomass level for the northern portion of the stock (Jagielo et al. 1997). An analysis was subsequently prepared which indicated that rebuilding to the $B_{40\%}$ level was possible within 10 years at F=0 (Jagielo 1999). Based on the analysis for the northern area, a 10 year rebuilding plan was implemented by PFMC for the entire West Coast (Washington-Oregon-California). The rebuilding plan began in 1999 and set the target date of the start of 2009 for achieving the $B_{40\%}$ spawning stock size.

Subsequently, a coastwide assessment for lingcod was completed in 2000 (Jagielo et al. 2000). The 2000 assessment provided separate estimates of spawning stock biomass for the northern (LCN: US-Vancouver and Columbia) and southern (LCS: Monterey, Eureka, Conception) areas. An updated rebuilding analysis was conducted with the 2000 stock assessment model results using the SSC default rebuilding analysis software (Punt 2001).

Recently, an updated lingcod stock assessment was conducted in 2003 (Jagielo et al. 2003) which provided new, separate estimates of spawning stock biomass for the northern (LCN) and southern (LCS) areas. The present rebuilding analysis utilizes information from the 2003 stock assessment and conforms to the SSC Terms of Reference for Groundfish Rebuilding Plans. This analysis provides new coastwide rebuilding trajectories that provide for lingcod rebuilding within the time frame originally established by PFMC in 1999.

Data and Parameters

This analysis uses the most recent version of the SSC Default Rebuilding Analysis software (Punt 2003). Six rebuilding analysis projections were produced using separate sets of information derived from the 2003 stock assessment (Jagielo et al. 2003). The six rebuilding analysis input files were: 1) a pooled, coastwide asymptotic fishery selectivity model; 2) a pooled, coastwide domed fishery selectivity model, 3) separate northern and southern area asymptotic fishery selectivity models, and 4) separate northern and southern area domed fishery selectivity models. Data inputs for each rebuilding analysis projection included: 1) spawning output by age (the product of the weight-at-age and % maturity-at-age vectors); 2) sex-specific natural mortality; 3) age specific weight (kg), selectivity, and numbers of fish for the year 2002; and 4) vectors of annual recruitment (age 1 fish) and spawning biomass estimates (1973-2002). Age specific data were input for ages 1-20+, with 20+ serving as an accumulator age. The age composition for the beginning year of the rebuilding program (T_{min}) was derived from the 2003 stock assessment model estimates of the 1999 age composition. The population projection was configured to begin in 2002 with rebuilding occurring by the start of 2009 (year 10 from the original rebuilding start year of 1999). Catches were pre-specified for 2002 and 2003, and were derived from the projections for the years 2004-2008. Estimates of B_0 were computed using random draws from recruitments estimated for 1973-2002.

It should be noted that the Coleraine estimate of depletion from the 2003 stock assessment (Jagielo et al. 2003) can differ from the estimate obtained from the rebuilding analysis presented here, because the rebuilding analysis computes B_0 using the average of recruitments from 1973-2002, while Coleraine uses the estimate of R_0 obtained in the model according to the formula provided in Hilborn et al.(2000). Additionally, the depletion values reported for Coleraine are with reference to 2003 spawning biomass, while those reported in the rebuilding analysis are with reference to 2002 spawning biomass.

Management Reference Points

Comparison of the spawning stock estimates for 2002 with the estimates of virgin spawning stock size under the asymptotic model assumption indicate that the recent coastwide spawning population size is approximately 25% of virgin levels (Table 1). Under the domed model assumption, the estimate of depletion was similar at 24%. By contrast, the model estimates of F_{45} differed between the asymptotic (F_{45} = 0.12) vs. domed (F_{45} = 0.18) cases, indicating higher productivity under the domed fishery selectivity assumption. Consequently, projected yields under the domed model assumption tend to be higher than under the asymptotic model assumption (Table 2).

When compared to the domed fishery selectivity model, the asymptotic fishery selection model is generally more consistent with the assumptions made in the previous lingcod stock assessment (Jagielo et al. 2000) and rebuilding analysis (Jagielo and Hastie 2000). (In the 2000 lingcod assessment, all fisheries were assumed to be asymptotic, with the exception for male fishery selectivity in the northern area, which was allowed to be dome shaped.) Estimates of F_{45} for the 2003 asymptotic model (0.12-north; 0.12-south) are similar to the estimates of F_{45} from the 2000 assessment, with a slightly higher value for the south (0.12-north; 0.14-south).

Rebuilding Projections

Rebuilding projection inputs and outputs are reported for the coastwide asymptotic fishery selectivity model in Tables 3-4 and Figures 1-3. The same information for the domed fishery selectivity model is provided in Tables 5-6 and Figures 4-6. Population projections were conducted using the "recruits" in lieu of the "recruits-per-spawner" option provided by Punt (2003), which was consistent with the previous analysis (Jagielo and Hastie 2001). The basis for this choice was the lack of a credible spawner-recruit relationship for lingcod. Recruitments for the projections were randomly drawn from the values estimated from the most recent years (1986-2002) in the assessment (Jagielo et al. 2000)(Figure 2-asymptotic; Figure 5-domed).

Performance of alternative rebuilding policies

The projected coastwide yields for 2004-2008 under both the asymptotic and domed fishery selectivity assumptions are constrained by the ABC rule, for values of $P < 0.6$ (Table ES2). Coastwide ABC yield for 2004-2008 ranges from 1,820 mt to 2,053 mt for the asymptotic fishery selection model, compared to 2,141 mt to 2,123 mt for the domed fishery selectivity model.

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Jagielo, T.H., F. Wallace, and Y.W. Cheng. 2003. Assessment of Lingcod (*Ophiodon elongatus*) for the Pacific Fishery Management Council in 2003. Document submitted to Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, Oregon 97201, October 2003.

Punt, A.E. 2001. SSC Default Rebuilding Analysis. Technical specifications and user manual. Ver. 1.000003 (July 2001).

Punt, A.E. 2003. SSC Default Rebuilding Analysis. Technical specifications and user manual. Ver. 2.7a (July 2003).

Table 1. Management reference points derived from the 2003 lingcod stock assessment (Jagielo et al. 2003). Alternative models included the assumption of asymptotic vs. domed fishery selectivity. Under each assumption, rebuilding projection input files were constructed for 1) coastwide (northern and southern model data pooled) and 2) northern and southern area model data separately.

	Asymptotic Fishery Selectivity			Domed Fishery Selectivity		
	Coastwide	Northern	Southern	Coastwide	Northern	Southern
FMSY proxy	0.121	0.124	0.122	0.184	0.165	0.190
FMSY SPR / SPR(F=0)	0.45	0.45	0.45	0.45	0.45	0.45
Virgin SPR	12.41	13.27	11.20	11.77	13.27	11.20
Virgin Spawning Output (mt)	36967	19434	16969	37115	19518	18848
Target Spawning Output (mt)	14787	7774	6788	14846	7807	7539
Current (2002) Spawning Output (mt)	9160	5410	3751	8931	5679	3253
Depletion ($SpBio_{2002}/SpBio_{Virgin}$)	0.25	0.28	0.22	0.24	0.29	0.17
Spawning Output (ydecl) (mt)	4203	2226	1972	4077	2464	1608

Table 2. Projected yield (mt) under model assumptions of asymptotic vs. domed fishery selectivity. Yields are shown for probability of recovery values ranging from P=0.5 to P=0.9, and for the 40-10 and ABC rules.

Model	Year	P= .5	P= .6	P= .7	P= .8	P= .9	Yr=Tmid	F=0	40-10 Rule	ABC Rule
Coastwide Asymptotic	**2004**	1843	1799	1750	1693	1631	1767	0	1429	1820
	2005	1947	1906	1859	1805	1744	1875	0	1753	1926
	2006	2006	1968	1924	1873	1816	1939	0	1970	1986
	2007	2043	2008	1967	1920	1866	1981	0	2085	2025
	2008	2069	2037	1999	1955	1904	2012	0	2102	2053
North Asymptotic	**2004**	1342	1328	1305	1285	1255	1339	0	1050	1109
	2005	1359	1346	1326	1309	1281	1356	0	1156	1149
	2006	1354	1343	1326	1311	1287	1352	0	1174	1168
	2007	1331	1322	1307	1294	1273	1330	0	1172	1168
	2008	1312	1304	1291	1279	1261	1311	0	1170	1166
South Asymptotic	**2004**	686	660	626	594	547	650	0	492	759
	2005	752	725	692	659	610	715	0	664	823
	2006	794	768	736	704	655	759	0	800	862
	2007	830	805	774	742	694	796	0	898	894
	2008	859	836	805	775	728	827	0	961	920
Coastwide Domed	**2004**	2058	2009	1962	1905	1838	2032	0	1616	2041
	2005	2135	2089	2045	1992	1930	2111	0	1966	2118
	2006	2138	2098	2058	2010	1953	2117	0	2137	2124
	2007	2139	2102	2066	2022	1969	2120	0	2182	2126
	2008	2135	2101	2067	2025	1976	2117	0	2167	2123
North Domed	**2004**	1512	1496	1478	1462	1440	1509	0	1164	1185
	2005	1477	1464	1449	1435	1416	1475	0	1198	1195
	2006	1438	1427	1414	1403	1387	1436	0	1194	1192
	2007	1376	1366	1355	1346	1332	1374	0	1165	1163
	2008	1339	1330	1320	1312	1300	1337	0	1148	1146
South Domed	**2004**	600	571	538	502	455	603	0	421	803
	2005	658	629	595	557	509	661	0	618	858
	2006	687	659	626	588	540	690	0	764	877
	2007	711	683	650	613	564	714	0	860	893
	2008	736	708	676	639	589	738	0	924	911

Table 3. Coastwide asymptotic fishery selectivity model rebuilding analysis: Input values.

Lingcod Coastwide-Asymptotic STAR Panel Final	
Created with Version 2.7b (August 2003)	
Directory	D:\
File Name	res.csv
Inputs	
Number of simulations	1000
Maximum age-class	20
Future recruits generated	from historical recruitments
Projections based on	constant fishing mortality
Economic discount rate	0.1
Defn of recovery	In or before year y
Policy after recovery	No change
Number of fleets	4
Parameter vectors	Best Estimates
Outputs	
FMSY proxy	0.12
FMSY SPR / SPR(F=0)	0.45
Virgin SPR	12.41
Generation time (yrs)	13
Minimum Rebuild Time (from ydecl)	5
Maximum Rebuild Time (from yinit)	13
Selected rebuild time (yrs)	5
Year for rebuild	2009
Virgin Spawning Output (mt)	36967
Target Spawning Output (mt)	14787
Current Spawning Output - 2002 (mt)	9160
Spawning Output (ydecl) (mt)	4203
Prob (<0.4B0) in ydecl	1
Prob (<0.25 B0) in ydecl	1
Tmin - calculation	
Year with age data (Yinit-Tmin)	1999
First zero-catch year (ydecl)	1999
Number of projected catches	0
Tmin	2004
Tmax - calculation	
Year with age data (yinit)	2002
First OY year	2004
Number of projected catches	2

Table 4. Coastwide asymptotic fishery selectivity model rebuilding analysis: Output values and recruitments used to compute B_0.

	Summary table							40-10 Rule	ABC Rule
Fishing rate	0.1225	0.1195	0.116	0.1121	0.1077	0.1172	0	0	0
OY	1842.8	1799.5	1749.7	1693.2	1630.6	1766.7	0	1429.4	1820.3
Prob to rebuild by Tmax	50.0	60.0	70.0	80.1	90.0	66.7	100.0	79.4	55.7
Median time to rebuild (yrs)	5	4.4	3.8	3.5	3.1	4	1.4	3	4.7
Prob overfished after rebuild	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Median time to rebuild (yrs)	2009.0	2008.4	2007.8	2007.5	2007.1	2008.0	2005.4	2007.0	2008.7
Probability above current spawning outptut in 100 years	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
Probability above current spawning outptut in 200 years	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
Probability below 0.01B0 in 100 years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Probability below 0.01B0 in 200 years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0

Highlighted values are used to compute B0

Recruitments (Number of age 1 fish in thousands)	Year	Recruitment
	1972	2839
	1973	2807
	1974	3152
	1975	3107
	1976	3168
	1977	3093
	1978	3462
	1979	4180
	1980	3268
	1981	3002
	1982	2348
	1983	2978
	1984	3848
	1985	5837
	1986	3333
	1987	2349
	1988	2550
	1989	2777
	1990	2976
	1991	3126
	1992	1690
	1993	2372
	1994	2437
	1995	2661
	1996	2317
	1997	2107
	1998	2901
	1999	2517
	2000	3195
	2001	2999

Figure 1. Coastwide asymptotic fishery selectivity model rebuilding analysis: Net spawning output and distribution of virgin biomass simulations (mt).

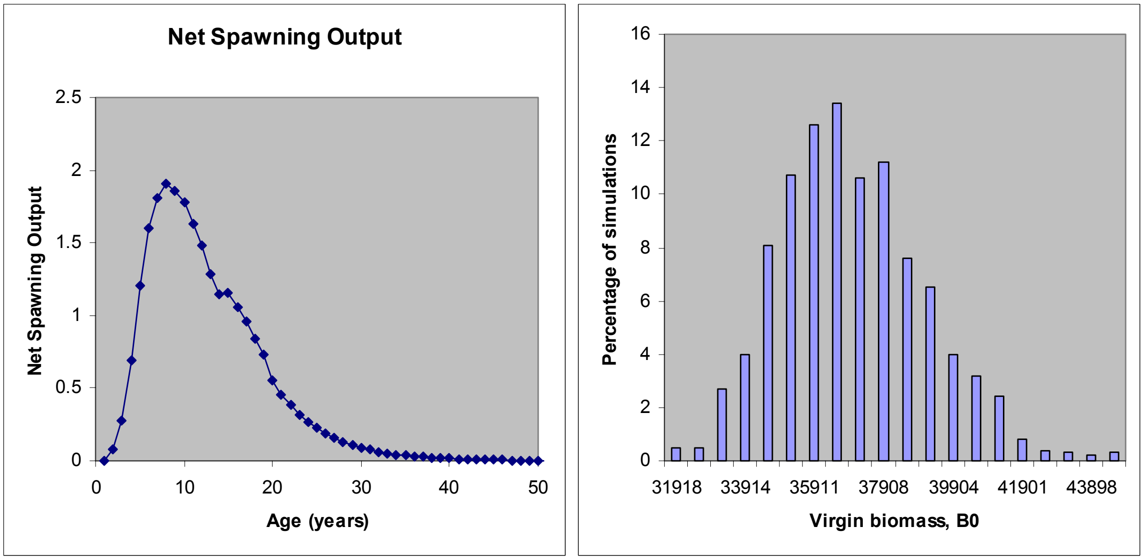


Figure 2. Coastwide asymptotic fishery selectivity model rebuilding analysis: Recruitments used for rebuilding projections (number of age 1 fish in thousands) (left) and distribution of years to rebuild (right).

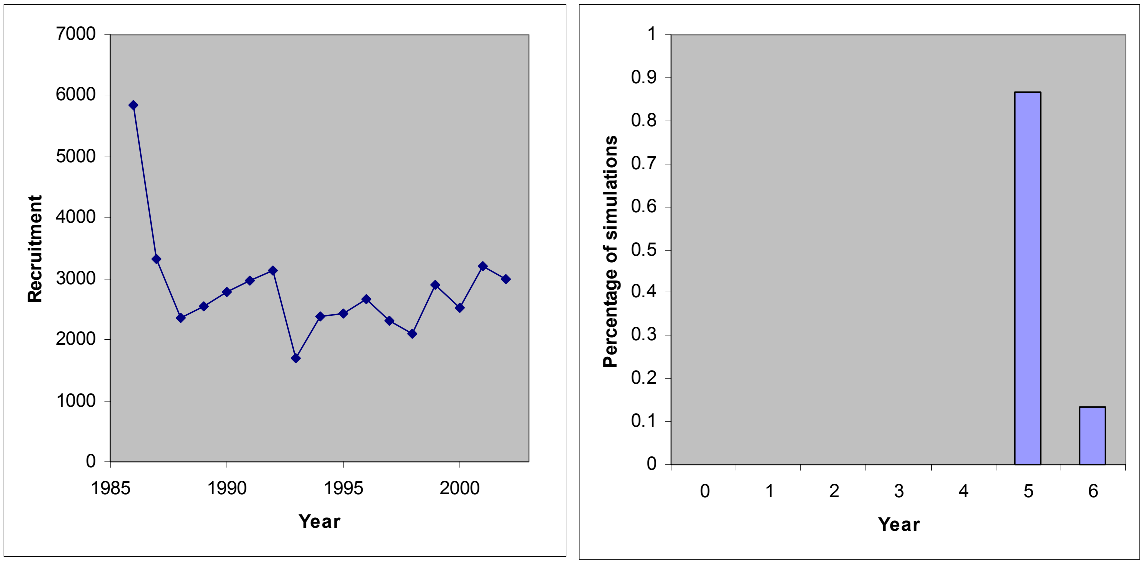


Figure 3. Coastwide asymptotic fishery selectivity model rebuilding analysis: Rebuilding trajectories showing probability above target (left) and catch (mt) (right) at selected P values.

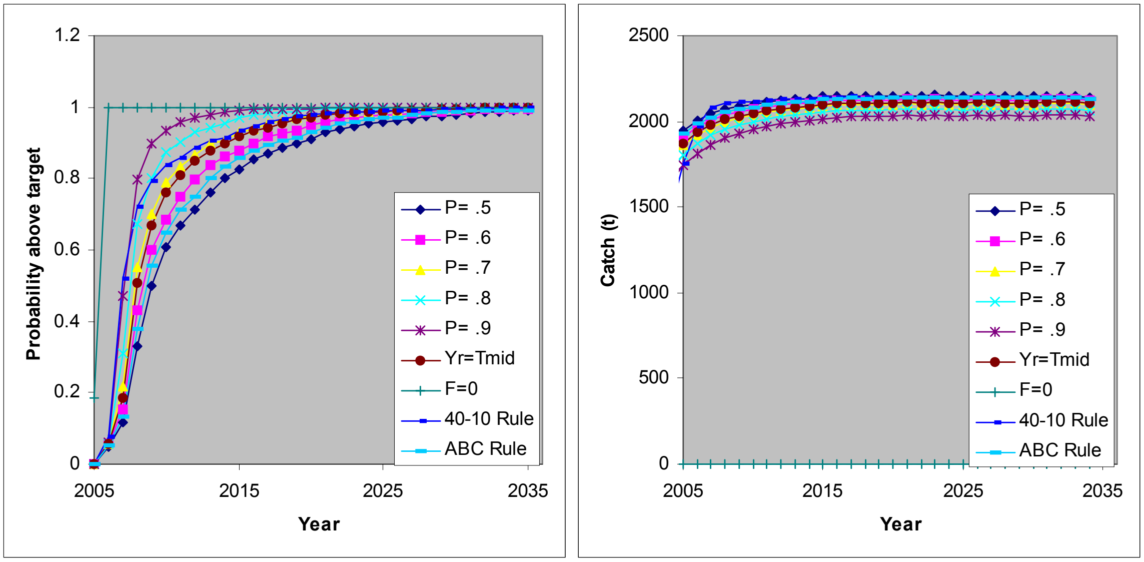


Table 5. Coastwide domed fishery selectivity model rebuilding analysis: Input values.

Lingcod Coastwide-Domed STAR Panel Final	
Created with Version 2.7b (August 2003)	
Directory	D:\
File Name	res.csv
Inputs	
Number of simulations	1000
Maximum age-class	20
Future recruits generated	from historical recruitments
Projections based on	constant fishing mortality
Economic discount rate	0.1
Defn of recovery	In or before year y
Policy after recovery	No change
Number of fleets	4
Parameter vectors	Best Estimates
Outputs	
FMSY proxy	0.18
FMSY SPR / SPR(F=0)	0.45
Virgin SPR	11.77
Generation time (yrs)	12
Minimum Rebuild Time (from ydecl)	6
Maximum Rebuild Time (from yinit)	13
Selected rebuild time (yrs)	5
Year for rebuild	2009
Virgin Spawning Output (mt)	37115
Target Spawning Output (mt)	14846
Current Spawning Output - 2002 (mt)	8931
Spawning Output (ydecl) (mt)	4077
Prob (<0.4B0) in ydecl	1
Prob (<0.25 B0) in ydecl	1
Tmin - calculation	
Year with age data (Yinit-Tmin)	1999
First zero-catch year (ydecl)	1999
Number of projected catches	0
Tmin	2005
Tmax - calculation	
Year with age data (yinit)	2002
First OY year	2004
Number of projected catches	2

Table 6. Coastwide domed fishery selectivity model rebuilding analysis: Output values and recruitments used to compute B_0.

	Summary table							40-10 Rule	ABC Rule
Fishing rate	0.1856	0.1809	0.1764	0.1709	0.1646	0.1831	0	0	0
OY	2058.2	2009.3	1961.7	1904.8	1838.3	2032.3	0	1615.9	2040.7
Prob to rebuild by Tmax	49.9	60.0	69.9	80.1	89.9	55.3	100.0	80.3	53.2
Median time to rebuild (yrs)	5	4	3.6	3	2.7	4.4	0.5	2.7	4.7
Prob overfished after rebuild	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Median time to rebuild (yrs)	2009.0	2008.0	2007.6	2007.0	2006.7	2008.4	2004.5	2006.7	2008.7
Probability above current spawning outptut in 100 years	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
Probability above current spawning outptut in 200 years	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
Probability below 0.01B0 in 100 years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Probability below 0.01B0 in 200 years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0

Recruitments (Number of age 1 fish in thousands)	Year	Recruitment
	1972	3516
	1973	3359
	1974	3557
	1975	3967
	1976	4087
	1977	3490
	1978	3598
	1979	5104
	1980	3516
	1981	3015
	1982	2264
	1983	2935
	1984	3438
	1985	5505
	1986	3359
	1987	2554
	1988	2478
	1989	2568
	1990	2939
	1991	2991
	1992	1725
	1993	2646
	1994	2507
	1995	2719
	1996	2016
	1997	2289
	1998	2469
	1999	3437
	2000	3369
	2001	3201

Highlighted values are used to compute B0

Figure 4. Coastwide domed fishery selectivity model rebuilding analysis: Net spawning output and distribution of virgin biomass simulations (mt).

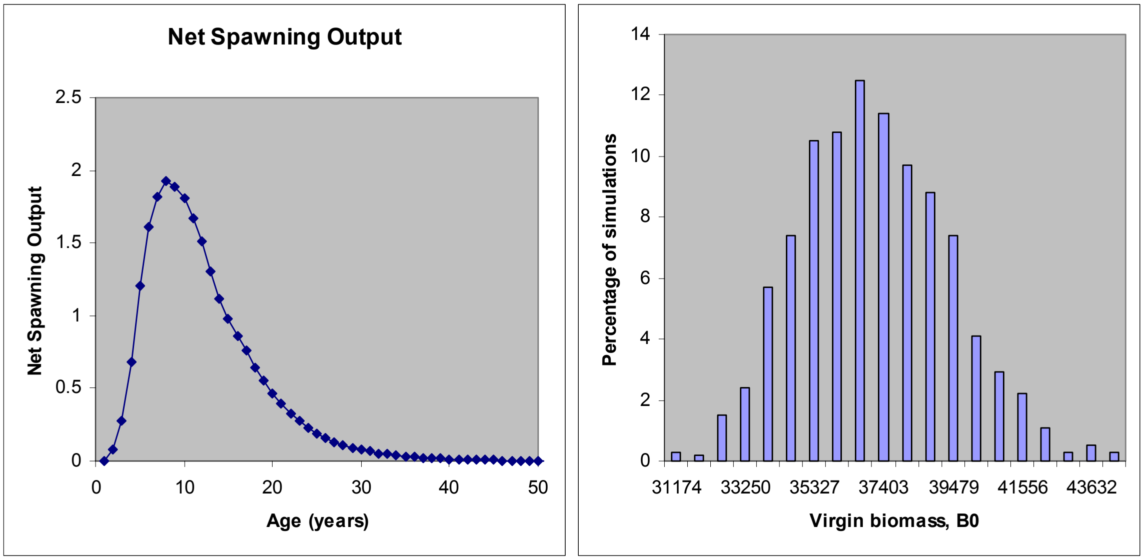


Figure 5. Coastwide domed fishery selectivity model rebuilding analysis: Recruitments used for rebuilding projections (number of age 1 fish in thousands) (left) and distribution of years to rebuild (right).

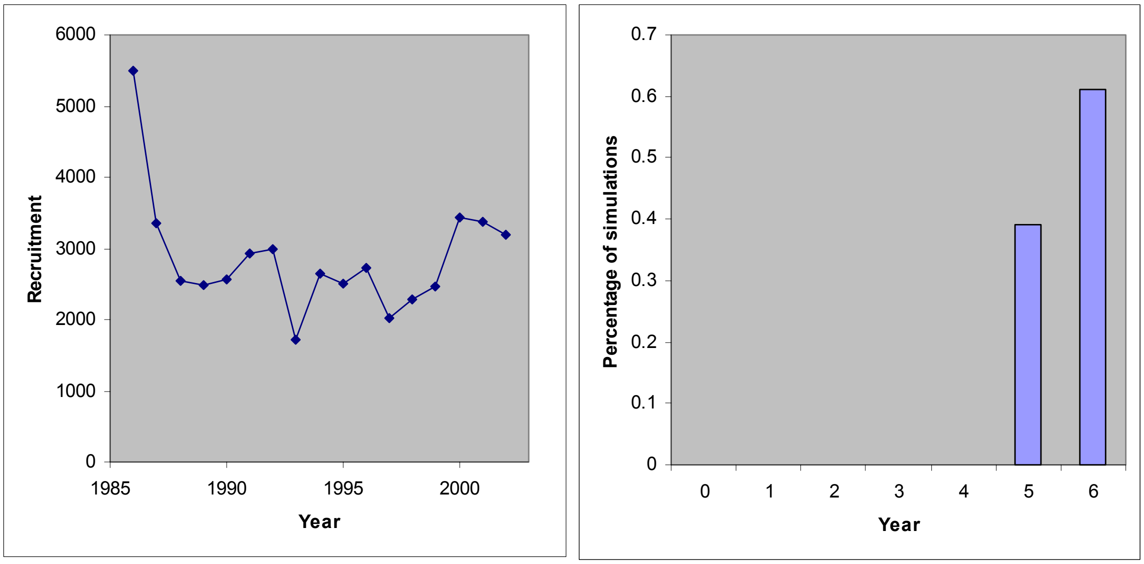
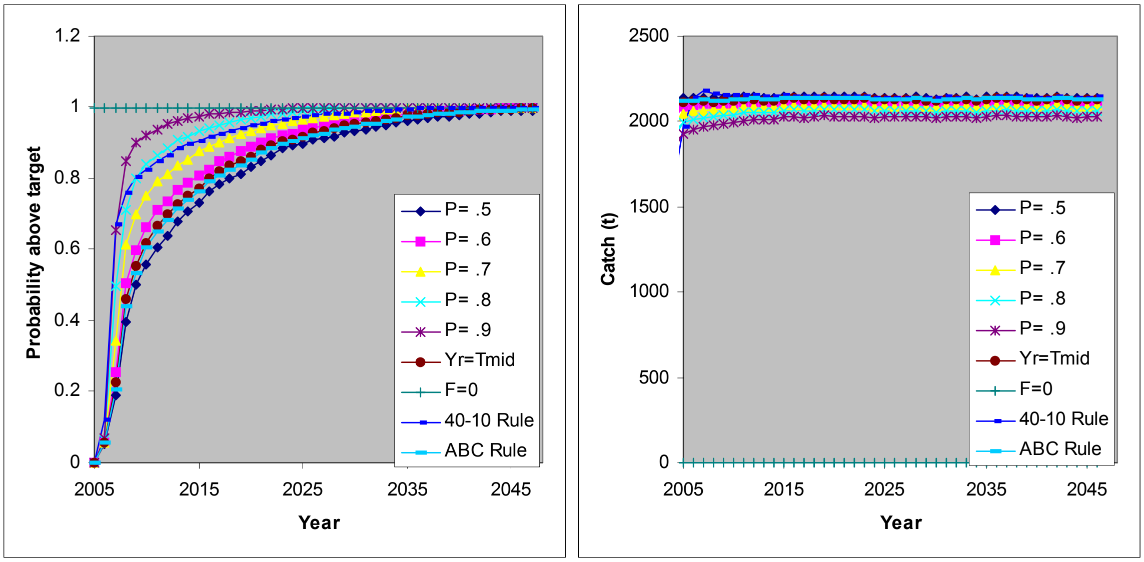


Figure 6. Coastwide domed fishery selectivity model rebuilding analysis: Rebuilding trajectories showing probability above target (left) and catch (mt) (right) at selected P values.



Lingcod

STAR Panel Meeting Report

NOAA/Northwest Fisheries Science Center
Seattle, Washington
September 15-19, 2003

STAR Panel
Han-Lin Lai, NOAA/Northwest Fisheries Science Center, PFMC SSC (Chair)
Chris Legault, NOAA/Northeast Fisheries Science Center (Rapporteur)
Mark Maunder, Inter-American Tropical Tuna Commission (CIE Reviewer)
David Smith, Primary Industries Research Victoria, Australia
Tony Smith, CSIRO Marine Research, Australia

PFMC
Tom Barnes, California Department of Fish and Game, PFMC GMT
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Thomas Jagielo, Washington Department of Fish and Wildlife
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Yuk Wing Cheng, Washington Department of Fish and Wildlife

Overview

The STAR Panel (hereafter the Panel) reviewed the assessment documents prepared by the STAT team for the lingcod fisheries. The entire STAT Team was available to present and discuss aspects of the report. This species was assessed previously in 1986 (coastal), 1994 (northern area), 1997 (northern area), 1999 (southern area) and 2000 (coastal).

This assessment treated the lingcod resource as two independent stocks; a northern stock (LCN: US-Vancouver, Columbia) and a southern stock (LCS: Eureka, Monterey, Conception). Both stocks were assessed using the multiple fleet age and sex structured model Coleraine, which also allows fitting length distributions. Both assessments utilized multiple tuning indices, the NMFS triennial surveys, trawl logbook CPUE, and in LCN only the WDFW tagging index (Table 1). The southern assessment was less well defined due to fewer data available, particularly the number of indices and years with catch at age.

The assessments were both sensitive to the levels of natural mortality rate (M) and steepness assumed. After considerable discussion and examination of many sensitivity analyses, the Panel agreed that steepness of 0.9 should be used as the base case in both LCN and LCS assessments. For LCN, the base case assessment resulted in current depletion of 29% while for the LCS current depletion is estimated to be 16%. The current assessments estimated depletions of 14% LCN and 9% LCS in 2000 compared to the 2000 assessments of 11% LCN and 14% LCS. This change in perception appears to be due to a combination of extension of the logbook indices back in time, extension of the NMFS triennial survey index forward in time, additional commercial and recreational catch at age data in recent years, and changes in the model structure.

Sensitivity analyses conducted by the STAT Team showed the level of depletion could vary widely due to changes in the natural mortality rate and the steepness parameter of the stock recruitment relationship. Neither of these parameters could be estimated by the model and had to be assumed but higher steepness was associated with better fit. Thus, different input assumptions lead to different results and management advice.

The consensus of the Panel is that the assessment has used the best available data and the analyses provide an adequate basis for Council decisions, if sufficient uncertainty in current depletion levels is considered. The Panel agreed that the stocks have been depleted and are now increasing; it is the level of decrease and subsequent increase that are not clearly defined, particularly for LCS.

The Panel commends the STAT Team for their cooperative spirit and willingness to respond to the Panel's requests for additional analyses. The large number of runs conducted during the meeting greatly facilitated the Panel's deliberations.

Requests made and comments to the STAT Team during the meeting

1. **Eliminate smoothing over years in the logbook CPUE index**. In the initial assessments the logbook index was estimated using a generalized additive model (GAM) that smoothed over years. This was thought to be inappropriate because the stock assessment model can be thought of as a smoother and so should receive year independent indices as input. The STAT Team initially conducted a GAM with years as factors, but could not estimate values for 1991 and 1997 due to missing variables in the dataset. The STAT Team then reanalyzed the logbook index using a generalized linear model (GLM) with years as factor, similar to the 2000 assessment, to address this request. The Panel agreed these GLM estimates provided a more appropriate index of abundance using the logbook CPUE data.
2. **Change years used in logbook CPUE index**. In the initial assessments the logbook data ranged from 1976 through 2002. Due to small sample sizes, the first two years of the LCS, but not the LCN, were dropped. Due to significant regulatory measured implemented in 1998, both series were truncated in 1997.
3. **Maintain consistency with the definition of water haul when forming the NMFS triennial index (Zimmermann et al. 2003[1])**. Although lingcod are a demersal species in general, they were not included in the list of species that determined water hauls in the NMFS triennial survey. The large change in the 1980 value when one tow was classified as a water haul demonstrates the responsiveness of the index to single tows with large catches. After much deliberation, the Panel agreed that consistency with the definition of water haul takes precedence when computing this index.
4. **Examine both the percent positive and density parts of the delta lognormal estimates for the logbook CPUE index**. The Panel initially had concerns regarding the large discrepancy between the raw and standardized catch rates, particularly in the early years. However, this appeared to be consistent with the data on proportion of positive tows.
5. **Report Canadian catches and results from their assessments**. Due to the artificial separation of a biological unit stock due to national boundaries it was thought that information from the Canadian stock could improve understanding of the LCN assessment.
6. **The fits of commercial catch at age in early years are not good for LCN**. The model predicts much younger catches than those observed in the first years of data. This means the model is predicting a more depleted stock than was present in those years, or else that the gear selectivities are incorrect for those years. Despite many sensitivity runs, there were no results that were able to fit these data at all.
7. **Convergence problems should always be noted when presenting results**. The apparent inconsistent responses seen in early sensitivity analyses were due to problems with convergence that were also not noted in the report. The STAT Team noted convergence problems in all later runs.

[1] Zimmermann, M., Wilkins, M.E., Weinberg, K.L., Lauth, R.R., and Shaw, F.R. 2003. Influence of improved performance monitoring on the consistency of a bottom trawl survey. ICES J. Mar. Sci. 60:818-826.

8. **The Panel requested a retrospective analysis that only included data up through 1999**. The STAT Team attempted this analysis but was unable to get the model to converge. However, the unconverged results were similar to the results using the full dataset.
9. **Compare dome with asymptotic selectivity patterns**. Although the parameter to cause dome selectivity could be estimated in the model, the STAR Panel requested sensitivity runs assuming asymptotic selectivity because there was difficulty in explaining how the dome pattern could be formed. The STAT Team provided a number of sensitivity runs with different combinations of allowed dome and assumed asymptotic by gear. Based on fit characteristics and lack of sensitivity to this specification, the Panel agreed to use the runs that allowed estimation of the parameter that causes a dome in both the commercial and recreational fisheries for both stocks. However, see Recommendations Item 13.
10. **Present management related statistics, such as depletion, when reporting sensitivity analysis results**. Initial tables of sensitivity results did not contain this information. The STAT Team provided this information for all runs conducted during the meeting.
11. **Correct "other" gear catch in US-Vancouver**. There was an error when generating the catch table of this gear type. This error has minor effects on the base runs. The STAT Team corrected this error in the subsequent runs.
12. **Modify sample sizes input for catch at age and length**. The multinomial-like method used to fit the catch at age data requires "effective" sample sizes as input, not "actual" sample sizes. The STAT Team produced runs that multiplied the initial sample sizes by 10% for input to the model in response to this request.
13. **Examine asymptotic and dome selectivity patterns applied by gender**. Due to differences in growth patterns, it was thought that one gender may be more susceptible to fishing at older ages than the other gender. This analysis was not possible due to limitations in the software used for the assessments.
14. **Provide summary tables of sensitivity analyses in hard copy form**. The STAT Team conducted an impressive number of sensitivity analyses during the meeting for which the Panel had trouble later recalling specific results. However, the results were only presented on screen because of the large number of runs conducted.

Technical merits and/or deficiencies of the assessment

The Panel appreciated the efforts of the STAT Team to transition the modeling from a flexible but stock specific approach to a tested and documented software package used in response to the recommendations of the 2000 STAR Panel. This should reduce the possibility of coding errors when conducting assessments. However, this standardized software does not eliminate the problem of poor data, especially in the LCS assessment, and reduces flexibility in representing the details of the fisheries. Results from a simple model, such as a production model or stock reduction analysis, would provide a check on the complex model results.

Areas of disagreement

There were no major disagreements between the STAR Panel and the STAT Team at the conclusion of the meeting.

Unresolved problems and major uncertainties

1. The influence on the LCN of the Canadian catches is not known. This could alter the interpretation of the status of the stock.
2. The strong dome selectivity patterns estimated by the model for the commercial and recreational fisheries, particularly for LCS, could not be easily explained based on biology, distribution, or gear effects.
3. It was reported to the Panel that both recreational and commercial fishers are seeing a lot more lingcod in recent years than they have seen previously. It is unclear whether this is due to a shift in fishing area due to management regulations, local abundance changes, or total abundance changes. However, recent increases in discarding suggest the possibility of recent good recruitment. Although the model results show an increasing trend in recent years, there are not signs of much higher recruitment. This apparent discrepancy needs to be explored further.
4. The incomplete split in biological parameters between LCN and LCS was noted. The two stocks have separate estimates of von Bertalanffy growth parameters and maturity ogives but the same parameter values for natural mortality, length weight relationship, and fecundity at age. In general, higher K values in the growth equation are associated with higher M values and fecundity at age is often related to weight at age.
5. The STAT Team was unable to reproduce the 2000 assessment due to structural differences in the models used in the two assessments. This was inevitable given the software used in response to recommendation by the previous STAR Panel.

Recommendations

The following recommendations are not given in priority order.

Data and monitoring issues

1. Estimation of discards in the recreational fisheries should be explored. The large estimates of fish caught recreationally but released alive means that these discards have the potential to be a large source of mortality. Factors to consider are the survival rate of discards and the age (or size) distribution of these discarded fish.
2. Observer data from the commercial fisheries should be used to estimate discards for this sector, and survival rates applied to the discards.
3. Appropriate biological parameters should be applied to the corresponding stock, particularly growth, mortality and fecundity. Data to support these estimates should be collected for both LCN and LCS.

4. Emphasis of collecting biological data should be placed on improving fishery age, length, and sex sample sizes and geographical coverage in both areas.
5. Check the validity of the early age composition data, which was inconsistent with later age composition data and could not be fitted by any model.
6. Indices should have year estimated as a factor, instead of smoothed, when GLM or GAM methods are applied.
7. Commercial trawl logbook CPUE data should be examined for trends in targeting or area fished to ensure the change in percent positive tows reflects change in population abundance. Investigate potential to develop a new index of abundance starting in 1998 using commercial logbook data.
8. Fishery independent information needs to be collected in the large areas that have recently been closed to both commercial and recreational fishing in order to document population level changes in abundance.
9. More frequent and synoptic fishery independent surveys should be conducted in both regions to aid in determination of stock status and recent recruitment. Surveys including nontrawlable areas should be conducted to address the issue of the habitat bias in trawl surveys.
10. The Panel endorsed the suggestion for a workshop to understand, analyze and interpret recreational CPUE data for all recreationally important species.
11. The Panel notes the importance of intercalibration of the NMFS triennial surveys conducted by the AFSC with the new NWFSC survey to ensure consistency in indices. This should be done before the next stock assessment.

Modelling and assessment issues

12. Changes from previous assessments in terms of data and model structure should be documented and attempts made to link the two results such that a clear understanding of the factors causing change in management parameters is apparent.
13. Determine reasonable expectations for the selectivity patterns in the commercial and recreational fisheries, through direct experimentation if possible, to reduce the large uncertainty in these parameters.
14. Do not use estimated CV for logbook CPUE index. The estimated coefficients of variation were thought to be unrealistically small (<6%) for use in assessment modeling and would impose too much emphasis on this index if used in the model. A better approach would be to estimate a factor that multiplies the estimated CVs so that a correct magnitude of uncertainty is used but year-to-year differences remain.
15. Projections should as far as practicable include all levels of uncertainty. The Panel agreed that the major uncertainties would be covered by projections of the base case (steepness of 0.9) and a sensitivity analysis using steepness set at 0.7.
16. Add recent management measures in the report. This information provides a context for understanding recent trends in catches and indices.

17. The Panel recommended that further exploration of the spatial structure of this fishery be undertaken, and that consideration be given in the future to the use of spatially explicit models.
18. The Panel recommended reporting convergence and other diagnostics on model runs as a matter of course and the reporting of CVs on management performance statistics.

Table 1. Data presented to the STAR Panel Meeting. Highlighted years are the data used in the base case. (*: Exclude water hauls; **: GLM is used to analyze this data; ***: Refer to STAT report)

LINGCOD	**Northern Stock**	**Southern Stock**
Catch Data		
[redacted]	1973-2002	1973-2002
	1973-2002	1973-2002
Abundance Indices		
[redacted]	1977-2001	1977-2001
	1986-1992	None
[redacted]	1976-1997	1978-1997
Catch at Age		
[redacted]	1979-2002	1992-1998; 2000-2002
	1980; 1986-2002	1992-1998; 2000-2002
	1992, 1995, 1998, 2001	1995, 1998, 2001
[redacted]	1994-1997	None
Catch at Length		
[redacted]	1975-1978	None
	1981-1983	None
	1986, 1989	None
[redacted]	1986-1993	None
Data Presented but Not Used* **		
Catch data	1935-1972	1916-1972
WA-OSP CPUE	1990-2002	None
RecFIN CPUE: OR	1980-1989; 1993-2002	None
N. CA	None	1980-1989; 1996-2002
S. CA	None	1980-1981; 1983-1985; 1988-1989; 1994; 1996; 1998-2002

Exhibit D.6
Situation Summary
November 2003

CABEZON AND LINGCOD STOCK ASSESSMENTS AND LINGCOD REBUILDING ANALYSIS FOR 2005-2006

Situation: The Council process for setting groundfish harvest levels and other specifications depends on periodic assessments of the status of groundfish stocks, rebuilding analyses of those stocks that are overfished and managed under rebuilding constraints, and a report from an established assessment review body or, in the Council parlance, a Stock Assessment Review (STAR) Panel. As appropriate, the Scientific and Statistical Committee (SSC) recommends the best available science for groundfish management decision-making in the Council process. The SSC reviews new assessments, rebuilding analyses, and STAR Panel reports and recommends the data and analyses that should be used to set groundfish harvest levels and other specifications for the following biennial management period.

New stock assessments for cabezon and lingcod were recently prepared. These have been reviewed by a STAR Panel and are now available for Council consideration. A new lingcod rebuilding analysis has also been prepared and should be entertained for use in management decision-making.

The Council should consider the new assessments, rebuilding analyses, and STAR Panel reports, as well as the advice of the SSC, other advisory bodies, and the public before adopting the new stock assessments and rebuilding analysis for use in 2005-2006 groundfish management.

Council Task:

1. **Consider Approving New Stock Assessments for Use in 2005-2006.**
2. **Consider Approving The Lingcod Rebuilding Analysis for Use in 2005-2006 Fishery Management.**

Reference Materials:

1. Exhibit D.6, Attachment 1: Status and Future Prospects for the Cabezon (*Scorpaenichthys marmoratus*) as Assessed in 2003 (*147 page document on CD-ROM, enclosed separately*, *limited hard copies available at meeting*).
2. Exhibit D.6, Attachment 2: Cabezon STAR Panel Meeting Report.
3. Exhibit D.6, Attachment 3: Assessment of Lingcod (*Ophiodon elongatus*) for the Pacific Fishery Management Council in 2003 (*129 page document on CD-ROM, enclosed separately, limited copies available at meeting*).
4. Exhibit D.6, Attachment 4: Lingcod STAR Panel Meeting Report.

Agenda Order:

a. Agendum Overview — John DeVore
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Approve Stock Assessments and Lingcod Rebuilding Analysis

PFMC
10/15/03

UPDATE ON RECFIN DATA IMPROVEMENTS

Situation: In response to concerns expressed by West Coast industry and fishery managers, the system for collecting data on the West Coast recreational fishery has undergone substantial revision in 2003. Accompanying that revision has been an increase in federal support for the West Coast Recreational Fishery Information Network, from $1.022 million in the 2002-2003 grant year to $2.2 million for the 2003-2004 grant year. A presentation will be provided on the revisions to the recreational data collection system. A summary for the changes for California is attached (Exhibit D.7, Attachment 1).

On a number of occasions the RecFIN program has approached the Council requesting complete specification of all data elements it would like included in the centralized RecFIN data repository. While some responses have been received, the responses have not been comprehensive. In order to ensure that the centralized data repository meets fishery management needs, the Council may want to consider the utility of a joint meeting between representatives from the RecFIN program, stock assessment scientists, the Groundfish Management Team, and others who rely on the data to support the fishery management system.

Council Task:

1. Discussion and provide guidance, as appropriate.

Reference Materials:

1. Exhibit D.7, Supplemental Attachment 1: California Recreational Fisheries Survey: A Plan to Collect and Estimate Recreational Fishing Catch and Effort.

Agenda Order:

a.	Agendum Overview	Jim Seger
b.	RecFIN Report	Russell Porter, Debbie Aseltine-Nielson
c.	Reports and Comments of Advisory Bodies	
d.	Public Comment	
e.	Council Discussion	

PFMC
10/22/03

Appendix A

AMENDATORY LANGUAGE FOR AMENDMENT 17 – MULTI-YEAR MANAGEMENT

This document presents draft amendatory language that would revise the FMP to allow multi-year management. Plain text shows status quo language. Bolded text shows where the FMP would be amended to allow a biennial specifications and management measures process under the preferred alternatives for each issue (Process Alternative 3 and OY Duration Alternative 1). Some ~~strikeout~~ text is shown as editing text that is not relevant to any of the alternatives. There are numerous places in the FMP where the words "annual," "year," or "yearly" are used in descriptive paragraphs mentioning the Council's annual specifications and management measures process without affecting that process. To better focus attention on the FMP processes that would be affected by Amendment 17, these descriptive paragraphs have not been provided here. The Council has given its staff permission to make minor edits to account for the change in process from a one-year management period to a two-year management period.

2.2 Operational Definition of Terms

Acceptable Biological Catch (ABC) is a biologically based estimate of the amount of fish that may be harvested from the fishery each year without jeopardizing the resource. It is a seasonally determined catch that may differ from MSY for biological reasons. It may be lower or higher than MSY in some years for species with fluctuating recruitment. The ABC may be modified to incorporate biological safety factors and risk assessment due to uncertainty. Lacking other biological justification, the ABC is defined as the MSY exploitation rate multiplied by the exploitable biomass for the relevant time period.

* * *

Biennial fishing period is defined as a 24-month period beginning January 1 and ending December 31.

* * *

5.0 SPECIFICATION AND APPORTIONMENT OF HARVEST LEVELS

The ability to establish and adjust harvest levels is the first major tool at the Council's disposal to exercise its resource stewardship responsibilities. Each ~~fishing year~~ **biennial fishing period,** the Council will assess the biological, social, and economic condition of the Pacific coast groundfish fishery and update maximum sustainable yield (MSY) estimates or proxies for specific stocks (management units) where new information on the population dynamics is available. The Council will make this information available to the public in the form of the *Stock Assessment and Fishery Evaluation (SAFE)* document described in Section 5.1. Based upon the best scientific information available, the Council will evaluate the current level of fishing relative to the MSY level for stocks where sufficient data are available. Estimates of the acceptable biological catch (ABC) for major stocks will be developed, and the Council will identify those species or species groups which it proposes to be managed by the establishment of numerical harvest levels (optimum yields [OYs], harvest guidelines [HGs], or quotas). For those stocks judged to be below their overfished/rebuilding threshold, the Council will develop a stock rebuilding management strategy.

The process for specification of numerical harvest levels includes the estimation of ABC, the establishment of OYs for various stocks, calculation of specified allocations between harvest sectors, and the apportionment of numerical specifications to domestic annual processing (DAP), joint venture processing (JVP), total allowable level of foreign fishing (TALFF), and the reserve. The specification of numerical harvest levels described in this chapter is the process of designating and adjusting overall numerical limits for a stock either throughout the entire fishery management area or throughout specified subareas. The process normally occurs ~~annually~~ **biennially** between ~~September and November~~ **November and June**, but can occur, under specified circumstances at other times of the fishing year. The Council will identify those OYs which should be designated for allocation between limited entry and open access sectors of the commercial industry. Other numerical limits which allocate the resource or which apply to one segment of the fishery and not another are imposed through the socioeconomic framework process described in Chapter 6 rather than the specification process.

The National Marine Fisheries Service (NMFS) Regional Administrator will review the Council's recommendations, supporting rationale, public comments, and other relevant information; and, if it is approved, will undertake the appropriate method of implementation. Rejection of a recommendation will be explained in writing.

The procedures specified in this chapter do not affect the authority of the U.S. Secretary of Commerce (Secretary) to take emergency regulatory action as provided for in Section 305(c) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) if an emergency exists involving any groundfish resource or to take such other regulatory action as may be necessary to discharge the Secretary's responsibilities under Section 305(d) of the Magnuson-Stevens Act.

The ~~annual~~ specification**s and management measures** process, in general terms, occurs as follows:

1. The Council will determine the MSY or MSY proxy and ABC for each major stock. Typically, the MSY proxy will be in terms of a fishing mortality rate ($F_{x\%}$,) and ABC will be the $F_{x\%}$ applied to the current biomass estimate.

2. Every species will either have its own designated OY or be included in a multispecies OY. Species which are included in a multispecies OY may also have individual OYs, have individual HGs, or be included in a HG for a subgroup of the multispecies OY. Stocks without quantitative or qualitative assessment information may be included in a numerical or non-numerical OY.

3. To determine the OY for each stock, the Council will determine the best estimate of current abundance and its relation to its precautionary and overfished thresholds. If the abundance is above the precautionary threshold, OY will be equal to or less than ABC. If abundance falls below the precautionary threshold, OY will be reduced according to the harvest control rule for that stock. If abundance falls below the overfished/rebuilding threshold, OY will be set according to the interim rebuilding rule until the Council develops a formal rebuilding plan for that species.

4. ****Editorial changes for this paragraph would be addressed under Amendment 16 (overfished species rebuilding) to the FMP**** For any stock the Secretary has declared overfished or approaching the overfished condition, or for any stock the Council determines is in need of rebuilding, the Council will develop a rebuilding plan and submit it in the same manner as recommendations of the annual management process. Once approved, a rebuilding plan will remain in effect for the specified duration or until the Council recommends and the Secretary approves revision.

5. The Council may reserve and deduct a portion of the ABC of any stock to provide for compensation for vessels conducting scientific research authorized by NMFS. Prior to the research activities, the Council will authorize amounts to be made available to a research reserve. However, the deduction from the ABC will be made in the year after the "compensation fishing"; the amounts deducted from the ABC will reflect the actual catch during compensation fishing activities.

6. The Council will identify stocks which are likely to be fully harvested (i.e., the ABC, OY, or HG achieved) in the absence of specific management measures and for which allocation between limited entry and open access sectors of the fishery is appropriate.

7. The groundfish resource is fully utilized by U.S. fishing vessels and seafood processors. The Council

may entertain applications for foreign or joint venture fishing or processing at any time, but fishing opportunities may be established only through amendment to this FMP. This section supercedes other provisions of this FMP relating to foreign and joint venture fishing.

This chapter describes the steps in this process.

5.1 SAFE Document

****Annual SAFE documents are required under NOAA guidelines implementing National Standard 2 of the Magnuson-Stevens Act (base conservation and management measures on the best available scientific information.) Under Amendment 16 to the FMP, the Council will consider revising the SAFE document production schedule (stock assessments available before final decision on specifications and management measures, evaluation of the fishery available after end of fishing year).**

Amendment 17 adopts a biennial management process. Under a biennial management process, some elements of the SAFE document may not be necessary in years when the Council is not preparing specifications and management measures. For example, elements 2, 5, 6, 7, and 11 could be eliminated from "off year" SAFE documents without violating the National Standards guidelines or hampering the Council's ability to conduct inseason management.**

For the purpose of providing the best available scientific information to the Council for evaluating the status of the fisheries relative to the MSY and overfishing definition, developing ABCs, determining the need for individual species or species group management, setting and adjusting numerical harvest levels, assessing social and economic conditions in the fishery, and updating the appendices of this fishery management plan (FMP); a SAFE document is prepared annually. Not all species and species groups can be reevaluated every year due to limited state and federal resources. However, the SAFE document will in general contain the following information:

1. A report on the current status of Washington, Oregon, and California groundfish resources by major species or species group.
2. Specify and update estimates of harvest control rule parameters for those species or species groups for which information is available.
3. Estimates of MSY and ABC for major species or species groups.
4. Catch statistics (landings and value) for commercial, recreational, and charter sectors.
5. Recommendations of species or species groups for individual management by OYs.
6. A brief history of the harvesting sector of the fishery, including recreational sectors.
7. A brief history of regional groundfish management.
8. A summary of the most recent economic information available, including number of vessels and economic characteristics by gear type.
9. Other relevant biological, social, economic, ecological, and essential fish habitat information which may be useful to the Council.
10. A description of any rebuilding plans currently in effect, a summary of the information relevant to the rebuilding plans, and any management measures proposed or currently in effect to achieve the rebuilding plan goals and objectives.

11. A list of annual specifications and management measures that have been designated as routine under processes described in the FMP at Section 6.2.

Under a biennial specifications and management measures process, elements 2, 5, 6, 7, and 11 would not need to be included in a SAFE document in years when the Council is not setting specifications and management measures for an upcoming biennial fishing period. The preliminary SAFE document is normally completed late in the year, generally late October, when the most current stock assessment and fisheries performance information is available and prior to the meeting at which the Council approves its final management recommendations for the upcoming year. The Council will make the preliminary SAFE document available to the public by such means as mailing lists or newsletters and will provide copies upon request. A final SAFE may be prepared after the Council has made its final recommendations for the upcoming year and will include the final recommendations, including summaries of proposed and pre-existing rebuilding plans. The final SAFE document, if prepared, will also be made available upon request.

* * *

5.4 Authorization and Accounting for Fish Taken as Compensation for Authorized Scientific Research Activities.

At a Council meeting, NMFS will advise the Council of upcoming resource surveys that would be conducted using private vessels with groundfish as whole or partial compensation. For each proposal, NMFS will identify the maximum number of vessels expected or needed to conduct the survey, an estimate of the species and amounts of compensation fish likely to be needed to compensate vessels for conducting the survey, when the fish would be taken, and when the fish would be deducted from the ABC in determining the OY/harvest guideline. NMFS will initiate a competitive solicitation to select vessels to conduct resource surveys. NMFS will consult with the Council regarding the amounts and types of groundfish species to be used to support the surveys. If the Council approves NMFS' proposal, NMFS may proceed with awarding the contracts, taking into account any modifications requested by the Council. If the Council does not approve the proposal to use fish as compensation to pay for resource surveys, NMFS will not use fish as compensation.

Because the species and amounts of fish used as compensation will not be determined until the contract is awarded, it may not be possible to deduct the amount of compensation fish from the ABC or harvest guideline in the year that the fish are caught. Therefore, the compensation fish will be deducted from the ABC the **year or biennial fishing period** after the fish are harvested. During the ~~annual~~ specifications **and management measures** process, NMFS will announce the total amount of fish caught during the year **or biennial fishing period** as compensation for conducting a resource survey, which then will be deducted from the following year's ABCs in setting the OYs.

* * *

5.6 ~~Annual~~ **Biennial** Implementation Procedures for Specifications and ~~Apportionments~~ (previously section 5.8)

~~Annually~~ **Biennially**, the Council will develop recommendations for the specification of ABCs, OYs, any HGs or quotas, ~~and apportionments to DAH, DAP, JVP, and TALFF and the reserve~~ over the span of ~~two~~ **three** Council meetings. In addition during this process, the Council may recommend establishment of HGs and quotas for species or species groups within an OY. **Depending on stock assessment availability and fishery management interactions with Canada, the Council may also develop recommendations for the specification of the Pacific whiting ABC/OY and quotas in a separate, annual process.**

The Council will develop preliminary recommendations at the first of ~~two~~ **three** meetings (usually in ~~August or September~~ **in November)**, based upon the best stock assessment information available to the Council at the time and consideration of public comment. After the first meeting, the Council will provide a summary of its preliminary recommendations and their basis to the public through its mailing list as well as providing copies of the information at the Council office and to the public upon request. The Council will notify the public of its intent to develop final recommendations at its ~~second~~ **third** meeting (usually ~~October or November~~ **in June**), and solicit public comment both before and at its second meeting.

At its second **and/or third** meeting, the Council will again consider the best available stock assessment information which should be contained in the recently completed SAFE report and consider public testimony before adopting final recommendations to the Secretary. Following the ~~second~~ **third** meeting, the Council will submit its recommendations along with the rationale and supporting information to the Secretary for review and implementation.

Upon receipt of the Council's recommendations supporting rationale and information, the Secretary will review the submission, and, if it is sufficient for public review, ~~publish a notice in the *Federal Register* making the Council's recommendations effective January 1 of the upcoming fishing year~~ **publish a proposed rule in the *Federal Register*, making the Council's recommendations available for public comment and agency review. Following the public comment period on the proposed rule, the Secretary will review the proposed rule, taking into account any comments or additional information received, and will publish a final rule in the *Federal Register*, possibly modified from the proposed rule in accordance with the Secretary's consideration of the proposed rule.**

In the event that the Secretary disapproves one or more of the Council's recommendations, he may implement those portions approved and notify the Council in writing of the disapproved portions along with the reasons for disapproval. The Council may either provide additional rationale or information to support its original recommendation, if required, or may submit alternative recommendations with supporting rationale. In the absence of an approved recommendation at the beginning of the ~~fishing year~~ **biennial fishing period**, the current specifications in effect at the end of the previous ~~fishing year~~ **biennial fishing period** will remain in effect until modified, superseded, or rescinded.

5.7 Inseason Procedures for Establishing or Adjusting Specifications and ~~Apportionments~~ (previously 5.9)

5.7.1 Inseason Adjustments to ABCs, OYs, HGs, and Quotas

Under the biennial specifications and management measures process, stock assessments for most species will become available every other year, prior to the November Council meeting that begins the three-meeting process for setting specifications and management measures. The November Council meeting that begins that three-meeting process will be the November of the first fishing year in a biennial fishing period. If the Council determines that any of the ABCs or OYs set in the prior management process are not adequately conservative to meet rebuilding plan goals for an overfished species, harvest specifications for that overfished species and/or for co-occurring species may be revised for the second fishing year of the then current biennial management period. ~~Occasionally, new stock assessment information may become available inseason that supports a determination that an ABC no longer accurately describes the status of a particular species or species group. However, adjustments will only be made during the annual specifications process and a revised ABC announced at the beginning of the next fishing year.~~

~~The only exception is in the case where the ABC announced at the beginning of the fishing year~~ **Beyond this process, ABCs, OYs, HGs, and quotas may only be modified in cases where a harvest specification announced at the beginning of the fishing period** is found to have resulted from incorrect data or from computational errors. If the Council finds that such an error has occurred, it may recommend the Secretary publish a notice in the *Federal Register* revising the ~~ABC~~ **incorrect harvest**

specification at the earliest possible date.

* * *

* * *5.7.2 would be eliminated and 5.7.3 would be renumbered as 5.7.2* * *

6.0 MANAGEMENT MEASURES

* * *

6.2 General Procedures for Establishing and Adjusting Management Measures

Management measures are normally imposed, adjusted, or removed at the beginning of the ~~fishing year~~ **biennial fishing period**, but may, if the Council determines it necessary, be imposed, adjusted, or removed at any time during the ~~year~~ **period**. Management measures may be imposed for resource conservation, social or economic reasons consistent with the criteria, procedures, goals, and objectives set forth in the FMP.

Because the potential actions which may be taken under the two frameworks established by the FMP cover a wide range analyses of biological, social, and economic impacts will be considered at the time a particular change is proposed. As a result, the time required to take action under either framework will vary depending on the nature of the action, its impacts on the fishing industry, resource, environment, and review of these impacts by interested parties. Satisfaction of the legal requirements of other applicable law (e.g., the Administrative Procedure Act, Regulatory Flexibility Act, **relevant** Executive **Orders** ~~12291~~, etc.) for actions taken under this framework requires analysis and public comment before measures may be implemented by the Secretary.

Four different categories of management actions are authorized by this FMP, each of which requires a slightly different process. Management measures may be established, adjusted, or removed using any of the four procedures. The four basic categories of management actions are as follows:

A. Automatic Actions - Automatic management actions may be initiated by the NMFS Regional Administrator without prior public notice, opportunity to comment, or a Council meeting. These actions are nondiscretionary, and the impacts previously must have been taken into account. Examples include fishery, season, or gear type closures when a quota has been projected to have been attained. The Secretary will publish a single "notice" in the *Federal Register* making the action effective.

B. "Notice" Actions Requiring at Least One Council Meeting and One *Federal Register* Notice - These include all management actions other than "automatic" actions that are either nondiscretionary or for which the scope of probable impacts has been previously analyzed.

These actions are intended to have temporary effect, and the expectation is that they will need frequent adjustment. They may be recommended at a single Council meeting ~~(usually November)~~, although the Council will provide as much advance information to the public as possible concerning the issues it will be considering at its decision meeting. The primary examples are those **inseason** management actions defined as "routine" according to the criteria in Section 6.2.1. These include trip landing and frequency limits and size limits for all commercial gear types and closed seasons for any groundfish species in cases where protection of an overfished or depleted stock is required, and bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements for all recreational fisheries. Previous analysis must have been specific as to species and gear type before a management measure can be defined as "routine" and acted upon at a single Council meeting. If the recommendations are approved, the Secretary will waive for good cause the requirement for prior notice and comment in the *Federal Register* and will publish a single "notice" in the *Federal Register* making the action effective. This category of actions presumes the Secretary will find that **the need for swift implementation and** the extensive notice and opportunity for comment on these types of measures along with the scope of their impacts already provided by the Council will serve as good cause to waive the need for additional prior notice and comment in the *Federal Register.*

C. ~~Abbreviated Rulemaking Actions Normally Requiring at Least Two Council Meetings and One *Federal Register* "Rule" or "Notice"~~ **C. Management Measures Rulemaking Actions Developed Through the Three Council Meeting Biennial Specifications Process and Two *Federal Register* Rules** - These include (1) management measures developed through the biennial specifications process, (2) management actions being classified as "routine", or (3) trip limits that vary by gear type, closed seasons or areas, and in the recreational fishery, bag limits, size limits, time/area closures, boat limits, hook limits, and dressing requirements the first time these measures are used or ~~(3) management measures that are intended to have permanent effect and are discretionary, and for which the impacts have not been previously analyzed~~ **(moved to Section D, below)**. Examples include changes to or imposition of gear regulations, or imposition of landings limits, frequency limits, or limits that are differential by gear type, or closed areas or seasons for the first time on any species or species group, or gear type. The Council will develop and analyze the proposed management actions over the span of at least two Council meetings ~~(usually September and November)~~ **(usually April and June)** and provide the public advance notice and opportunity to comment on both the proposals and the analysis prior to and during the Council process at the second Council meeting. ~~If the Regional Administrator approves the Council's recommendation, the Secretary will waive for good cause the requirement for prior notice and comment in the *Federal Register* and publish a "final rule" or "notice" in the *Federal Register* which will remain in effect until amended.~~ If a management measure is designated as "routine" under this procedure, specific adjustments of that measure can subsequently be announced in the *Federal Register* by "notice" as described in the previous paragraphs. ~~Nothing in this section prevents the Secretary from exercising the right not to waive the opportunity for prior notice and comment in the *Federal Register*, if appropriate, but presumes the Council process will adequately satisfy that requirement.~~ **The Secretary will publish a "proposed rule" in the *Federal Register* with an appropriate period for public comment followed by publication of a "final rule" in the *Federal Register.***

It should be noted the ~~two~~ **three** Council meeting process refers to two decision meetings. The first meeting to develop proposed **harvest specifications** ~~management measures and their alternatives~~, the second meeting to **finish drafting harvest specifications and to develop the management measures and the third meeting to** make final **recommendations** to the Secretary **on the complete harvest specifications and management measures biennial management package**. For the Council to have adequate information to identify proposed management measures for public comment at the first meeting, the identification of issues and the development of proposals normally must begin at a prior Council meeting, ~~usually the June Council meeting~~.

D. Full Rulemaking Actions Normally Requiring at Least Two Council Meetings and Two *Federal Register* Rules (Regulatory Amendment) - These include any proposed management measure that is highly controversial or any measure which directly allocates the resource. **These also include management measures that are intended to have permanent effect and are discretionary, and for which the impacts have not been previously analyzed. (moved from Section C, above)** The Council normally will follow the two meeting procedure described for the ~~abbreviated~~ **specifications and management measures** rulemaking category. For the Council to have adequate information to identify proposed management measures for public comment at the first meeting, the identification of issues and the development of proposals normally must begin at a prior Council meeting. The Secretary will **normally** publish a "proposed rule" in the *Federal Register* with an appropriate period for public comment followed by publication of a "final rule" in the *Federal Register.*

Management measures recommended to address a resource conservation issue must be based upon the establishment of a "point of concern" and consistent with the specific procedures and criteria listed in Section 6.2.2.

Management measures recommended to address social or economic issues must be consistent with the specific procedures and criteria described in Section 6.2.3.

Exhibit D.8
Attachment 2
November 2003

TABLE 2.1.1-1. Groundfish Management Team-recommended alternatives for acceptable biological catches (ABCs) and total catch optimum yields (OYs) (mt) for 2005. (Overfished stocks in CAPS).

Stock	2004 ABCs/OYs		2005 ABC and OY Alternatives							
			Low OY		Med OY		High OY		Council OY a/	
	ABC	OY	ABC	OY	ABC	OY	ABC	OY	ABC	OY
LINGCOD	1,385	735	2,118	1,992	2,118	2,045	2,118	2,089		
Pacific Cod	3,200	3,200			3,200	3,200				
PACIFIC WHITING (Coastwide)	Decision deferred until March 2004				Decision deferred until March 2005					
Sablefish (Coastwide)	8,487	7,786				7,761		8,335		
North of Conception	8,185	7,510				7,486		8,040		
Conception area	302	276				275		295		
PACIFIC OCEAN PERCH	980	444				447				
Shortbelly Rockfish	13,900	13,900			13,900	13,900				
WIDOW ROCKFISH	3,460	284				285				
CANARY ROCKFISH b/	256	47		43		48		48		
Chilipepper Rockfish	2,700	2,000			2,700	2,000				
BOCACCIO	400	250								
Splitnose Rockfish	615	461			615	461				
Yellowtail Rockfish	4,320	4,320			3,896	3,896				
Shortspine Thornyhead	1,030	983				999				
Longspine Thornyhead	2,461	2,461			2,461	2,461				
S. of Pt. Conception	390	195			390	195				
COWCOD (S. Concep)	5	2.4			5	2.4				
N. Concep & Monterey	19	2.4			19	2.4				
DARKBLOTCHED	240	240			269	269				
YELLOWEYE	53	22								
Nearshore Species										
Black WA	540	540			540	540				
Black OR-CA	775	775			753	753				
Minor Rockfish North	3,680	2,250			3,680	2,250				
Remaining Rockfish North	1,612	1,216			1,612	1,216				
Bocaccio	318	239			318	239				
Chilipepper - Eureka	32	32			32	32				
Redstripe	576	432			576	432				
Sharpchin	307	230			307	230				
Silvergrey	38	29			38	29				
Splitnose	242	182			242	182				
Yellowmouth	99	74			99	74				
Other Rockfish North	2,068	1,034			2,068	1,034				
Minor Rockfish South	3,412	1,968			3,412	1,968				
Remaining Rockfish South	854	689			854	689				
Bank	350	263			350	263				
Blackgill	343	306			343	306				
Sharpchin	45	34			45	34				
Yellowtail	116	87			116	87				
Other Rockfish South	2,558	1,279			2,558	1,279				
Cabezon	Managed under "Other Fish"		96	74	96	81	96	88		
Dover Sole	8,510	7,440			8,510	7,440				
English Sole	3,100	3,100			3,100	3,100				
Petrale Sole	2,762	2,762			2,762	2,762				
Arrowtooth Flounder	5,800	5,800			5,800	5,800				
Other Flatfish	7,700	7,700			7,700	7,700				
Other Fish	14,700	14,700			14,604	14,604				

a/ Council OY is the Council's preferred harvest alternative for 2005.

b/ The canary rockfish ABC and OY are based on the Council's adopted rebuilding strategy that has a P_{MAX} (probability of successful rebuilding within the maximum allowable time period) of 60%. The OY varies by the commercial:recreational catch share due to the fact that the recreational fishery takes smaller fish and therefore has a greater "per ton" impact than the commercial fishery. The canary stock was not assessed in 2004.

TABLE 2.1.1-2. Pacific Fishery Management Council-recommended alternatives for acceptable biological catches (ABCs) and total catch optimum yields (OYs) (mt) for 2006. (Overfished stocks in CAPS).

Stock	2004 ABCs/OYs		2006 ABC and OY Alternatives							
			Low OY		Med OY		High OY		Council OY a/	
	ABC	OY	ABC	OY	ABC	OY	ABC	OY	ABC	OY
LINGCOD	1,385	735	2,124	2,010	2,124	2,058	2,124	2,098		
Pacific Cod	3,200	3,200			3,200	3,200				
PACIFIC WHITING (Coastwide)	Decision deferred until March 2004				Decision deferred until March 2006					
Sablefish (Coastwide)	8,487	7,786				7,634		8,149		
North of Conception	8,185	7,510				7,363		7,860		
Conception area	302	276				271		289		
PACIFIC OCEAN PERCH	980	444				447				
Shortbelly Rockfish	13,900	13,900			13,900	13,900				
WIDOW ROCKFISH	3,460	284				289				
CANARY ROCKFISH b/	256	47		45		51		51		
Chilipepper Rockfish	2,700	2,000			2,700	2,000				
BOCACCIO	400	250								
Splitnose Rockfish	615	461			615	461				
Yellowtail Rockfish	4,320	4,320			3,681	3,681				
Shortspine Thornyhead	1,030	983				1,018				
Longspine Thornyhead	2,461	2,461			2,461	2,461				
S. of Pt. Conception	390	195			390	195				
COWCOD (S. Concep)	5	2.4			5	2.4				
N. Concep & Monterey	19	2.4			19	2.4				
DARKBLOTCHED	240	240			294	294				
YELLOWEYE	53	22								
Nearshore Species										
Black WA	540	540			540	540				
Black OR-CA	775	775			736	736				
Minor Rockfish North	3,680	2,250			3,680	2,250				
Remaining Rockfish North	1,612	1,216			1,612	1,216				
Bocaccio	318	239			318	239				
Chilipepper - Eureka	32	32			32	32				
Redstripe	576	432			576	432				
Sharpchin	307	230			307	230				
Silvergrey	38	29			38	29				
Splitnose	242	182			242	182				
Yellowmouth	99	74			99	74				
Other Rockfish North	2,068	1,034			2,068	1,034				
Minor Rockfish South	3,412	1,968			3,412	1,968				
Remaining Rockfish South	854	689			854	689				
Bank	350	263			350	263				
Blackgill	343	306			343	306				
Sharpchin	45	34			45	34				
Yellowtail	116	87			116	87				
Other Rockfish South	2,558	1,279			2,558	1,279				
Cabezon			96	79	96	85	96	91		
Dover Sole	8,510	7,440			8,510	7,440				
English Sole	3,100	3,100			3,100	3,100				
Petrale Sole	2,762	2,762			2,762	2,762				
Arrowtooth Flounder	5,800	5,800			5,800	5,800				
Other Flatfish	7,700	7,700			7,700	7,700				
Other Fish	14,700	14,700			14,604	14,604				

a/ Council OY is the Council's preferred harvest alternative for 2005.

b/ The canary rockfish ABC and OY are based on the Council's adopted rebuilding strategy that has a P_{MAX} (probability of successful rebuilding within the maximum allowable time period) of 60%. The OY varies by the commercial:recreational catch share due to the fact that the recreational fishery takes smaller fish and therefore has a greater "per ton" impact than the commercial fishery. The canary stock was not assessed in 2004.

Exhibit D.8
Situation Summary
November 2003

PRESEASON MANAGEMENT SCHEDULE AND PROCESS, ACCEPTABLE BIOLOGICAL CATCH, PRELIMINARY OPTIMUM YIELD, AND MANAGEMENT MEASURES FOR 2005-2006 FISHERIES

Situation:

Preseason Management Schedule

Amendment 17 of the groundfish fishery management plan (FMP) established a new process to set biennial groundfish harvest specifications and management measures. The Council selected a three-meeting process in recognition of many inadequacies of the prior two-meeting process, including the considerable analytical workload associated with the high degree of complexity of current groundfish fishery management issues, the extensive NEPA documentation requirements, and the need for improvements to the public input process during the latter stages of the process. Adding a third meeting to the end of the prior two-meeting process allows the opportunity for solutions to most problems associated with these inadequacies. However, beyond selecting a process that included the November, March/April, and June Council meetings, the adoption of Amendment 17 provided relatively little guidance and, therefore, allowed meaningful flexibility in scheduling a detailed process (Exhibit D.8, Attachment 1 shows the amendatory language adopted in Amendment 17).

The Council should adopt a detailed schedule and process for the development of 2005-2006 groundfish harvest specifications and management measures. The salmon management schedule and process typically contains considerable detail in terms of dates for key meetings, such as Salmon Technical Team meetings and constituent meetings, as well as deadlines for the production of necessary documents; this structured approach has proven quite successful for the salmon management process in recent years (see Exhibit E.3, Attachment 1: Pacific Fishery Management Council Schedule and Process for Developing 2004 Ocean Salmon Fishery Management Measures for the current proposed process). A schedule and process with similar detail for the development of 2005-2006 groundfish fishery specifications and management measures would include the following sequential key features:

- Formal adoption of a range of acceptable biological catch (ABC) and optimum yield (OY) levels and associated preliminary management measures.
- An ending date for the introduction of new, large data sets (such as observer program summaries) and analytical methodologies to be used in analyses throughout the process.
- An initial analysis of preliminary management measures.
- Constituent meetings.
- Formal adoption of ABC and OY levels and a range of refined management measures.
- Analysis of the refined range of management measures.
- Formal adoption of a range of management measures for public review.
- Preparation and distribution of a draft of the draft environmental impact statement (DEIS) document for public review.
- Constituent meetings.
- Formal adoption of a final recommendation to the U.S. Secretary of Commerce on complete

fishery specifications and management measures.
- After the final Council meeting, preparation and transmittal of the final DEIS document.

A detailed proposed schedule and process for setting 2005-2006 groundfish fishery specifications and management measures will be shown in Exhibit D.8, Supplemental Attachment 3.

ABCs, OYs, and Management Measures

The FMP requires the Council to establish reference points for each major species or species complex: an ABC, OY, and an overfishing threshold. The Council must also ultimately adopt management measures that are designed to attain, but not exceed, OYs. The tasks at this meeting are to adopt a range of ABC and OY levels for public review and analysis, as well as a preliminary range of 2005-2006 management measures or guidance in developing management measures. ABC and OY levels are to be adopted as two, single-year sets: one for the 2005 fishing year and one for the 2006 fishing year.

The new stock assessments and lingcod rebuilding analysis contemplated under agendum D.6 were considered by the Groundfish Management Team (GMT) at their October 2003 meeting to develop a recommended preliminary range of 2005-2006 harvest levels (Exhibit D.8, Attachment 2). Based on new model runs, Scientific and Statistical Committee advice, and Council action under agendum D.6, the GMT is expected to refine the range of recommended harvest levels in a supplemental statement.

The complexity of the groundfish fishery and the potentially significant impacts associated with 2005-2006 management decision-making appears to require the preparation of an Environmental Impact Statement (EIS). A preliminary draft EIS with fully analyzed alternatives needs to be prepared in time for the June 2004 Council meeting. The EIS process begins with a scoping session on Sunday November 2, 2003 (1 p.m. at the Council meeting in Del Mar, California).

<u>Council Tasks</u>:

1. **Adopt a preseason management schedule for 2005-2006.**
2. **Adopt a range of harvest levels for 2005-2006.**
3. **Adopt a preliminary range of management measures for 2005-2006.**

<u>Reference Materials</u>:

1. Exhibit D.8, Attachment 1: Amendatory Language for Amendment 17 to the Groundfish Fishery Management Plan.
2. Exhibit D.8, Attachment 2: Tables 2.1.1-1 & -2. Groundfish Management Team-recommended alternatives for acceptable biological catches (ABCs) and total catch optimum yields (OYs) (mt) for 2005 and 2006, respectively.
3. Exhibit D.8, Supplemental Attachment 3: Proposed Pacific Fishery Management Council Schedule and Process For Developing 2005-2006 Groundfish Fishery Specifications and Management Measures.

Agenda Order:

a. Agendum Overview — John DeVore
b. GMT Report on Estimates of ABC and OY — Michele Robinson
c. Recommendations of the States, Tribes, and Federal Agencies
d. Reports and Comments of Advisory Bodies
e. Public Comment
f. **Council Action:** Adopt Preliminary Harvest Levels, Management Measures, and Preseason Management Schedule for 2005-2006

PFMC
10/22/03

TRANSITION TO BIENNIAL MANAGEMENT PROCESS UNDER ADOPTED ALTERNATIVE 3

	Jan '03	April '03	June '03	Sept '03	Nov '03	Jan '04	Mar/Apr 04	June '04	Sept '04	Nov '04	Jan '05
Stock Assessments	Assessments and STAR for '04 due **5/03**					"Off" year for stock assessments. Advanced model development and stock assessment model refinement year.					"On" year begins
	Assessments and STAR for '05-'06 due **10/03**										
Management Specifications			Proposed '04 Specs	Final '04 Specs	Proposed '05-'06 ABC/OY; prelim mgmt measures		Proposed '05-'06 mgmt measures	Final '05-'06 Specs	First "off" year for Council management specifications process begins 9/04 and ends 11/05. In 11/05, proposed ABC/OY for '07-'08		
NMFS Post-Council Regulatory Process					'04 Specs via emergency for Jan-**Apr**			NMFS sends '05-'06 out for public review via proposed rule and implements via final rule by 01/05			
					'04 Specs proposed rule, public review; final rule due 3/04						

PLANNING OF "OFF-YEAR" NON-REGULATORY SCIENCE ACTIVITIES (e.g., STOCK ASSESSMENT MODELS, B_0, AND B_{MSY} WORKSHOPS)

Situation: The Council approved Amendment 17 to the Pacific Coast Groundfish Fishery Management Plan as a means of providing more opportunity for public input, regulatory efficiencies, and to create various improvements in the management process. One of the benefits of a biennial fishery is an "off year" for both (1) the direct fishery management activity of developing regulatory specifications and (2) the scientific activity of the stock assessment production and review process. During the "off year" break from what had been a repetitive, annual process, both direct fishery management and scientific foundation processes are enabled the opportunity to address key, long-term issues.

The table in Attachment 1, adapted from the environmental assessment analysis, illustrates the biennial management time line including identification of the off years for non-regulatory science activities ("stock assessments" and direct fishery management activities ("Council management specifications process").

Some key, long-term, science issues have been discussed by the Council in the past, but have been given a lower workload priority relative to the immediate needs of the former annual management process. These are now candidates for off year priority, and include such examples as reviewing and updating models used in stock assessments and conducting workshops to discuss methods for estimating critical aspects stock status such as virgin stock biomass (B_0) and the stock biomass that provides the maximum sustainable yield (B_{MSY}).

Dr. Elizabeth Clarke, Division Director at NMFS, Northwest Fisheries Science Center, will report on non-regulatory science activities from the perspective fo the Fishery Resource Analysis and Monitoring Division. The Council is to consider the input from NMFS, the Advisory Bodies, and the public and provide guidance relevant to the scheduling of off-year workload priorities.

Council Task:

1. **Discuss issues relevant to planning of "off-year" non-regulatory science activities and make recommendations to the NMFS Fishery Science Centers.**

Reference Materials:

1. Exhibit D.9, Attachment 1, Transition to Biennial Management Process Under Adopted Alternative 3.
2. Exhibit D.9.b, Supplemental NMFS Report.

Agenda Order:

a. Agendum Overview — Mike Burner
b. NMFS Report — Elizabeth Clarke
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. Council Discussion and Guidance

PFMC
10/20/03

VESSEL MONITORING SYSTEM: TRANSITING REQUIREMENTS AND EXPANSION OF THE PROGRAM

Situation: A Vessel Monitoring System (VMS) is a shoreside tracking system that allows shoreside personnel to remotely track vessel locations. Depth-based restrictions are a fundamental aspect of the current groundfish management regime but, fathom contours and management lines can be erratic in shape and difficult to follow and enforce, particularly in deep water. Therefore, the Council formed the Ad Hoc VMS Committee (VMSC) in 2002 to explore the use of this new tool in enforcing West Coast groundfish fishery regulations. The Council identified a preferred alternative at the October 28 - November 1, 2002 meeting and recommended that NMFS, in consultation with the VMSC, prepare a proposed rule for a pilot VMS program. NMFS accepted public comments on a proposed rule through July 21, 2003 and is anticipated to implement a final rule in October implementing VMS requirements for groundfish limited entry permitted vessels.

At the June 16-21, 2003 meeting the Council revised the membership of the VMSC to involve a larger range of fishing sectors as the Council looks to future expansion of the VMS program. The Council directed the VMSC to explore new applications for VMS technology in West Coast groundfish fisheries.

At the September 8-12, 2003 meeting the Enforcement Consultants (EC) requested the Council, as part of the 2004 annual specification process, restrict fixed gear vessel activity in the non-trawl Rockfish Conservation Area (RCA). The EC stated that, due to an oversight, the following intended language was left out of the prohibitions section of the proposed VMS rule: "Operate any vessel registered to a limited entry permit with a fixed gear endorsement in a non-trawl RCA (as defined in 660.302), except for purposes of continuous transiting and, therefore needed to be covered by the annual fishing regulation." Members of the EC familiar with the VMS and its capabilities, advised that drifting vessels and vessels actively fishing will show similar vessel location signatures, and allowing drifting in the RCA will adversely effect the use of VMS for it's intended purpose and tax limited resources. The Groundfish Advisory Subpanel (GAP) submitted formal comments to NMFS citing vessel safety as the principal reason for allowing vessels to drift for short periods in RCAs. The GAP also stated that if a vessel location signature allows NMFS to determine when a vessel is fishing there is no reason to prohibit drifting and that the drifting issue should be considered through the VMS regulatory process not under groundfish specifications. The Council was silent to any requirements on this issue when adopting management measures for 2004, but directed the VMSC to address the issue. The Council anticipated hearing from the VMSC, and other Advisory Bodies, at the November Council meeting and potentially submitting a recommendation to NMFS during the open comment period in the proposed and final rulemaking process for the 2004 annual specifications.

The VMSC met October 7, 2003 and topics included expansion of the existing program and RCA transiting requirements. The VMSC was unable to reach consensus on transiting requirements for use in the near future, but discussed possible solutions that may unfold as the program evolves.

Further, the VMSC discussed the merits of expanding the use VMS technology to open access commercial sectors and recreational fisheries. The full report of the VMSC and draft summary minutes of the meeting were not available in time for this distribution but will be included as supplemental material.

The Council is to hear reports from the VMSC, as well as advice from the Advisory Bodies and the public on RCA transit requirements and the future use of VMS in groundfish fisheries, and consider providing recommendations to NMFS and guidance to the further development of the VMS program.

Council Action:

1. **Consider Providing Recommendations to NMFS Regarding Transiting Requirements for Fixed Gear Limited Entry Vessels in the Existing Program and Provide Guidance as Necessary.**
2. **Consider Next Steps in Expanding the Program and Provide Guidance as Necessary.**

Reference Materials:

1. Exhibit D.10.b, Supplemental Attachment 1: Report of the Ad Hoc VMS Committee.
2. Exhibit D.10.b, Supplemental Attachment 2: Draft Summary Minutes of the October 7, 2003 Meeting of the Ad Hoc VMS Committee.

Agenda Order:

a. Agendum Overview — Mike Burner
b. Report of the Ad Hoc VMS Committee — Dayna Matthews
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action:** Provide Guidance on Transiting Requirements and Expanding the VMS Program

PFMC
10/15/03

Exhibit D.11
Situation Summary
November 2003

GROUNDFISH BYCATCH PROGRAM ENVIRONMENTAL IMPACT STATEMENT

Situation: The National Marine Fisheries Service (NMFS) is preparing a Programmatic Environmental Impact Statement (PEIS) for the groundfish bycatch management program. The EIS evaluates a variety of management measures to mitigate bycatch and to monitor and report bycatch levels. Draft purpose and need for action, alternatives, and affected environment sections were presented at the September Council meeting. A more complete analysis of the individual mitigation tools and alternative combinations of those tools is now available for Council consideration. A preliminary draft EIS (DEIS) is attached; however, additional economic analysis will be presented as a supplemental attachment at the Council meeting. The Council should review the scope and content of the analysis, provide comments and suggestions to NMFS, and consider approving the DEIS for public review and comment. The authors will make any suggested revisions and prepare the DEIS for publication and broader public distribution.

NMFS intends to provide an extended public comment period on the DEIS from mid-January 2004 through April, overlapping the April Council meeting. The Council's public review process and the public comment period required by the National Environmental Policy Act (NEPA) will run concurrently during this time. All public comments during the review period will be provided to both NMFS and the Council. At the April meeting, the Council will identify its preferred alternative, taking into account public comments and recommendations from its advisory entities. NMFS will review the Council's preferred alternative, any other Council recommendations, and public comments and prepare the final EIS under NEPA. The Record of Decision is expected to be completed in June 2004.

At their April meeting the Council should decide if an amendment to the groundfish fishery management plan and/or regulations are necessary and then begin the amendment process. Alternatively, because this is a program-level evaluation, the Council could delay implementing specific measures, which would then be implemented through subsequent actions based on analyses tiered from the PEIS.

Council Task:

1. **Make recommendations for any revisions to the document before release of the DEIS.**
2. **Decide whether to recommend a January 2004 release of the DEIS for public review/comment.**

Reference Materials:

1. Exhibit D.11.b, Attachment 1: Executive Summary Groundfish Bycatch Programmatic Environmental Impact Statement.
2. Exhibit D.11.b, Attachment 2: Preliminary Draft Bycatch Program Environmental Impact Statement (*document on CD-ROM, enclosed separately, limited copies available at meeting*).
3. Exhibit D.11.b, Supplemental Attachment 3: Draft Economic Analysis for Bycatch Programmatic EIS.

<u>Agenda Order</u>:

a.	Agendum Overview	Jim Seger
b.	NMFS Report	Jim Glock
c.	Reports and Comments of Advisory Bodies	
d.	Public Comment	
e.	**Council Action:** Approve DEIS for Public Review	

PFMC
10/21/03

Executive Summary
Groundfish Bycatch Programmatic EIS

1.0 The Proposed Action

The Pacific Fishery Management Council and National Marine Fisheries Service propose to establish a program to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law. The proposed action would establish the policies and program direction to achieve this purpose.

1.2 Purpose of the Proposed Action

As identified by the Council's ad hoc Environmental Impact Statement Oversight Committee (Committee), the purposes (objectives) of the proposed action include the following:

- **account for total fishing mortality by species**
- **establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits**
- **reduce unwanted incidental catch and bycatch of groundfish and other species**
- **reduce the mortality of animals taken as bycatch**
- **provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods**
- **monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly**
- **reduce unobserved fishing-caused mortalities of all fish**
- **gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches**.

1.3 Need for the Proposed Action

The proposed action is needed to (1) reduce waste, discard, and collateral damage to marine plants and animals by groundfish fishing activities on the Pacific coast, (2) collect and report appropriate and adequate information to support the groundfish fishery management program, and (3) balance these needs with environmental and social values (i.e., need to allow for fishing).

1.4 Selecting and Implementing a Preferred Alternative

The Council and NMFS will consider how each alternative addresses the purpose and need for action. While six alternatives have been proposed, there are a variety of management measures that could be included (or excluded) from any alternative. The Council and/or NMFS may find that by revising an alternative they may be able to achieve greater benefits or better mitigate anticipated negative effects. Finally, the Council and NMFS will determine if and how each alternative reduces bycatch to the extent practicable and, for bycatch that cannot be avoided, reduces bycatch mortality to the extent practicable.

The Council will review this preliminary draft EIS at its November 2003. NMFS will consider any Council comments on the preliminary draft and will prepare a final draft EIS (DEIS) in early 22004. NMFS expects to make the DEIS available for public comment in January 2004 and provide an extended comment period through April 2004. The Council will review the DEIS during the comment period and identify its preferred alternative at its April 2004 meeting. NMFS will prepare the Final EIS after the public comment period when it has received the Council's final recommendations.

1.5 How The EIS is Organized

This EIS follows the standard organization established by the CEQ regulations. Chapter 1 identifies the issue of bycatch reduction and reporting as the focus of the proposed action and describes why action is needed. Previous Council and NMFS actions relating to bycatch are described to help set the context for the proposed action. Chapter 1 also lays out the criteria the Council and NMFS will use for making their final decision.

Chapter 2 presents the six alternatives to reduce bycatch and bycatch mortality, and to establish a standardized reporting methodology. It describes how the alternatives were developed, and provides a summary of the anticipated environmental impacts of the each alternative. It briefly describes the management "tools" available to the Council and NMFS for reducing bycatch and for monitoring the effects and effectiveness of the various tools, and how the alternatives apply the tools. It identifies the direct, indirect and cumulative impacts so the decision-makers can make a reasoned and informed decision, and the public can understand the conclusions and how they were reached.

Chapter 3 describes the affected environment as it pertains to incidental catch, bycatch, bycatch mortality, and catch reporting/monitoring. The factors related to bycatch are identified and described: co-occurrence in time and space; species behavior; fish body size and shape; and types of fishing gears and methods used. Chapter 3 describes the current human environment as it relates to incidental catch, bycatch and bycatch mortality. The current condition of particularly important groundfish and other species of marine animals are described, and how they are directly affected (that is, bycaught) in groundfish fisheries. The social and economic conditions relating to bycatch, bycatch reduction methods, and bycatch monitoring are also described.

Chapter 4 presents the analysis of environmental impacts. The basic relationship between catch and effort, gear selectivity, and species abundance are described. Bycatch mitigation tools work through changing effort levels, gear selectivity/effectiveness, or by restricting access to areas of species abundance. Chapter 4 describes the capture methods of the various fishing gears, including selectivity features and placement factors (that is, where and in what conditions they can be used). Potential mitigation tools are described, that is, the available management measures and adjustments to control incidental catch and bycatch and to achieve other objectives. Regulations not related to fishing gears are identified and described: harvest specifications, allocation, retention limits, catch/ mortality limits, time/area management, and limiting effort (reducing fleet size). Collectively, these management measures are identified as the "bycatch mitigation toolbox." Potential effects of each tool are described and the effects and effectiveness of each tool are ranked. Next, those ranks are applied to each alternative. This stepwise process provides the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes.

2.0 The Alternatives

Chapter 2 presents the alternatives that have been developed to resolve bycatch issues and to ensure the FMP complies with the bycatch reduction mandates of the Magnuson-Stevens Act. Each alternative describes a bycatch management program and includes all the parts of the program: the overall objectives, the methods to achieve the objectives, and the reporting and monitoring requirements that would be required. The six alternatives represent a variety of policies, approaches, and methods to reduce bycatch. The alternatives range from the current (2003) methods of reducing bycatch (Alternative 1, no action or the "status quo") to more aggressive and comprehensive bycatch reduction policies and methods.

Section 2.1.1 presents the bycatch mitigation "toolbox," that is, the variety of regulatory measures available to the Council and NOAA Fisheries to implement a bycatch monitoring, reporting and reduction program. Each tool is described in terms of its usefulness, effectiveness, effects, etc.

Section 2.1.2 describes how the alternatives are structured so they can be compared and understood more clearly. Sections 2.2.1-2.2.6 describe each alternative in detail. Section 2.3 summarizes the anticipated effects or impacts or each alternative in comparison to current conditions.

Alternative 1 reduces incidental catch and bycatch through a combination of indirect measures: Optimum Yield (OY) specifications, area closures, gear restrictions, variable trip limits and bag limits, seasons and other measures. High priority is given to minimize cost of catch monitoring. Vessel trip limits are calculated using a computer model and incidental catch ratios from past years.

Alternative 2 would reduce groundfish bycatch by increasing the size of trip limits. This would be achieved by reducing the trawl fleet by 50%; the goal of maintaining a year-round fishery would continue. The focus on fleet reduction is based on the Council's *Strategic Plan for Groundfish*. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 3 would reduce groundfish bycatch by increasing the size of trip limits. This would be achieved by eliminating the goal of maintaining a year-round fishery and establishing a short season or series of seasons. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 4 would reduce bycatch by establishing catch limits for various fishery sectors in addition to vessel landing/retention limits. A portion of the overall allowable harvest would be held in reserve for those individuals with the lowest bycatch rates. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 5 would reduce bycatch by establishing groundfish catch quotas for individual commercial fishers and other qualified entities. Monitoring would be focused at the individual vessel level rather than at the sector level. Fishing restrictions might be relaxed to all vessels more flexibility to develop individual bycatch reduction methods.

Alternative 6 would reduce bycatch to near zero by (1) closing large areas, (2) establishing individual vessel catch allowances (caps), (3) requiring each commercial vessel to carry an onboard observer at all times the vessel fishes, and (4) requiring increased retention (limited discard) of groundfish.

3.0 The Affected Environment

Chapter 3 describes various components of the coastal marine ecosystem and how people and communities use and rely on the groundfish resources of this region. The groundfish FMP and management regime covers groundfish stocks off Cape Flattery, Washington to the California border with Mexico. Hundreds of plant and animal species occur along the West Coast and groundfish-related bycatch may affect many of them.

The chapter begins with a brief description of the physical environment, including marine geology, climate and currents. Basic biology of selected species, including important groundfish species, protected species, and other relevant fish and shellfish species, is provided. Species given special emphasis are identified: nine overfished groundfish species and protected marine species including Pacific salmon, marine birds, marine mammals and sea turtles. Other species are also described.

Fishing activities, gears and patterns are described. Important interactions among species, gears and fisheries are also described, as well as types of management tools and their application to bycatch issues. Chapter 3 also describes the human uses of West Coast groundfish stocks, and how these activities relate to other fishing activities in the region. The commercial and recreational fisheries, commercial fish buyers and processors, and coastal communities where groundfish-related activities occur are described.

4.0 Impacts of the Alternatives

Bycatch mitigation effects fall into four broad categories:

- Avoid catching fish that will not be kept and other animals
- Reduce the mortality of fish and other animals that are caught and released
- Reduce the waste of fish that are caught and are dead or will die as a result of being caught

- Avoid unobserved mortality of fish and other animals that directly results from fishing gear.

The highest priority of bycatch mitigation is to reduce the capture of any marine plant or animal that is unintended or unwanted. The goal is to harvest desired fish with the minimum impact on all other fish and animals. The second priority is to minimize damage to fish and animals that should or would not be caught in a perfectly selective fishery.

The amount of catch of any fish or other animal is related to the amount of effort, the selectivity of the gear, and the number of animals present. To reduce catch, any or all of these three factors can be modified.

The complicated relationships among these factors becomes evident when one considers more than one species at a time. No gear is equally selective for two species because of differences, however small, in species shape, size and behavior. Also, species abundance and distribution are never identical. This means that with any amount of fishing effort, the catch of two species will never be the same. The extent of geographic overlap affects the co-occurring catch, as does the degree of similarity in size and shape.

Capture methods of the various fishing gears are described, including selectivity features and placement factors. Non-gear related regulations are identified and described, such as harvest specifications, allocation, retention limits, catch/mortality limits, time/are management, and limiting effort (reducing fleet size). Collectively, these management measures are called the "bycatch mitigation toolbox." Potential effects of each tool are then described and ranked according to their effects and effectiveness. Then those ranks are applied to each alternative.

Section 4.1.2 describes the critical comparative methods used to analyze the effects of the various bycatch mitigation tools and the six alternatives. Section 4.1.3 identifies the available mitigation tools, and Section 4.1.4 describes the effects and effectiveness of the tools. The effects and effectiveness of each tool are ranked, and then ranks applied to each alternative. In this stepwise process, we provide the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes. Direct and indirect effects are described in Sections 4.2 through 4.11 Impacts to ecosystem and biodiversity are outlined in section 4.2. Impacts of the six alternatives are described in section 4.3. Section 4.5 summarizes impacts of each alternative proposed monitoring program. Section 4.6 summarizes impacts to the biological environment. Section 4.7 describes socioeconomic impacts. Effects on catch and bycatch distribution are discussed in section 4.8. Cumulative effects are summarized in section 4.9 and irreversible and irretrievable effects are discussed in Section 4.10. Impacts to management and environmental management issues are discussed in section 4.11.

5.0 Agency Preferred Alternative and the Environmentally Preferred Alternative

This chapter will be drafted when a preferred alternative has been identified, which may not be until April 2004. Chapter 5 will describe the decisions that went into the agency's choice of a preferred alternative. It will also identify the environmentally preferred alternative. If the preferred alternative is not the environmentally preferred alternative, this chapter will explain how and why they differ.

Table 2.2 Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

Goals and Objectives	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce bycatch by decreasing effort and permitting larger or more flexible trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce bycatch by reducing effort and permitting larger or more flexible trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector catch/ mortality caps	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch limits (individual quotas) for groundfish species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	Y	Y	Y	Y	Y	Y
Set **overfished groundfish catch caps** by **fishing sector**	N	N	N	Y	N	Y
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	Y	Y	Y	Y*	N	N
Use **catch limits** to control groundfish bycatch	N	N	N	Y	Y	Y
Set individual vessel/permit catch caps for overfished groundfish species	N	N	N	N	Y	Y
Set groundfish **discard caps** (require increased retention)	N	N	N	N	Y	Y
Establish **IQs** for other groundfish	N	N	N	N	Y	Y
Establish bycatch **performance standards**	N	N	N	N	Y	Y
Establish a reserve for fishers who achieve performance standards	N	N	N	Y	N/Y	Y
Gear Restrictions						
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	Y	Y	Y	Y	N	Y
Time/Area Restrictions	Y	Y	Y	Y	Y	Y
Establish **long term closures for all groundfish fishing**	N	N	N	N	N/Y	Y
Establish **long term closures for on-bottom fishing**	N	N	N	N	N/Y	Y
Capacity reduction (mandatory)	N	Y(50%)	N	N	N	N
Monitoring/Reporting Requirements						
Trawl logbooks	Y	Y	100%	Y	??	??
Fixed-gear logbooks	N	N	100%	Y	??	??
CPFV logbooks	N	N	N	Y		
Commercial **port sampling**	Y	Y	Y	>Y	N/Y	Y
Recreational port sampling	Y	Y	Y	>Y	Y	>>x
Observer coverage (commercial)	10%	10%	10%+logbook	60%?	100%	100%
CPFV observers	N	N	N	Y	Y	100%
VMS	Y	Y	Y	Y	Y	Y
Post-season observer data OK	Y	Y	Y	Y/N	N	N
Inseason observer data required	N	N	N	Y/N	Y	Y
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	Y	Y	Y	Y	N	N

* Trip limits may be required for some sectors to prevent "derby fishing".

Table 4.1.1 Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Harvest Levels					
ABC/OY	Low OYs often require management measures such as low cumulative landing limits under some alternatives that made lead to discard. On the other hand, higher OYs may result in higher levels of effort and catch. Depending on alternatives, higher discard may also result.	Many species limited by markets do not reach OY limits, due to the market limit and other constraints placed on fishery by overfished species OYs.	If OY's are reduced, regulatory bycatch mortality may increase for some species if trip limits are reduced. If overall effort is reduced due to restrictions, overall bycatch and bycatch mortality may be reduced.	Lower OY's should reduce fishing effort. Reducing effort should result in reduced habitat impacts.	Lower OYs required for rebuilding of some species may make it difficult to accurately track total catch under some alternatives.
Sector allocations 1/	Distributed OY may have a postive effect in reducing bycatch. Risk and consequences of encountering a "disaster tow" can be spread out among several boats within the sector.		Under a given OY, catch is allocated and distributed to fishery sectors in some alternatives. Distributed OY may have a postive effect in reducing bycatch mortality to the degree risk of bycatch can be spread and managed by the sector.		Sector allocations would work best with a robust monitoring program. With increased monitoring, There would be less incentive to discard allocated fish as it would count against the allocation.
Trip (landing) limits 2/	If landing limit increases, bycatch is reduced. Studies have shown that as trip limits decline or cumulative limits are approached, bycatch increases. As cumulative limits are reached there are stronger incentives to keep higher valued fish and discard species that are close to the limit in order to continue fishing for species having more cumulative limit remaining.	Economic factors such as price, demand, and minimum fish size needed for processing often determine market limits on the amount of fish landed. These factors can lead to discarding of fish after a market limit is reached.	If bycatch is reduced due to increased landing limit, bycatch morality is also reduced. If limits are increased due to larger OYs, bycatch and bycatch mortality may increase due to higher harvest levels.		If landing limits increase, regulatory induced discard is reduced. Reducing discard increases accuracy of estimating total catch at lower levels of fishery monitoring.
Catch limits	Vessel catch limits reduce bycatch when fishing ceases and/or there is a retention requirement. Effect is enhanced when limit is on individual boat, when applied to all groundfish, and monitoring is robust.	If all groundfish catch is retained (alternative 6), vessel catch limit will have no market induced bycatch.	Vessel catch limits should reduce bycatch mortality as there is less need to compete to catch fish (no derby fishery). Same pattern of effect as with regulatory bycatch.	Vessel catch limits may reduce hours trawled through incentives and efficencies to maintain strict catch caps under some options. Reducing trawl hours should reduce habitat impacts.	Catch limits may provide more flexibility by relaxing or eliminating landing limits and reducing discarded catch of those species that are not market limited. Thus, accountability is improved, if full retention is required and/or observer coverage is significantly

Table 4.1.1 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Gear Regulations 4/	Regulatory induced bycatch may be reduced by allowing modified gear or alternative gear types that are more selective for non-overfished species and less selective for overfished species.	Allowing modified or alternatives gears that are more selective for marketable species may reduce market induced bycatch. Gear changes to select against overfished species may interact with market induced bycatch both positively and negatively.	Making gears less efficient or more selective may result in some species or sizes being avoided, thus reducing bycatch mortality.	Gear modifications may reduce impacts to habitat. Smaller roller gear requires fishers to avoid high relief habitat. Other alternatives allow use of fixed gear to take unused portions of OY. In the latter case, habitat interactions are different, but likely reduced.	Flexible gear regulations may permit experimentation, and use of alternative and more selective gears to access unused portion of OY. Coupled with observers, species selective gears should reduce discarded fish and improve accountability.
Time/area restrictions 5/	Time/area closures eliminates regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, regulatory bycatch could increase outside the closure.	Time/area closures eliminates non-regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, non-regulatory bycatch could increase outside the closure.	Bycatch mortality would be reduced within the closed area. Bycatch mortality could increase outside of the closed area if fishing effort increases.	Habitat impacts would be reduced or eliminated within closed areas. Habitat impacts could increase outside of closed areas if effort increases outside the closure.	Accountability would be increased through VMS verification of fishing location
Capacity Reduction	Capacity reduction could occur through a buyback program or through sales of IQs. Reduced effort should allow more flexibility in vessel landing limits that would likely reduce regulatory induced bycatch.	If overall effort is reduced as a consequence of capacity reduction, bycatch of species with low or no value would be reduced. Fewer boats may induce buyers to relax market limits (supply and demand response) and effort could increase. Non-marketable or low valued fish would still contribute to bycatch.	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished however, offsetting positive effects.	Reduced effort should have a positive impact in reducing habitat impacts Fewer boats could result in increased hours fished however, offsetting positive effects.	

Table 4.1.1 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Data Reporting					
Logbooks					
Observers					Increased observer coverage under some alternatives would increase accountability by ensuring retention, if required, or accurately accounting for discarded fish.
Vessel monitoring system 6/	VMS can directly reduce regulatory bycatch. Compliance with area closures to protect overfished species, for example, would be assured.		VMS can directly reduce regulatory bycatch mortality. Compliance with area closures to protect overfished species, for example, would be assured.		VMS increases accountability by verifying fishing location.
Enforcement					

1/ PFMC, 2003d.
2/ Pikitch, 1988, Methot, 2000.
3/ Larkin, 2003.
4/ Hanna, 2003 and Davis, 2003.
5/ PFMC, 2001.
6/ PFMC, 2003e.

Table 4.1.2 Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Harvest Levels				
ABC/OY	Abundance of overfished species should increase as stocks are rebuilt, those a above MSY could be reduced. *Any changes in population abundance and structure may affect forage available for other animals (birds, mammals, etc.).*			
Sector allocations				
Trip (landing) limits 1/	Present trip limit management attempts to maintain ratios of species in some sectors of the multi-species groundfish fishery. Ratio management may reduce discard but might result in long-term changes in abundance of individual species.		Present trip limit management attempts to maintain ratios of species in some sectors of the multi-species grounfish fishery. Ratio management may result in effort shifting, increasing and/or decreasing bycatch of individual species.	
Catch limits			Catch limits provide flexibility and accountability to manage bycatch. A reduction in derby style fishing should allow fishers to more effeciently pick fishing times and locations to minimize take of species with small catch or bycatch limits.	
Individual quotas 2/			Similar effect as described above under catch limits, but with more flexibility if IQs can be purchased.	

Table 4.1.2 (continued). Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Gear Regulations 3/	Allowing modified or alternatives gears that are less selective for overfished or other groundfish (undersized fish for example) should contribute to increased abundance of target species. If these changes also allow increased selection and catch per unit effort on non-overfished species, abundance of these species could decrease.	Gears modified to reduce bycatch of target species may have different impacts on habitat. The direction of impact is unknown.	Gear restrictions may have a positive impact at reducing regulatory bycatch of overfished species. If effort and target fishing increases on healthier stocks, bycatch of non-overfished species may increase.	Some gear modifications will make fishing gear less efficient, increasing cost per unit of value of catch.
Time/Area Closure 4/	Abundance (biomass) inside area closures should increase through growth. To the degree density dependence occurs, recruitment may be limited inside but increase outside of reserves.	Incentives for fishing outside of closed areas may result in effort shifts. Effort shifting may free up some kinds of habitat from impacts but increase those impacts elsewhere.	Area closures could result in effort shifting. While overfished species bycatch might be reduced, bycatch of market limited species might be increased, depending on alternatives.	
Capacity Reduction	Longer term, capacity reduction, if it results in reduced effort, contributes to a reduction in overall mortality and bycatch mortality which will in turn increase abundance.	Response to capacity reduction would be to reduce habitat interactions with fishing gears. Latent capacity exists even with a 50% reduction in fleet size. Thus, there is the potential for effort increase even though capacity is reduced. This would tend to offset any benefit and gear impacts on habitat could rebound.	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished however, offsetting positive effects. Less effort may allow more flexibility in choice of fishing location - reducing spatial or temporal concentrations of bycatch.	

Table 4.1.2 (continued). Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Data Reporting				
Logbooks				
Observers	Increased observer coverage may reduce fishing behaviors that lead to regulatory induced discard. This would have a positive indirect effect in reducing bycatch, reducing unaccounted for fishing mortality, and positively influencing abundance. Increased observer coverage should increase the quality of data used in stock assessments. Estimates of abundance should therefore be improved.	Increased observer coverage may provide better information on habitat - especially if observers collect data on bycatch of benthic invertebrate communities.	Increased observer coverage should provide more accurate data on distributional changes in bycatch.	Increased observer coverage will add to cost of management and fishing operations.
Vessel Monitoring Systems (VMS) 5/		VMS ensures compliance with fishing locations. Habitat protection within closed areas would be enhanced.		VMS add to cost of fishing and management operations. To the degree compliance and catch accounting are improved, future fishing opportunities and economic stability should be preserved.
Enforcement				

1/ Hastie, 2003.
2/ Larkin, 2003.
3/ Hanna, 2003 and Davis, 2003.
4/ PFMC, 2001.
5/ PFMC, 2003e.

Table 4.5.1 Monitoring tools and effects on improving accountability and cost impacts of each tool. Effects scaled as follows: Y (definitely, substantially), y (probably, moderately), n (probably not, minor), and N (no, none); L = lower cost, M = moderately higher cost, H = highest cost.

Monitoring/Reporting Requirements	Alternatives	Program	Identify fishing locations	Identify fishing depths	Provide tow by tow data	good data quality	Increase quantity and timeliness of data	Identify groundfish discards	Provide groundfish biological data	Provide non-groundfish data	Provide other non-finfish data	Provide mammal and seabird data	Ease of enforcement	Administrative Costs	Compliance Costs (to industry)
fish tickets	1-6	state	N	N	N	y	Y	N	N	y	N	N	Y	L	L
logbooks	1-2,4-6	state	y	y	y	y	n	N	N	N	N	N	Y	M	M
logbooks	3	federal	y	y	y	y	y	y	N	N	N	N	Y	M	M
observers															
commercial 10%	1-3	federal	Y	Y	Y	Y	n	Y	Y	Y	Y	Y		H	M/H
commercial 60%	4	federal	Y	Y	Y	Y	y	Y	Y	Y	Y	Y		H	M/H
commercial 100%	5,6	federal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		H	M/H
CPFV	4-5	(state)	Y	y	-	Y	Y	Y	Y	Y	Y	y		H	M/H
sport		n/a			-		-							HH	
port sampling															
commercial	1-6	state	y	y	N	Y		n	y	N	N	N		M	L
CPFV	1-6	state	y	y	-	Y		n	y	y	N	N		M	L
sport	1-6	state	y		-				y?	y?				M/H	L
VMS	1-6	federal	Y	y	N	Y	Y	N	N	N	N	N	Y	L	M
mandatory retention	5,6	federal				Y	Y	y	y	n	n	N	N	H/M	M/H
Enforcement cost			H	H	H			H		H	H				

Table 4.5.2 Monitoring alternatives and rank of effects on improving accountability, and cost impacts of each alternative.

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**	**Alternative 6**
RELATIVE RANK OF ALTERNATIVES BY EFFECTIVENESS AT IMPROVING ACCOUNTABILITY, EASE OF ENFORCEMENT, REDUCING COMPLIANCE COSTS	10% Commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, 100% log coverage, log verification, VMS.	60% commercial and recreational (CPFV) observer coverage, increased commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and increased recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.
Indentify fishing locations (VMS)	1	1	1	1	1	1
Identify fishing depths (VMS)	1	1	1	1	1	1
Provide tow by tow data	2	2	1	1	1	1
Provide good quality data	4	4	3	2	1	1
Increase quantity of data	5	4	3	2	1	1
Allow inseason use of data	3	3	3	2	1	1
Identify groundfish discards	5	4	3	2	1	1
Provide groundfish biological data	6	5	4	3	2	1
Provide non-groundfish biological data	3	3	3	2	1	1
Provide non-finfish biological data	3	3	3	2	1	1
Provide mammal and seabird data	3	3	3	2	1	1
Ease of enforcement	5	4	3	2	1	1
Keep administrative costs low	2	3	4	5	6	6
Keep industry compliance costs low	2	3	4	5	6	6
Rank of location	2	2	1	1	1	1
Rank of quality, quantity, timeliness	5	4	3	2	1	1
Rank of groundfish biological data	6	5	4	3	2	1
Rank of non-groundfish biological data	3	3	3	2	1	1
Rank of ease of enforcement	5	4	3	2	1	1
Rank of cost	1	2	3	4	5	5
Number of first place scores	2	2	4	4	15	17
Number of last place scores	15	8	5	0	3	3
Overall Rank	6	5	4	3	2	1

Table 4.6.1 Relative rank of bycatch reduction methods (tools) for each alternative used to reduce bycatch and bycatch mortality, and address accountability issues.

RELATIVE RANK OF ALTERNATIVES BY BYCATCH REDUCTION TOOL TYPE	Alternative 1 Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	Alternative 2 Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	Alternative 3 Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	Alternative 4 Reduce all groundfish bycatch by establishing sector caps	Alternative 5 Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	Alternative 6 Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	1	1	1	1	1	1
Set **overfished groundfish catch caps** by **fishing sector**	2	2	2	1	2	2
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	4	2	3	2	1	1
Use **catch limits** to control groundfish bycatch	3	3	3	2	1	1
Set individual vessel/permit catch caps for overfished groundfish species	3	3	3	3	2	1
Set groundfish **discard caps** (require increased retention)	2	2	2	2	1	1
Establish **IQs** for other groundfish	2	2	2	2	1	1
Establish bycatch **performance standards**	3	3	3	2	1	1
Establish a reserve for fishers who achieve performance standards	3	3	3	2	1	1
Gear Restricitons						
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	2	2	2	2	3	1
Time/Area Restrictions	3	3	3	3	2	1
Establish **long term closures for all groundfish fishing**	3	3	3	3	2	1
Establish **long term closures for on-bottom fishing**	2	2	2	2	1	1
Capacity reduction (mandatory)	3	1	3	3	2	2
Monitoring/Reporting Requirements						
Trawl logbooks	2	2	1	2	2	2
Fixed-gear logbooks	2	2	1	2	2	2
CPFV logbooks	2	2	2	1	1	1
Commercial **port sampling**	3	3	3	2	1	1
Recreational port sampling	3	3	3	1	2	1
Observer coverage (commercial)	5	4	3	2	1	1
CPFV observers	3	3	3	2	2	1
VMS	1	1	1	1	1	1
Post-season observer data OK	3	3	3	2	1	1
Inseason observer data required	3	3	3	2	1	1
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	2	2	2	2	1	1
Discount fish ticket records of overfished species landings due to the low likelihood they accurately reflect actual catch and mortality.	2	2	2	1	1	1
Number of first place scores	2	3	4	5	16	22
Number of last place scores	23	20	18	12	3	3
Overall Rank	5	4	4	3	2	1

* Trip limits may be required for some sectors to prevent "derby fishing".

Table 4.6.2 Alternatives ranked by their effectiveness at reducing bycatch, enforcing and monitoring bycatch measures, and reducing compliance costs to industry.

RELATIVE RANK OF ALTERNATIVES BY POTENTIAL BYCATCH REDUCTION, EASE OF ENFORCEMENT AND COST	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector caps	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
Reduce catch in excess of vessel limits?	5	4	5	3	2	1
Reduce proportion of overfished species?	5	3	4	2	1	1
Reduce encounters with overfished	5	3	4	2	1	1
Reduce fishing in high relief seafloor	5	3	4	2	2	1
Reduce catch proportion of on-bottom	5	3	4	3	2	1
Reduce catch proportion of off-bottom	6	4	5	3	2	1
Reduce catch proportion of small fish?	3	3	3	3	2	1
Reduce catch of unwanted finfish species?	3	3	3	3	2	1
Reduce potential for "ghost fishing"?	1	1	1	1	1	1
Reduce catch of marine mammals?	2	1	2	2	2	2
Reduce catch of seabirds?	2	1	2	2	2	2
How easily enforced/ monitored?	5	4	3	2	1	1
Compliance Costs (to vessel)	1	2	3	4	5	6
Rank of Groundfish Bycatch Reduction	6	4	5	3	2	1
Rank of Other Bycatch Reduction	2	1	2	2	2	2
Rank of Enforcement	5	4	3	2	1	1
Rank of Cost	1	2	3	4	5	6
Number of first place scores	2	3	1	1	4	10
Number of last place scores	11	2	4	4	2	3
Overall Rank	6	4	5	3	2	1

Pacific Fishery Management Council

NEWS RELEASE

FOR IMMEDIATE RELEASE — Monday, September 22, 2003

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AD HOC GROUNDFISH TRAWL INDIVIDUAL QUOTA COMMITTEE APPOINTED

The Pacific Fishery Management Council announces the appointment of a committee to work on development of an individual quota program for the groundfish trawl fishery. Appointment of the committee by the Council chair was authorized at the September 2003 Council meeting. Dr. David Hanson, Pacific States Marine Fisheries Commission, will chair the committee, which will be composed of representatives of whiting and non-whiting groundfish trawl catcher vessels, shoreside and at-sea processors, Pacific Northwest groundfish fishing tribes, conservation groups, and fisheries enforcement. The committee will be supported by representatives from the National Marine Fisheries Service, NOAA General Counsel, the three coastal states' fish and wildlife agencies, and Pacific Council staff. The committee is charged with making recommendations to the Pacific Council regarding development of individual quotas associated with the groundfish trawl fishery. The committee's first meeting will occur this fall. Date and location of this meeting will be noticed in the near future, and the announcement will be placed on the Council website *www.pcouncil.org*.

Ad Hoc Groundfish Trawl Individual Quota Committee Membership

Chair
Dr. David Hanson

Trawl Fishing Representatives
Mr. Steve Bodnar
Mr. Chris Garbrick
Mr. Alan Hightower
Mr. David Jincks
Mr. Marion Larkin
Mr. Pete Leipzig
Mr. Brad Pettinger
Dr. Richard Young

Processors
Mr. Jay Bornstein
Mr. Dale Myer
Mr. Joe Plesha

Conservation Groups
Ms. Dorothy Lowman

Tribal
Mr. Steve Joner

Enforcement
CAPT Mike Cenci

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F:\!PFMC\News Releases\Groundfish IQ Committee.wpd

Exhibit D.12
Attachment 2
November 2003

PROPOSED AGENDA
Ad Hoc Groundfish Trawl Individual Quota Committee

Pacific Fishery Management Council
Embassy Suites Hotel
7700 NE 82nd Ave.
Portland, OR 97220
(503) 460-3000
October 28-29, 2003

Note: Actual Times May Vary from Those Provided

TUESDAY, OCTOBER 28, 2003 - 8:30 A.M.

A. ***Call to Order and Administrative Matters*** *(8:30 a.m.)*

1. Roll Call, Introductions, Announcements, etc. — Dave Hanson
2. Committee's Charge
3. Decision Rules
4. Individual Member Roles
5. Approve Agenda

B. ***Status of Individual Quotas (IQs) in Congressional and Executive Branch Policy (9:30 a.m.)***

C. ***Review of Regulatory Process*** *(9:45 a.m.)* — Eileen Cooney

1. National Environmental Policy Act
2. Magnuson-Stevens Fishery Conservation and Management Act
3. Other

D. ***Review Development and Implementation Steps and General Timeline (10:15 a.m.)*** — Jim Seger

BREAK

E. ***Review Potential Segments for IQ Programs*** *(11 a.m.)*

LUNCH (NOON-1 P.M.)

F. ***Review Work on Segments Done So Far*** *(2:30 p.m.)*

BREAK

***G. Develop Work Plan** (3:30 p.m.)*

Public Comment

WEDNESDAY, OCTOBER 29, 2003 - 8:30 A.M.

***H. Begin Work on Developing Alternatives** (8:30 a.m.)*

Public Comment

I. Schedule Next Meeting (4:30 p.m.)

J. Other

ADJOURN

PFMC
10/22/03

ACTION: Notification of petition finding.

SUMMARY: NMFS has received a petition to delist all west coast salmon (*Oncorhynchus* spp.) inhabiting the Pacific Basin, including all rivers and tributaries emptying into the Pacific Basin, from the endangered species list. NMFS has determined that the petition does not contain any new, substantial scientific or commercial information, indicating that the petitioned action may be warranted.

DATES: The finding announced in this document was made on September 28, 1998.

ADDRESSES: Requests for information concerning this petition should be sent to Chief, Endangered Species Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East West Highway, Silver Spring, MD 20910; telephone: (301)713-1401.

FOR FURTHER INFORMATION CONTACT: Lisa Lierheimer at (301)713-1401.

SUPPLEMENTARY INFORMATION:

Background

Section 4(b)(3)(A) of the ESA of 1973, as amended (16 U.S.C *et seq.*), requires that NMFS make a finding on whether a petition to list, delist, or reclassify a species presents substantial scientific or commercial information to demonstrate that the petitioned action may be warranted. NMFS' standard for substantial information is stated at 50 CFR 424.14(b) as "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted." This finding is to be based on all information available to NMFS at the time. To the maximum extent practicable, this finding is to be made within 90 days of the receipt of the petition, and the finding is to be published promptly in the **Federal Register**. If the finding is positive, NMFS is also required to promptly commence a review of the status of the involved species.

NMFS has made a 90-day finding on a petition to delist all Pacific salmon (*Oncorhynchus* spp.). The petition, dated July 8, 1998, was submitted by Mr. Richard A. Gierak, Director of New Frontiers Institute, Inc., and was received by NMFS on July, 14, 1998. The petitioner requested that NMFS delist all west coast salmon inhabiting the entire Pacific Basin including all rivers and tributaries emptying into the Pacific Basin.

The petitioner submitted information from various documents from 1985 through 1998, including NMFS publications, reports, and **Federal Register** documents of salmon listings, and from personal communications on the primary causative factors in the decline of coho salmon in northern California rivers. The petitioner identifies two categories of major factors contributing to the decline of northern California coho: nature (i.e., floods, fire, drought, El Nino), and human activities (i.e., the Marine Mammal Protection Act and the overpopulation of salmonid predators, the removal of salmonid eggs for hatchery production, and the destruction of estuarine habitats along the coast).

Under section 4(a)(1) of the ESA and the listing regulations at 50 CFR 424.11(c), when a species is considered for listing, NMFS must determine whether the species is endangered or threatened due to any one or a combination of the following factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanism; or (5) other natural or manmade factors affecting its continued existence.

Under 50 CFR 424.11(d), the factors considered in delisting a species are the same as those used to list a species. A species may be delisted only if the best scientific and commercial data indicates that the species is no longer threatened or endangered for the following reasons: (1) Extinction; (2) recovery (the point at which the purposes of the ESA are no longer required); (3) subsequent investigation reveals that the original data or the interpretation of that data used to list the species was in error.

For listed coho salmon, the present condition of the population is a result of long-standing, human-induced conditions (i.e., harvest, habitat degradation, and artificial propagation) that serve to exacerbate the negative effects of adverse environmental conditions (i.e., drought, poor ocean conditions). However, the present conditions of listed coho salmon and the information presented throughout the petition as factors directly attributable to the devastation of salmon populations correspond to the factors listed here, requiring NMFS to list a species under the ESA. Information demonstrating that listed salmon have recovered or that the threats to salmon no longer exist were not presented in the petition.

NMFS has reviewed the petition, the literature cited in the petition, and other available literature and information. NMFS finds that the petitioned action does not present substantial scientific or commercial information indicating that delisting Pacific salmon may be warranted.

Authority: 16 U.S.C. 1531 *et seq.*

Dated: September 28, 1998.

Andrew A. Rosenberg,

Acting Assistant Administrator for Fisheries, National Marine Fisheries Service.

[FR Doc. 98-26768 Filed 10-5-98; 8:45 am]

BILLING CODE 3510-22-F

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 660

[Docket No. 980918242-8242-01; I.D. 090898B]

RIN 0648-AL87

Fisheries off West Coast States and in the Western Pacific; Pacific Coast Groundfish Fishery; Advance Notice of Proposed Rulemaking

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Advance notice of proposed rulemaking; request for comments.

SUMMARY: The Pacific Fishery Management Council (Council) is considering whether there is a need to impose additional management measures to further limit harvest capacity or to allocate between or within the limited entry commercial and the recreational groundfish fisheries in the U.S. exclusive economic zone off the States of Washington, Oregon, and California. If the Council determines that additional management measures are needed, the Council will recommend a rulemaking to implement those measures. Possible measures include allocating harvest of particular groundfish species (rockfish and lingcod) between limited entry gear groups and between commercial and recreational fisheries and further limiting access to certain species within the Pacific Coast groundfish complex. The Council may proceed with some or all of these measures. In order to discourage fishers from intensifying their fishing efforts for the purpose of amassing catch history for any allocation or additional limited access program developed by the Council, the Council announced on April 9, 1998, that any program proposed would not include consideration of catch landed after that date. At present, the Council is planning to consider catch history

through the 1997 fishing season. Persons interested in the Pacific Coast groundfish fishery should contact the Council to stay up to date on the management of the fishery.

DATES: Comments must be submitted in writing by November 5, 1998.

ADDRESSES: Comments may be mailed to Jerry Mallet, Chairman, Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

FOR FURTHER INFORMATION CONTACT: Katherine King or Yvonne deReynier at 206–526–6140; or Svein Fougner at 562–980–4000; or the Pacific Fishery Management Council at 503–326–6352.

SUPPLEMENTARY INFORMATION: The Pacific Coast Groundfish Fishery Management Plan (FMP) was approved on January 4, 1982 (47 FR 43964, October 5, 1982), and implementing regulations appear at 50 CFR 660.302 through 660.341. On November 16, 1992, NMFS published final regulations implementing Amendment 6 to the FMP. Amendment 6 and its implementing regulations established a license limitation program for the commercial groundfish fishery based on the issuance of gear-specific Federal limited entry permits. Limited entry permits are endorsed for one or more of three gear types (trawl, longline, and trap(or pot)). A vessel meeting specific minimum landing requirements with a particular gear during the qualifying "window period" (July 11, 1984 through August 1, 1988) received a transferable permit with an "A" endorsement for that gear.

Amendment 6 also divided the Pacific Coast commercial groundfish fishery into two segments. The first segment is the limited entry fishery, consisting of vessels with limited entry permits endorsed for longline and/or trap (or pot) gear and all vessels using groundfish trawl gear. The second segment is the open access fishery, consisting of all vessels using all other gear, as well as vessels that do not have limited entry permits endorsed for use of longline or trap (or pot) gear, but that make small landings with longline or trap (or pot) gear. Implementation of Amendment 6 included setting harvest allocations between limited entry and open access fishers at percentages equal to the percentages of groundfish species taken by those same fishers during the window period.

On June 27, 1997, NMFS published final regulations implementing Amendment 9 to the FMP (62 FR 34670). Amendment 9 and its implementing regulations established a sablefish endorsement requirement for limited entry permits endorsed for fixed gear (longline or trap). The sablefish endorsement limits participation in the limited entry, regular, and mop-up fisheries for sablefish taken with fixed gear to permits with a minimum sablefish landing requirement during any one year within a window period of January 1, 1984, through December 31, 1994.

The Council in meetings from September 1997 through June 1998 discussed a trawl permit buyback program under the authority of Section 312(b) of the Magnuson-Stevens Fishery Conservation and Management Act. During these discussions, the Council determined that a buyback program would only be acceptable to trawl endorsed limited entry permit holders if the trawl fleet could retain a specific share of the total limited entry catch. At the same time, declining stock levels of some of the more valuable species in the groundfish complex had led to lower harvest levels and to greater concerns about catch allocation between the commercial and recreational sectors of the groundfish fisheries. These combined events led the Council to begin discussions on a rockfish and lingcod endorsement program to limit catch of those species to permit holders with greater dependence upon those species. At its April 1998 meeting, the Council realized that it might be addressing several different allocation issues over the coming year and that announcing the end of the time frame for considering catch history for groundfish allocation or further access limitation might prevent speculative fishing during Council resolution of these issues. The Council also established an Allocation Committee to review these issues and report back to the Council. The Allocation Committee has held two public meetings and reported to the Council at its September 1998 meeting in Sacramento, CA. The Council discussed these issues at that meeting and will hold further discussions at future meetings.

Implementation of any management measures for the fishery will require amendment of the regulations implementing the FMP and possibly of the FMP itself. Any action will require Council development of a regulatory proposal with public input and a supporting analysis, NMFS approval, and publication of implementing regulations in the **Federal Register**.

As the Council considers management options, some permit holders may decide to intensify their fishing effort for the sole purpose of establishing a record of making higher levels of commercial groundfish landings. When management authorities begin to consider limited access management regimes, this kind of speculative fishing is often responsible for a rapid increase in fishing effort in fisheries that are already fully developed or overdeveloped. The original fishery problems, such as overcapitalization or overfishing, may be exacerbated by the entry of new participants or effort expansion by current participants.

The Council began its formal discussion of management measures to allocate species or to limit participation or effort in the fishery on April 9, 1998. Groundfish harvest after that date may not be used as a basis for allocation or participation if a management program is developed using catch history as all or part of the basis for allocation or participation. Fishermen are not guaranteed future participation in the groundfish fishery, regardless of their date of entry or intensity of participation in the fishery before or after Council discussions on these issues.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: September 30, 1998.

Andy Rosenberg,

Deputy Assistant Administrator for Fisheries.

[FR Doc. 98–26769 Filed 10–5–98; 8:45 am]

BILLING CODE 3510–22–F

DEVELOPMENT OF GROUNDFISH TRAWL INDIVIDUAL QUOTAS AND CONTROL DATE

Situation: Based on direction received from the Council at its September 2003 meeting, the Council Chair appointed the Ad Hoc Trawl Individual Quota (IQ) Committee (Exhibit D.12, Attachment 1). The committee is scheduled to meet October 28 and 29, 2003 and will provide a report under this agenda item. That report may include requests for additional guidance from the Council. The IQ committee meeting agenda is included as reference material (Exhibit D.12, Attachment 2).

In addition to responding to the committee report, the Council should evaluate the status of control dates pertaining to this program and determine whether or not additional control dates are required. Control dates put fishermen on notice that landings after the control date may not be counted toward qualification for IQs. The control date is intended to discourage increased effort during deliberation on a new program. Deliberations on IQ programs may encourage increased effort if fishers hope that additional landings will qualify them for a greater share of the initial allocation of quota shares. Such increases can deteriorate conditions in the fishery. Additionally, landings made only on the speculative basis of qualifying for greater initial allocation do not reflect true economic dependence or involvement in the fishery. Economic dependence and involvement are usually significant criteria on which initial allocation rules are based. Control dates do not require that the Council not consider landings after the date, but provide the Council with a more defendable position if it should decide to do so.

There are currently two control dates that may have some bearing on the program which will be developed for consideration: a general IQ control date of November 13, 1991 for all groundfish fisheries and a control date of April 9, 1998 which was announced in support of measures to ". . . further limit harvest capacity or to allocate between or within the limited entry commercial and the recreational groundfish fisheries. . . Possible measures include allocating harvest of particular groundfish species (rockfish and lingcod) between limited entry gear groups and between commercial and recrational fisheries and further limiting access to certain species within the Pacific Coast groundfish complex" (Exhibit D.12, Attachment 3).

Council Action:

1. Provide Guidance on the Next Steps in the Groundfish Trawl IQ Process.

Reference Materials:

1. Exhibit D.12, Attachment 1: Ad Hoc Groundfish Trawl Individual Quota Committee Appointed press release.
2. Exhibit D.12, Attachment 2: Proposed Agenda for the Ad Hoc Trawl Individual Quota Committee meeting October 28-29, 2003.
3. Exhibit D.12, Attachment 3: *Federal Register* notice, Advance Notice of Proposed Rulemaking.
4. Exhibit D.12.b, Supplemental TIQC Report: Report of the Ad Hoc Trawl Individual Quota Committee.

Agenda Order

a. Agendum Overview — Jim Seger
b. Report of the Ad Hoc Groundfish Trawl IQ Committee — Dave Hanson
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action:** Provide Guidance on the Next Steps in the Groundfish Trawl IQ Process

PFMC
10/22/03

REPORT OF THE AD HOC GROUNDFISH TRAWL INDIVIDUAL QUOTA COMMITTEE

The Ad Hoc Groundfish Trawl Individual Quota Committee (TIQC) met October 28 and 29, 2003. All members were present. Substantial progress was made on the initial specification of the provisions for an individual quota (IQ) program alternative. This progress report solicits Council comment or action on:

- TIQC charge and the goals for an individual quota (IQ) program.
- TIQC recommendation for a control date.

The report also provides the Council with:

- The projected time line for action presented to the committee.
- An initial draft of the elements for a program.

The TIQC views the development of an IQ program to cover limited entry trawl landings to be a matter of utmost urgency and asks the Council to do everything possible to enlist the assistance needed to move forward rapidly on this issue. This should include finding a way to make use of the assistance offered from outside sources.

The TIQC would like to meet again as soon as information has been developed to assist the committee in evaluating, refining, and further developing the proposals. The target period for the next meeting is late-January early-February.

The TIQC received a report from Mr. Bill Robinson, NMFS, on the administration policy with respect to IQs for processors. He reviewed Dr. Hogarth's recent comments to congress on the issue and the Department of Justice opinion. Ms. Eileen Cooney, NOAA General Counsel, reviewed National Environmental Policy Act (NEPA) and Magnuson-Stevens Fishery Conservation and Management Act (MSA) requirements as they pertain to the committee task.

Committee Charge and Goals for Individual Quotas

The draft charge given the TIQC was, essentially, to provide assistance to the Council in scoping alternatives and impacts in support of MSA and NEPA processes and to specifically identify provisions for an IQ program.

The statement of need (problem statement) and goals determine the types of alternatives to status quo and IQ programs that should be considered in this process. The goals to be addressed should be closely related to the statement of need. The draft charge provided to the committee was stated in the context of the Council Strategic Plan capacity reduction goal. The committee believes capacity reduction should not be the primary goal addressed by the IQ program and suggests the Council endorse the following as the preliminary goals for this process.

- Provide for a well-managed system for protection and conservation of groundfish resources.
- Provide for a viable and efficient groundfish industry.
- Provide for a fair and equitable distribution of fishery benefits.
- Provide for a safe fishery.

A list of objectives related to these goals is provided as part of the section of this report on elements of the program. Also provided, there is a draft statement of need. Based on these goals and objectives and the statement of need, the committee suggests its draft charge be as follows.

> The TIQC is charged with assisting the Council in developing an IQ program to address problems identified in the statement of need, together with reasonable alternatives to such a program. In meeting this charge the committee should provide supporting rationale for recommendations and ensure its recommendations take into account other standards and criteria contained in the Magnuson-Stevens Fishery Management and Conservation Act and other applicable law, as well as, public comment received during scoping processes. Additionally, the committee should assist the Council in identifying critical impacts that should be analyzed.

Control Date

The committee recommends the Council adopt a control date of November 6, 2003. The date should cover the issuance of individual fishing quota to all potential initial recipients, possibly, but not necessarily including, and not limited to, vessel owners, permit owners, vessel operators, crew, and first receivers (processors and buyers).

Time Line for Action

The committee was presented with a possible time line for implementing a an IQ program (Table 1). Under the time line, if the Council chooses to recommend an IQ program, it would not be implemented until the start of 2007. It is the committee's hope that the resources can be found to stay on this schedule, and if possible, accelerate it.

Exhibit D.12.c
Supplemental EC Report
November 2003

ENFORCEMENT CONSULTANTS REPORT ON DEVELOPMENT OF GROUNDFISH TRAWL INDIVIDUAL QUOTAS AND CONTROL DATE

The Enforcement Consultants (EC) would suggest that the Council consider allowing the EC to meet with other enforcement sectors involved in activities related to individual quotas (IQs) outside of the *ad-hoc* IQ process. Enforcement pitfalls need to be identified early in the program's development in order for us to properly advise the Ad Hoc Groundfish Trawl Individual Quota Committee and the Council. The recommended meetings should coincide with Groundfish Management Team meetings so that technical perspectives on catch accounting issues associated with IQ's, and unlawful harvests in general, can be sought.

PFMC
11/06/03

Final Application for Exempted Fishing Permit to Test a Reduced-Discard Strategy for The Deepwater Complex Fishery

A. Application Date

October 10, 2003

B. Applicant Contact

Oregon Department of Fish and Wildlife
2040 SE Marine Science Drive
Newport, OR 97365

Phone: 541 867-4741
FAX: 541 867-0311
Contacts: Dr. Patricia Burke, Bob Hannah, Dr. Stephen J. Parker

C. Statement of Purpose and Goal

The purpose of this EFP is to test a discard reduction strategy for the deepwater complex trawl fishery for Dover sole, shortspine thornyhead and sablefish (DTS). The strategy uses written vessel-processor, state-vessel and state-processor agreements to reduce economic incentives for discarding, mandate more complete retention of DTS species, and create modest incentives for retention of DTS. The incentives created promote reduced discard, fewer tows, higher economic efficiency, and may be scalable to the West Coast fishery as a whole.

D. Justification

Reduced catch limits in recent years and size-related prices in the DTS fishery have created strong incentives for vessels to high-grade their catch to maximize income obtained from the reduced limits (Table 1). At the same time, any mismatch between the ratio of Dover sole, shortspine thornyhead (SST) and sablefish in the catch and the ratio of the respective limits, can create very high "regulatory" discard. These two factors, in combination, can result in very high discard rates in this fishery. Typically, low harvest limits for SST, followed by sablefish, result in high discard of these species while targeting Dover sole.

Comments from fishermen and research trawl data from the May-June period of 2003 can be used to illustrate the extent of this problem. All values presented are based on simulation modeling conducted by ODFW using actual catch data from research fishing conducted off Newport, Oregon with normal trawl gear in May 2003 in the deepwater complex fishery. Accordingly, the simulation data are considered reasonably representative of catches in the actual trawl fishery in that area at that time. Table 1 shows that to maximize ex-vessel value from the limits that were in place, a vessel can high-grade sablefish and thornyheads to land a combined catch with an ex-vessel value of about $31,400 (Table 1). Simulations with more realistic retention of all medium and large sablefish and thornyheads produced an average ex-vessel value of about $30,000 for this "high-grading" scenario. These simulations suggested however, that with this realistic "high-grading" scenario, combined DTS discard rates averaged 69% of the DTS brought aboard (43,800 lbs retained, 99,000 lbs discarded). In the simulations modeled, about 80-90 tows were required to catch all limits (a short tow duration was standardized across all simulations only for comparative purposes; the number of tows would be less if longer duration was modeled).

Table 1. Example DTS limits and prices, by size grade from May-June 2003.

Species	Size	Price/lb	Catch Limit	Maximum Value
Dover Sole	All Marketable	$0.33	31,000 lbs	$10,230
SST	Over 16"	$1.12	2,800 lbs	$3,136
	10-15"	$0.79		
	8.5-10"	$0.42		
Sablefish	Large	$1.80	10,000 lbs	$18,000
	Medium	$1.61		
	Small	$1.48		
	Extra Small	$0.98		
Total				$31,366

Table 2 shows an example of how vessel-processor agreements could be used to redefine the market categories, prices, and limits to reduce discard incentives. In this example, the fish grades that are likely to be high-graded for are lumped under the existing limits for that species; in this case medium and large sablefish under the "high-value sablefish" limit, and medium and large SST under the "high-value SST" limit. The species that are likely to be graded out and discarded, but are still marketable are combined under one market category named "Low-value DTS complex" (LVDTS), which is sold at a single price (how this will work is described below under "EFP Structure"). As can be seen from Table 2, the total maximum ex-vessel value obtained from catching all of the redefined limits goes up, however this depends on the actual negotiated ex-vessel price for low-value DTS complex, which is impossible to predict (we used $0.42/lb only for illustration, although a price somewhere between the Dover sole price and the small SST price is anticipated). More importantly though, simulation modeling shows that if the redefined limits are combined with a requirement that the vessel cease fishing for DTS when any 2 of the 3 redefined limits in Table 2 are met, discard falls to only about 11% of the DTS brought on board (42,300 lbs retained, 5,400 lbs discarded), all of which is fish that are below the minimum marketable size. In essence, with this limit structure, "regulatory discard" of DTS is brought to zero lbs.

The other important result from the simulation modeling is that using the redefined limits, the vessel quits fishing after only 25-30 tows, versus 80-90 tows for the "high-grading' scenario. If we assume complete mortality for discarded DTS, the population impacts on DTS species and on all other incidental species would be greatly reduced under the "redefined limits". A side benefit of a reduced number of tows needed to reach redefined DTS limits would be reduced bycatch of other species, such as darkblotched rockfish.

Table 2. Example of redefined DTS limits and prices, based on this EFP.

Market Category	Species	Grade	Price/lb	Catch Limit	Maximum Value
Low-value DTS Complex			$0.42	31,000 lbs	$13,020
	Dover sole	All Marketable			
	SST	8.5-10"			
	Sablefish	Small			
	Sablefish	Extra Small			
High-value SST	SST	Over 16"	$1.12	2,800 lbs	$3,136
	SST	10-15"	$0.79		
High Value Sablefish		Large	$1.80	10,000 lbs	$18,000
		Medium	$1.61		
Total					$34,156

E. Significance of Results

The information collected will have a broad and timely significance for fishery management on the West Coast, and potentially in other regions because it will provide information on the feasibility and scalability of a discard reduction strategy based on altering vessel incentives for discarding fish without increasing the total mortality imposed on any stock. Reduced discard could ultimately allow for higher directed fishing limits for DTS species, and because of reduced waste, could increase economic yield from this and possibly other mixed stock fisheries where high-grading occurs.

F. EFP Structure

This EFP is a small-scale test to judge the feasibility of potential expansion to the coast-wide DTS fishery. Therefore, only one vessel in each of three ports will participate, and this test will be conducted in the March-April and May-June trip limit periods. The three test ports will be Astoria, Newport, and Charleston.

Observer Coverage

The Northwest Fisheries Science Center's Observer Program would need to provide the chosen vessels with observer coverage for all trips within the two periods. If supplied, and an observer is not available, the vessel must wait for an observer to become available. The two trip limit periods will not count towards normal observer coverage requirements. Observer coverage will be coordinated through the Observer Program.

The observer will have two tasks. First, the observer will document discard of any species, estimating weight and number discarded, as normal. Second, the observer will sample the discarded Dover sole, shortspine and longspine thornyheads, and sablefish to document size selectivity. This data will serve as a check to ensure vessels are retaining all marketable DTS species. Following the end of the field test, observer data will be error checked and provided to the Oregon Department of Fish and Wildlife for analysis.

Processor Participation

Processors will be enter into written agreements with the State of Oregon, and with the test vessel. Processors and vessel owners will be required to negotiate a single price to be paid for the LVDTS market category. The "low-value DTS complex" market category price may be re-negotiated during the EFP period, provided new written copies of the vessel–processor agreement are provided to the state. The low-value DTS category must include at least one grade of both SST and sablefish. Processors must also agree not to set separate market limits on LVDTS component species and agree to accept landings of all rockfish and DTS retained by the vessel. The ex-vessel value of catches of high-value sablefish and SST or LVDTS in excess of redefined limits will be forfeited to the state of Oregon as a legal overage.

G. Vessel Obligations

Vessels will be identified through an application process beginning in January 2004. The applicant must be the registered owner of the vessel named in the application. A total of 3 vessels will be selected to participate in the EFP fishery. The EFP fishery will be conducted from March 1 through June, 2004.

All fishing and processor activities under this EFP will be conducted subject to written agreements with ODFW, and authorization to participate in this EFP can be revoked by ODFW at any time. After a vessel is selected for the EFP program, agreements between the state and vessel owner and between the state and processor will be completed. All marketable DTS will be retained, as well as all rockfish captured (excluding longspine and shortspine thornyheads).

The vessel must agree to take an observer for all trips during the trip limit period so that data can be collected on any discard that occurs. We expect that through cooperation with the West Coast Groundfish Observer Program, we will be able to provide 100% coverage for three vessels. If the vessel operator chooses to fish without an observer, the contract with the ODFW will be terminated, and the vessel can return to fishing under normal trip limit regulations.

Vessels operating under this EFP must agree to abide by the terms and conditions of the EFP. Each participating vessel will also have a contract with the ODFW detailing the vessel's responsibilities for the EFP fishery. Failure to abide by the conditions in the contract or to follow provisions in the EFP will result in revocation of the contract and of the EFP for the year.

Vessels must retain all catch of marketable DTS and all Sebastes. The vessel must agree to cease fishing as soon as any 2 of the 3 "redefined" DTS limits illustrated by example in Table 2 are met (actual limits will depend on PFMC specified limits for DTS for March-June 2004). The vessel will not be allowed to fish for groundfish for the remainder of the trip limit period. The vessel owner will be responsible (via the vessel operator) to ensure that all trip period limits are observed and tracked so that when 2 of the 3 redefined DTS limits are reached, the vessel will stop fishing and return to port. All other trip period limits remain in effect during the fishery.

H. Bycatch Limits

No increased take of any overfished rockfish species is anticipated as a result of this EFP program. In fact, due to a reduced number of hauls needed to reach redefined DTS limits, reduced bycatch of rockfish is anticipated under this EFP program.

I. Incentives

The incentive to participate in this EFP program is a modest increase in modeled revenue to the vessel and a decrease in vessel operation costs. Costs to vessels are minimal, consisting mostly of forfeited incidental catch of other species such as arrowtooth flounder and skate which would normally accumulate during the additional tows. Benefits to processors include access to more sablefish and SST catch, and the opportunity to participate in a discard reduction program.

J. Signature of Applicant

Patricia M. Burke

Oregon Department of Fish and Wildlife
Dr. Patricia M. Burke, Manager

Oregon

Theodore R. Kulongoski, Governor

Department of Fish and Wildlife
Marine Resources Program
2040 SE Marine Science Drive
Newport, OR 97365
(541) 867-4741
FAX (541) 867-0311

October 13, 2003

Dr. Robert Lohn
Regional Administrator
National Marine Fisheries Service
7600 Sand Point Way NE
Bin C15700
Seattle, WA 98115

Dear Dr. Lohn:

Enclosed is our application for an exempted fishing permit (EFP) for your review and approval. The EFP is requested to allow the testing of a novel approach to encourage discard reduction in the "deepwater complex" trawl fishery on the upper continental slope. This new approach uses modified definitions of the market categories, limits and processor-vessel price agreements for Dover sole, sablefish and shortspine thornyheads to reduce incentives for discarding of smaller fish and non-target species. While we can't predict how successful the experiment may be, if it is successful the approach could help to significantly reduce the discard problem in this fishery on the west coast.

Sincerely,

Patricia M. Burke

Dr. Patricia M. Burke, Manager
Marine Resources Program
541-867-0300 x226

attachment

FINAL APPROVAL OF EXEMPTED FISHING PERMITS FOR THE 2004 SEASON

Situation: Exempted fishing permits (EFPs) allow fishing activities that would otherwise be prohibited. As an example, EFPs provide a process for testing innovative fishing gears and strategies to substantiate methods for prosecuting sustainable and risk-averse fishing opportunities. The Council has signaled its intent to make greater use of EFPs in the new groundfish management regime of depth restrictions and widespread area closures to reduce harvest of overfished species.

At the September meeting, the Council considered seven draft EFP applications for 2004 and adopted set-aside harvest caps for six. The California Department of Fish and Game (CDFG) and the Washington Department of Fish and Wildlife (WDFW) are each sponsoring EFPs to experiment with trawl modifications for the selective harvest of shelf flatfish while excluding non-target species. These studies are intended to complement promising research completed by the Oregon Department of Fish and Wildlife (ODFW) using low-rise trawl nets with cut-back headropes. These gear modifications could be considered for fleet-wide regulations in 2005-2006. WDFW is also sponsoring EFPs to selectively harvest dogfish while avoiding canary and yelloweye rockfish, continue an Arrowtooth Flounder Trawl EFP with mandatory gear modifications designed to exclude rockfish and retain flatfish, and to test strategies to selectively harvest pollock. ODFW applied for a new EFP to test a discard reduction strategy using written agreements between the state, vessels, and processors to reduce the economic incentive for discarding in the Dover sole, thornyhead, and sablefish (DTS) trawl fishery.

Additionally, a joint ODFW, WDFW, CDFG application has been submitted to allow legal retention of Pacific salmon, Pacific halibut, and incidental groundfish in the shore-based Pacific whiting fishery. At the September meeting, the Council recommended the continued use of EFPs for enumerating bycatch in this fishery to allow more time for public input on a permanent monitoring program being developed.

Applicants have had the opportunity to review and revise their EFP proposals in response to comments received from the Council and Advisory Bodies at the September meeting. Final EFP applications not available in time for this distribution will be included as supplemental material. Included in the reference materials is a copy of the time line for EFP consideration under multi-year management that was approved by the Council at the last meeting, including the schedule for the release of set-aside quotas to the general fisheries should final approval not occur.

Council Action:

1. Approve EFPs for Implementation in 2004.

Reference Materials:

1. Exhibit D.13.b, ODFW Report 1, *Joint ODFW, WDFW, CDFG Application for Issuance of an Exempted Fishing Permit to Allow Retention on Incidentally Caught Species in the Shore-based Pacific Whiting Fishery*.

2. Exhibit D.13.b, ODFW Report 2, *Application for Issuance of an Exempted Fishing Permit to Test a Reduced-Discard Strategy for The Deepwater Complex Fishery*.
3. Exhibit D.13.b, Supplemental CDFG Report 1, *Application for Issuance of an Exempted Fishing Permit to Test a Selective Flatfish Trawl (including Scottish Seine) in and area otherwise closed to fishing, 2004.*
4. Exhibit D.13.b, Supplemental WDFW Report 1, *Application for Issuance of an Exempted (Experimental) Fishing Permit for Arrowtooth Flounder.*
5. Exhibit D.13.b, Supplemental WDFW Report 2, *Application for Issuance of an Exempted (Experimental) Fishing Permit for Nearshore Flatfish.*
6. Exhibit D.13.b, Supplemental WDFW Report 3, *Application for Issuance of an Exempted (Experimental) Fishing Permit for Pollock.*
7. Exhibit D.13.b, Supplemental WDFW Report 4, *Application for Issuance of an Exempted (Experimental) Fishing Permit for Spiny Dogfish.*
8. Exhibit D.13.c, GMT Attachment 1, *Council Process for Consideration of Exempted Fishing Permits for Multi-Year Management.*

Agenda Order:

a. Agendum Overview — Mike Burner
b. State EFP Proposals for 2004 — State Representatives
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action:** Approve EFPs for Implementation in 2004

PFMC
10/15/03

EXPERIMENTAL FISHING PERMIT APPLICATION

1. Date of Application

October 28th, 2003

2. Applicant Name(s)

Washington Department of Fish and Wildlife
48A Devonshire Road
Montesano, WA 98563-9618
Attention: Brian Culver (360) 249-1205

Oregon Department of Fish and Wildlife
2040 SE Marine Science Drive
Newport, OR 97365-5294
Attention: Mark Saelens (541) 867-0300 x251
Steve Parker (541) 867-0300 x256

California Department of Fish and Game
411 Burgess Drive
Menlo Park, CA 94025-3488
Attention: Dave Thomas (415) 581-7358

3. Purposes and Goals of the Proposed Experiment

The goal of the exempted fishery is to implement an observation program, at the request of the Pacific Fishery Management Council, to enumerate the bycatch in hake harvests delivered to shoreside processing plants for 10 -15 percent of all EFP deliveries. Hake must be handled quickly to ensure quality, and as a result many vessels dump tows directly into the hold and are unable to sort their catch. The purpose of the EFP is to allow delayed sorting from mid-water trawl catches of Pacific hake until the catch is unloaded at a shoreside processing plant. In addition, in order to sample unsorted total catch shoreside, the EFP may need to include provisions to allow for potential overages in groundfish trip limits as well as the retention of prohibited species (e.g. salmon and halibut) until offloading. The amounts of groundfish which exceed the trip limits set for the year will be forfeited to the state in which the delivery is made and port price paid. Current groundfish regulations at 50 CFR 663.7(b) stipulates that prohibited species must be returned to the sea as soon as practicable with a minimum of injury when caught and brought aboard. The EFP is necessary to authorize retention of prohibited species until delivery shoreside by vessels participating in the observation program. The EFP would be valid only for landings by permitted vessels at processing plants that have been designated by the States of Washington, Oregon or California as participants in the observation program. Designated processing plants will have signed agreements with their state and would have to agree to set aside prohibited species for biological sampling and disposition, and allow sampling of hake landings and groundfish bycatch.

There are two options for disposal of incidentally caught prohibited species brought ashore: (1) donate to a local food share or other appropriate charitable organization, or (2) reduction in the fish meal plant. Option 1 is preferred, but salmon caught by trawls are often in poor condition, and they are also very perishable.

In addition to enumerating each prohibited species, other data to be collected include length, sex, weight and in the case of salmon, scales for age. Salmon snouts will be collected for coded wire tags from appropriately marked fish.

Another goal is to document the bycatch rate of other groundfish species encountered while target fishing for Pacific hake. Biological data (age, weight, length and sex) will be collected for Pacific hake, sablefish, yellowtail rockfish, widow rockfish, Pacific mackerel, and jack mackerel.

4. Justification

The EFP is requested so that an accurate count of incidentally caught salmon can be generated, and estimates of groundfish bycatch rates can be obtained from shoreside deliveries of Pacific hake. An EFP will also offer legal protection for trawlers and processors that have possession of incidentally caught prohibited species, and may offer legal protection from overages of groundfish, which resulted from targeted fishing trips for hake, made under the EFP.

5. Statement of Project Significance

Enumeration of incidentally caught species is the primary purpose for this EFP. Monitoring the bycatch of salmon in the hake fishery also is a requirement of an ESA Section 7 consultation. Estimation of groundfish bycatch rates and collection of biological information to support stock assessment work is a secondary purpose. Results from this project will be needed to project bycatch if regulation changes should occur (e.g. modification of prohibited species) to allow this fishery to operate without the need for an EFP each year.

6. Vessels to be covered by the EFP

List to be provided at a later date.

7. Species and Amounts to be Harvested

The target species to be harvested is Pacific hake (*Merluccius productus*). The preliminary U.S. Pacific hake harvest guideline in 2004 is 120,000 mt(Supplemental GMT Report 3- Final Groundfish Management Measures states "U.S. whiting OY ...constrained to around 120,000mt" to due to a widow rockfish rebuilding OY of 284 mt). The corresponding shore-based allocation would be approximately 42,000 mt. Based on bycatch information from our EFP program during 1992-2003, the following catches of salmon, sablefish, widow rockfish, yellowtail rockfish, and other species would be expected if the bycatch rates were the same as in 2003:

Species/Species Group	Bycatch Rate (no/mt.)	Expected Bycatch (number)
Salmon	0.0084	351
Halibut	0.0003	13

Species/Species Group	Bycatch Rate (kg/mt.)	Expected Bycatch (kilograms)
Sablefish	0.8122	34,112
Widow Rockfish	0.1765	7,411
Yellowtail Rockfish	0.9559	40,146
Canary Rockfish	0.0095	87
Yelloweye Rockfish	0.0001	3
Darkblotch Rockfish	0.0051	214
Boccacio Rockfish	0.0001	3
Lingcod	0.0080	334
POP	0.0058	245
Misc. Rockfish	0.1973	8,286
Mackerel	1.4229	59,761
Walleye Pollock	0.0221	929
*Other Misc. Fish	0.3024	12,700

*Other misc. fish include: American shad, Pacific herring, Pacific cod, shark, squid, octopus, flatfish(other than halibut), and skates.

8. Conduct of Fishing Experiment

Fishing will occur in the EEZ in the INPFC Eureka, Columbia and Vancouver areas. Ports of interest are Ilwaco and Westport, WA; Astoria, Newport and Charleston, OR; and

Crescent City and Eureka, CA. Trawls, which conform to current legal requirements for midwater trawls, will be used to capture the target species. The season will open June 15, 2004 (April 1 off northern California), and will probably run through August 2004. The EFP should be valid for through the end of December 2004, to allow for any delay in shore-based allocation attainment.

The program will continue to rely on industry funding to pay for: observers, part of the salary for a coordinator and data analysis assistant, supplies, and travel to processing plants and meetings.

Oregon

Theodore R. Kulongoski, Governor

Department of Fish and Wildlife
Marine Resources Program
2040 SE Marine Science Drive
Newport, OR 97365
(541) 867-4741
FAX (541) 867-0311

October 9, 2003

Dr. Robert Lohn
Regional Administrator
National Marine Fisheries Service
7600 Sand Point Way NE
Bin C15700
Seattle, WA 98115

Dear Dr. Lohn:

Enclosed is a joint ODFW, WDFW and CDFG application for an exempted fishing permit (EFP) for your review and approval. The EFP is requested to allow legal retention, delivery and temporary possession of incidentally caught Pacific salmon and Pacific halibut in the shoreside Pacific hake fishery, and potentially to allow for overages of other groundfish species caught while target fishing for hake. It is our opinion that accurate enumeration of the incidental catch in this fishery continues to be needed. During 2003, 100% of the catch was enumerated. In addition, the minimum observation rate of 10% of all trips was achieved with such observations being conducted shoreside. We also included collection of biological data for bycatch of key groundfish species. Participating processors allowed us to achieve a 100% observation rate for salmon and halibut bycatch by setting aside all salmon and halibut encountered during offloads, regardless of whether the trip was observed or not. An EFP for the "shoreside" processing sector of the Pacific hake fishery continues to be the only means available to estimate the bycatch of prohibited species and groundfish.

Under this program, permitted vessels would be required not to sort their catch at-sea so that the entire catch can be sampled. Shoreside observers enumerate prohibited species and groundfish bycatch for 10 to 15% of all shoreside deliveries, and also collect biological information on hake and bycatch species. An allowance for overages of groundfish catch continues to be needed for calculating the groundfish bycatch rate and to facilitate collection of valuable biological data (age, sex, weight and length) for bycatch groundfish species (e.g. sablefish, yellowtail rockfish and widow rockfish). These biological samples will be used to support stock assessment work. The shoreside hake industry, in cooperation with state fishery managers, has dramatically reduced the bycatch rates for rockfishes (60% from late 1990's levels). This is in addition to new methods for predicting and reducing salmon bycatch in this fishery. Any prohibited species and proceeds from groundfish overages will be forfeited to the State of landing.

We have not yet determined how many vessels will participate in the fishery next year, but expect 30-35 vessels. We will generate a participating vessels list as soon as possible and forward it to you.

Sincerely,

Patricia M. Burke

Patricia M. Burke, Manager
Marine Resources Program
541-867-0300 x226

attachment

COUNCIL PROCESS FOR CONSIDERATION OF EXEMPTED FISHING PERMITS FOR MULTI-YEAR MANAGEMENT

Year 1 (2003)

November

Final EFP Applications for Year 2 (2004).
Preliminary ABCs/OYs for Years 3 and 4 (2005 & 2006).

Year 2 (2004)

April

Preliminary EFP Concepts for Year 3 (2005).
Preliminary EFP OY "set asides" for Years 3 and 4 (2005 & 2006).
Preliminary Management Measures for Years 3 and 4 (2005 & 2006).
Update bycatch scorecard catch projections for 2004 and consider release of EFP set asides for inseason action.

June

Draft EFP Applications for Year 3 (2005).
EFP Application review by GMT, GAP, and SSC.
Council consider approving for public review.
Adopt final EFP OY "set asides" for Years 3 and 4 (2005 & 2006).
Final Management Measures for Years 3 and 4 (2005 & 2006).
Update bycatch scorecard catch projections for 2004 and consider release of EFP set asides for inseason action.

September

Update bycatch scorecard catch projections for 2004 and consider release of EFP set asides for inseason action.

November

Final EFP Applications for Year 3 (2005).
EFP Application review (if revised) by GMT, GAP, and SSC.
Council consider recommending approval to NMFS.

Year 3 (2005)

April

Preliminary EFP Concepts for Year 4 (2006).
Preliminary report on EFPs conducted in Year 2 (2004).
Update bycatch scorecard catch projections for 2005 and consider release of EFP set asides for inseason action.

Year 3 (2005), *continued*

June
Draft EFP Applications for Year 4 (2006).
EFP Application review by GMT, GAP, and SSC.
Council consider approving for public review.
Update bycatch scorecard catch projections for 2005 and consider release of EFP set asides for inseason action.

September
Final written report on EFPs conducted in Year 2 (2004).
Update bycatch scorecard catch projections for 2005 and consider release of EFP set asides for inseason action.

November
Final EFP Applications for Year 4 (2006).
EFP Application review (if revised) by GMT, GAP, and SSC.
Council consider recommending approval to NMFS.

PFMC
10/15/03

COUNCIL PROCESS FOR CONSIDERATION OF EXEMPTED FISHING PERMITS FOR MULTI-YEAR MANAGEMENT

Year 1 (2003)

November

Final EFP Applications for Year 2 (2004).
Preliminary ABCs/OYs for Years 3 and 4 (2005 & 2006).

Year 2 (2004)

April

Preliminary EFP Concepts for Year 3 (2005).
Preliminary EFP OY "set asides" for Years 3 and 4 (2005 & 2006).
Preliminary Management Measures for Years 3 and 4 (2005 & 2006).
Update bycatch scorecard catch projections for 2004 and consider release of EFP set asides for inseason action.

June

Draft EFP Applications for Year 3 (2005).
EFP Application review by GMT, GAP, and SSC.
Council consider approving for public review.
Adopt final EFP OY "set asides" for Years 3 and 4 (2005 & 2006).
Final Management Measures for Years 3 and 4 (2005 & 2006).
Update bycatch scorecard catch projections for 2004 and consider release of EFP set asides for inseason action.

September

Update bycatch scorecard catch projections for 2004 and consider release of EFP set asides for inseason action.

November

Final EFP Applications for Year 3 (2005).
EFP Application review (if revised) by GMT, GAP, and SSC.
Council consider recommending approval to NMFS.

Year 3 (2005)

April

Preliminary EFP Concepts for Year 4 (2006).
Preliminary report on EFPs conducted in Year 2 (2004).
Update bycatch scorecard catch projections for 2005 and consider release of EFP set asides for inseason action.

Year 3 (2005), *continued*

June

Draft EFP Applications for Year 4 (2006).
EFP Application review by GMT, GAP, and SSC.
Council consider approving for public review.
Update bycatch scorecard catch projections for 2005 and consider release of EFP set asides for inseason action.

September

Final written report on EFPs conducted in Year 2 (2004).
Update bycatch scorecard catch projections for 2005 and consider release of EFP set asides for inseason action.

November

Final EFP Applications for Year 4 (2006).
EFP Application review (if revised) by GMT, GAP, and SSC.
Council consider recommending approval to NMFS.

PFMC
10/15/03

Amendment 16-3 to the Pacific Coast Groundfish Fishery Management Plan: Rebuilding Plans for Bocaccio, Cowcod, Widow Rockfish, and Yelloweye Rockfish

Scoping Information Document
Pacific Fishery Management Council
October 2003

Introduction

To date the U.S. Secretary of Commerce (Secretary) has declared nine groundfish stocks overfished. These stocks are bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinniger*), cowcod (*S. levis*), darkblotched rockfish (*S. crameri*), Pacific ocean perch (*S. alutus*), widow rockfish (*S. entomelas*), yelloweye rockfish (*S. ruberrimus*), lingcod (*Ophiodon elongatus*), and Pacific whiting (*Merluccius productus*). These declarations, stemming from Magnuson-Stevens Act (MSA) requirements, are based on overfishing criteria adopted by the Council under Amendment 11 to the Pacific Coast Groundfish FMP. The MSA (§304(e)(3)) also requires councils to "prepare a fishery management plan, plan amendment, or proposed regulations" in order to prevent overfishing and implement a plan to rebuild the overfished stocks. Existing provisions in the FMP did not meet this requirement and were struck down in Federal Court. Rebuilding parameters for the nine overfished West Coast groundfish stocks are shown in Tables 1 and 2.

In response, the Council is adopting a series of amendments under an umbrella title of Amendment 16. The first of these amendments, Amendment 16-1, establishes a legally-compliant framework for the adoption and implementation of rebuilding plans. It was submitted to NMFS on August 7, 2003, and is currently under review. Amendment 16-2, prepared as an environmental impact statement (EIS) adopts rebuilding plans for canary rockfish, darkblotched rockfish, Pacific ocean perch, and lingcod. According to the framework proposed in Amendment 16-1, adoption of a rebuilding plan includes amending the FMP to include crucial information about the stock and the rebuilding strategy, publishing the numerical values for two key rebuilding parameters in federal regulations, and publishing the rebuilding plan in the next Stock Assessment and Fishery Evaluation (SAFE) document distributed after approval of the FMP amendment. (Amendment 16-2 rebuilding plans will therefore be published in Volume I of the 2004 SAFE document, if they are approved by NMFS on behalf of the Secretary of Commerce.) The draft EIS (DEIS) for Amendment 16-2 was made available on September 19, 2003, commencing a 45-day public comment period. A parallel review process, required under the MSA, will begin at the end of October. The NEPA process, which includes the production of a final EIS incorporating any comments received on the DEIS, and the NMFS review process are timed to end at the same time, in late January. If approved, Amendment 16-2 will be implemented shortly thereafter.

Amendment 16-3 will follow a similar sequence to adopt rebuilding plans for bocaccio, cowcod, widow rockfish, and yelloweye rockfish. NMFS and the Council published a notice of intent to prepare an EIS for this action in the Federal Register on September 12, 2003 (68 FR 53712). This announced a public scoping period ending on November 10, 2003. During this period the Council is asking the public to identify issues of concern, either in relation to alternatives for implementing the proposed action, or potential impacts to the environment. The Council is scheduled to take preliminary action at their November 2003 meeting by approving a preliminary list of alternatives that will be evaluated in the subsequent EIS. Final Council action is scheduled for their April 2004 meeting when they will identify a preferred alternative. A DEIS will then be completed, with a scheduled release date in June 2004. Assuming no delays in the timeline, these

Table 1. Current rebuilding parameter/target estimates specified for overfished west coast groundfish: shelf species.

Rebuilding Parameter/Target	Shelf rockfish & lingcod				
	Bocaccio[a/]	**Canary**[b/]	**Cowcod**[c/]	**Lingcod**[d/]	**Yelloweye**[e/]
T_0 (year declared overfished)	1999	2000	2000	1999	2002
T_{MIN} (minimum time to achieve B_{MSY}; F = 0)	2018	2057	2062	2007	2027
Mean generation time	14 years	19 years	37 years	NA	44 years
T_{MAX} (maximum time to achieve B_{MSY})	2032	2076	2099	2009	2071
P_{MAX} (P to achieve B_{MSY} by T_{MAX})[f/]	$\geq$70%	60%	55%	60%	92%
Most recent stock assessment	MacCall 2003a	Methot and Piner 2002a	Butler et al. 1999	Jagielo et al. 2000	Methot et al. 2002
Most recent rebuilding analysis	MacCall 2003b	Methot and Piner 2002b	Butler and Barnes 2000	Jagielo and Hastie 2001	Methot and Piner 2002
B_0 (estimated unfished biomass)	13,387 B eggs in 2003	31,550 mt	3,367 mt	22,882 mt N 20,971 mt S	3,875 mt
$B_{CURRENT}$ (current estimated biomass)	984 B eggs in 2003	2,524 mt in 2002	238 mt in 1998	3,527 mt N 3,220 mt S in 2000	934 mt in 2002
$B_{CURRENT}$ % Unfished Biomass	7.4% in 2003	8% in 2002	7% in 1998	17% N 15% S in 2000	24% in 2002
MSST (minimum stock size threshold = 25% of B_0)	3,347 B eggs	7,888 mt	842 mt	5,720 mt N 5,243 mt S	969 mt
B_{MSY} (rebuilding biomass target = 40% of B_0)	5,355 B eggs	12,620 mt	1,350 mt	9,153 mt N 8,389 mt S	1,550 mt
MFMT (maximum fishing mortality threshold = F_{MSY})	$F_{50\%}$	$F_{73\%}$	$F_{50\%}$	$F_{45\%}$: F = 0.12 N F = 0.14 S	$F_{57\%}$
Harvest control rule[f/]	F $\approx$ 0.041	F = 0.0220	F = 0.0136	F = 0.053 N F = 0.061 S	F = 0.0139
T_{TARGET}[f/]	2021	2074	2095	2009	2052

a/ Bocaccio were assessed by MacCall (2003a) in the Conception and Monterey INPFC areas combined. Biomass estimates are spawning output in billions of eggs. All rebuilding parameters based on model STATc in the most recent rebuilding analysis (MacCall 2003b). The strategic rebuilding parameters (T_{TARGET}, the harvest control rule (F), and P_{MAX}) are interpolated from model STATc results. A rebuilding plan for bocaccio south of 40°10' N. latitude will be analyzed in an EIS contemplated for groundfish FMP Amendment 16-3 scheduled for 2004.

b/ A canary rockfish rebuilding plan was adopted by the Council and submitted for incorporation in the groundfish FMP under Amendment 16-2.

c/ Cowcod were assessed in the Conception area. All parameters/targets are for the Conception area, although harvest specifications and management measures decided under the proposed action analyzed under the *Council Interim* alternative are for the Conception and Monterey INPFC areas combined. A rebuilding plan for cowcod will be analyzed in an EIS contemplated for groundfish FMP Amendment 16-3 scheduled for 2004.

d/ West coast lingcod were assessed as two stocks north (Columbia and U.S. Vancouver INPFC areas) and south (Eureka, Monterey, and Conception INPFC areas). The 2005-2006 specifications setting process contemplates changing the harvest control rule, and perhaps the target rebuilding year adopted for lingcod with Amendment 16-2.

e/ Yelloweye rockfish rebuilding parameters are from the most recent rebuilding analysis (Methot and Piner 2003). A rebuilding plan for yelloweye rockfish will be analyzed in an EIS contemplated for groundfish FMP Amendment 16-3 scheduled for submission in 2004.

f/ Under *Council Interim* alternative harvest specifications and/or rebuilding strategies.

Table 2. Current rebuilding parameter/target estimates specified for overfished west coast groundfish: slope and midwater species.

Rebuilding Parameter/Target	Slope rockfish: Darkblotched[a/]	Slope rockfish: POP[b/]	Midwater species: Widow[c/]	Midwater species: Pacific whiting[d/]
T_0 (year declared overfished)	2000	1999	2001	2002
T_{MIN} (minimum time to achieve B_{MSY} @ F = 0)	2011	2011	2026	2004
Mean generation time	33 years	28 years	16 years	8 years
T_{MAX} (maximum time to achieve B_{MSY})	2044	2042	2042	2012
P_{MAX} (P to achieve B_{MSY} by T_{MAX})[e/]	>90%	>70%	60%	NA
Most recent stock assessment	Rogers 2003	Hamel et al. 2003	He et al. 2003a	Helser et al. 2002
Most recent rebuilding analysis	Rogers 2003	Punt et al. 2003	He et al. 2003b	NA
B_0 (estimated unfished biomass)[e/]	30,775 mt	37,230 units of spawning output	43,580 M eggs	5.25 M mt
$B_{CURRENT}$ (current estimated biomass)	3,385 mt in 2003	10,313 units of spawning output in 2003	9,756 M eggs in 2002	1.26 M mt in 2002
% Unfished Biomass	11% in 2003	27.7% in 2003	22.4% in 2002	24% in 2002
MSST (minimum stock size threshold = 25% of B_0)	7,694 mt	9,308 units of spawning output	10,895 M eggs	1.31 M mt
B_{MSY} (rebuilding biomass target = 40% of B_0)	12,310 mt	14,892 units of spawning output	17,432 M eggs	2.1 M mt
MFMT (maximum fishing mortality threshold = F_{MSY})	$F_{50\%}$	$F_{50\%}$	$F_{50\%}$	$F_{40\%}$
Harvest control rule[e/]	F = 0.032	F = 0.0257	F = 0.0093	Decision deferred until adoption of groundfish FMP Amendment 16-4
T_{TARGET}[e/]	2030	2027	2037	

a/ A darkblotched rockfish rebuilding plan was adopted by the Council and submitted for incorporation in the groundfish FMP under Amendment 16-2. The proposed action in the 2004 specifications setting process was to raise the harvest control rule (F) from 0.027 estimated in the previous rebuilding analysis (Methot and Rogers 2001) and specified in FMP Amendment 16-2 to 0.032 estimated in the recent rebuilding analysis (Rogers 2003). However, the target rebuilding year of 2030 was not revised as part of the proposed action resulting in an increased probability of rebuilding by T_{MAX} (P_{MAX} increases from 80% to >90%). Rebuilding parameters are based on an intermediate model run and are consistent with the range of OYs adopted by the Council.

b/ A Pacific ocean perch rebuilding plan was adopted by the Council and submitted for incorporation in the groundfish FMP under Amendment 16-2. The proposed action in the 2004 specifications setting process was to change the harvest control rule (F) from 0.0082 estimated in the previous rebuilding analysis (Punt and Ianelli 2001) and specified in FMP Amendment 16-2 to 0.0257 estimated in the most recent rebuilding analysis (Punt et al. 2003). However, the target rebuilding year of 2027 was not revised as part of the proposed action resulting in an increased probability of rebuilding by T_{MAX} (P_{MAX} increases from 70% to >70%).

c/ The widow rockfish stock was assessed in 2003. All rebuilding parameters estimated in the most recent rebuilding analysis (He et al. 2003). Rebuilding spawning biomass parameters (i.e., B_0, B_{MSY}, $B_{CURRENT}$, MSST) are in millions of eggs. A rebuilding plan for coastwide widow rockfish will be analyzed in an EIS contemplated for groundfish FMP Amendment 16-3 scheduled for 2004.

d/ The Pacific whiting stock was assessed in 2002. Biomass estimates are in millions of mt of age 3+ fish. Some rebuilding parameters are unspecified since a rebuilding analysis has not been endorsed by the SSC. A new Pacific whiting assessment and rebuilding analysis is anticipated in March, 2004. A rebuilding plan for Pacific whiting based on a new assessment and rebuilding analysis will be analyzed in an EIS contemplated for groundfish FMP Amendment 16-4 scheduled for 2004.

e/ Under either a Council-adopted rebuilding plan (for those species' plans considered under FMP Amendment 16-2) or under the *Council Interim* alternative, except Pacific whiting.

rebuilding plans would be implemented in late 2004 or early 2005. A rebuilding plan for the ninth overfished species, Pacific whiting, is also scheduled to be developed in 2004 as Amendment 16-4. Before it can be developed an approved stock assessment and a rebuilding analysis have to be completed.

An EIS must include several elements specified in federal regulations. Four of these elements comprise the heart of an environmental impact analysis: a description of the purpose of and need for the proposed action, a reasonable range of alternatives for implementing the proposal, a description of the status of the environment before the proposal is implemented, and an analysis of the environmental effects of the proposed alternatives. The rest of this information document is a proposal for how these elements will be addressed in the Amendment 16-3 EIS. The alternatives and analyses proposed herein may be modified based on scoping and directions given by the Council.

Purpose of and Need for the Proposed Action

The Proposed Action

The proposed action is to implement legally-compliant rebuilding plans, consistent with the framework established in Amendment 16-1, that will set strategic rebuilding parameters to guide stock rebuilding for bocaccio (*Sebastes paucispinis*), cowcod (*S. levis*), widow rockfish (*S. entomelas*), and yelloweye rockfish (*S. ruberrimus*). These rebuilding parameters stem from the MSA and National Standard 1 guidelines (50 CFR 600.310). Three strategic rebuilding parameters guide the rebuilding process. These are: (1) the target year (T_{TARGET}) by which the stock is estimated to reach a biomass capable of supporting maximum sustainable yield (MSY); the harvest control rule needed to allow the stock to reach that biomass by T_{TARGET}; and (3) the probability of the stock rebuilding (P_{MAX}) in the maximum allowed time frame under National Standard Guidelines (T_{MAX}). Amendment 16-1 states that new management measures intended to achieve these targets may be added to the FMP as part of rebuilding plans. However, it is likely that existing management measures implemented through the biennial management process will be used to constrain fishing to the targets identified in the rebuilding plans.

Need (Problems for Resolution)

Rebuilding plans are mandated when the size of a stock or stock complex falls below a level described in the FMP as the minimum stock size threshold or MSST, which is 25% of unfished biomass ($B_{25\%}$) for stocks managed under the groundfish FMP. Diminished stock size may be caused or exacerbated by fishing. Regardless of the cause of the decline, fishing mortality needs to be controlled to prevent further deterioration in the condition of the stock, and if the stock has been overfished, to allow it to rebuild.

The proposed action is needed, because the four stocks in question are overfished. National Standard 1 in the MSA requires conservation and management measures that prevent overfishing. Preventing overfishing also means returning stocks to a size capable of achieving MSY, or to a stock size less than this if such stock size results in long-term net benefit to the nation. In order to rebuild overfished stocks and satisfy this mandate, legally compliant rebuilding plans must be adopted for stocks that have been declared overfished by the Secretary of Commerce.

Purpose of the Proposed Action

The purpose of the *Proposed Action* is to rebuild bocaccio, cowcod, widow rockfish, and yelloweye rockfish stocks managed under the Pacific Coast Groundfish FMP to a size capable of supporting MSY, or to a stock size less than this if such stock size results in long-term net benefit to the nation, and according to the requirements of the MSA. The MSA states: “For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations... for such fishery shall... specify a time period for ending overfishing and rebuilding the fishery...” (Sec. 304(e)(4)). The MSA also states that this time period “shall be as short as possible,” and usually may not exceed 10 years. However, in setting a time period for rebuilding the stock, fishery managers may take into account various mitigating factors, such as the biology of the stock and the needs of fishing communities, such that the time period may exceed 10 years. Rebuilding plans must also take into account variations and contingencies in ecological and environmental conditions that cause MSY biomass to vary over time, which affects the practicable time period for rebuilding the stock.

Description of the Alternatives

The alternatives will be structured around management targets for each of the four overfished species considered in the EIS (Table 3). These targets are derived from National Standards Guidelines, which specify how rebuilding should occur (50 CFR600.310(e)). Rebuilding should bring stocks back to a population size that can support MSY (B_{MSY}). A rebuilding plan must specify a target year (T_{TARGET}) based on the time required for the stock to reach B_{MSY}. This target is bounded by a lower limit (T_{MIN}) defined as the time needed for rebuilding in the absence of fishing (i.e., fishing mortality rate [F] = 0). Rebuilding plans for stocks with a T_{MIN} less than 10 years must have a target less than or equal to 10 years. If, as is the case with all of the groundfish stocks considered in this amendment, the biology of a particular species dictates a T_{MIN} of 10 years or greater, then the maximum allowable rebuilding time, T_{MAX}, is the rebuilding time in the absence of fishing (T_{MIN}) plus "one mean generation time."

Because of the uncertainty surrounding stock assessments and future population trends (due, for example, to variable recruitment), the rebuilding period limits and the target need to be expressed probabilistically. At the policy level this makes the tradeoff between long-term risk and short-term costs explicit. Long-term risk is expressed in terms of the probability that the stock will rebuild in the maximum time period (T_{MAX}), given a specified level of harvest during the rebuilding period. If harvest limits are lowered, representing greater short-term costs, this probability (P_{MAX}) increases. Conversely, if a higher harvest rate is chosen, P_{MAX} decreases, representing greater long-term risk that the stock will fail to rebuild. The target year is derived from the same computation. For a given harvest rate, T_{TARGET} is the year in which there is a 50% probability the stock will be rebuilt. (In other words, it is equally likely the stock will have already been rebuilt by this year as it is that the stock will not be rebuilt until a later year.) If catches of an overfished species are prohibited, then T_{TARGET} will be equal to T_{MIN}, the minimum possible rebuilding time. (T_{MIN} is also calculated in a similar way: it is the year with a 50% rebuilding probability, but with the harvest rate set to zero.) Choosing a target year equal to T_{MAX} results in a P_{MAX} equal to 50% since the T_{TARGET} and T_{MAX} are equal.

National Standards Guidelines identify a "mixed-stock complex" exception to the definition of overfishing (50 CFR 600.310(d)(6)), which is applicable to some overfished groundfish species. Different fish assemblages—some with healthy stocks and some with overfished stocks—can co-occur in a mixed-stock complex, and thus, both can be caught simultaneously. An optimum yield (OY) harvest for the healthy stock can result in overfishing the depleted stock. The guidelines allow councils to authorize this type of overfishing if three conditions are met (50 CFR 600.315(d)(6)). First, an FMP (or plan amendment) must assess the overall benefits of such a policy in comparison to other measures, such as reducing the OY for the healthy stock. Second, councils must consider mitigating measures that reduce overfishing by, for example, modifying fishing strategy or gear configuration. The benefits of mitigation must be compared to those determined in the preceding assessment; the measures would only be implemented if they will result in greater benefits. Finally, permitted overfishing cannot result in eventual listing of the species (or evolutionarily significant unit thereof) under the Endangered Species Act (ESA).

Given the framework described above, the alternatives represent different rebuilding strategies for each of the four overfished species and—with the exception of the use of the mixed stock exception—can be described in terms of a harvest rate and the associated P_{MAX} and T_{TARGET} values. Up to eight alternatives, including a No Action alternative, are proposed for evaluation in the Amendment 16-3 EIS; they are similar to the alternatives proposed for Amendment 16-2 and are described below.

Table 3. Harvest specifications (2004-2006 total catch OYs) and strategic rebuilding parameters associated with bocaccio, cowcod, widow rockfish, and yelloweye rockfish rebuilding alternatives.

Harvest Specifications and Strategic Rebuilding Parameters	Rebuilding Alternatives								
	No Action	***Mixed Stock Exception***	***Maximum Harvest***	***60%***	***70%***	***80%***	***90%***	***Maximum Conservation***	***Council Interim a/***
Bocaccio b/									
2004 OY (mt)	0	959	439.1	376.5	306.3	236.5	130.1	0	250.0
2005 OY (mt)	0	959	NA	NA	NA	NA	NA	0	TBD
2006 OY (mt)	0	959	NA	NA	NA	NA	NA	0	TBD
P_{MAX}	64.6%	NA	50%	60%	70%	80%	90%	100%	TBD
T_{TARGET}	2025	NA	2028	2025	2023	2020	2018	2016	TBD
F rate	NA	0.1700	0.0721	0.0615	0.0498	0.0383	0.0209	0.0000	TBD
Cowcod c/									
2004 OY (mt)	0	NA	NA	4.2	NA	NA	NA	0	4.8
2005 OY (mt)	0	NA	NA	4.2	NA	NA	NA	0	4.8
2006 OY (mt)	0	NA	NA	4.2	NA	NA	NA	0	4.8
P_{MAX}	NA	NA	50%	60%	70%	80%	90%	100%	55%
T_{TARGET}	NA	NA	2099	2089	NA	NA	NA	2061	2095
F rate	NA	NA	NA	0.0090	NA	NA	NA	0.0000	0.0100

Table 3. Harvest specifications (2004-2006 total catch OYs) and strategic rebuilding parameters associated with bocaccio, cowcod, widow rockfish, and yelloweye rockfish rebuilding alternatives.

Harvest Specifications and Strategic Rebuilding Parameters	Rebuilding Alternatives								
	No Action	***Mixed Stock Exception***	***Maximum Harvest***	***60%***	***70%***	***80%***	***90%***	***Maximum Conservation***	***Council Interim a/***
Widow Rockfish d/									
2004 OY (mt)	1,439	≥501	354	284	212	123	4	0	284
2005 OY (mt)	1,359	≥501	355	285	213	124	4	0	TBD
2006 OY (mt)	1,317	≥501	359	289	216	126	4	0	TBD
P_{MAX}	0%	≤30.9%	50%	60%	70%	80%	90%	100%	TBD
T_{TARGET}	NA	NA	2041	2037	2034	2030	2028	2028	TBD
F rate	NA	≥0.0165	0.0117	0.0093	0.0070	0.0040	0.0001	0.0000	TBD
Yelloweye Rockfish e/									
2004 OY (mt)	NA	55.6	NA	NA	NA	NA	NA	0	22
2005 OY (mt)	NA	55.6	NA	NA	NA	NA	NA	0	TBD
2006 OY (mt)	NA	55.6	NA	NA	NA	NA	NA	0	TBD
P_{MAX}	NA	NA	50%	60%	70%	80%	90%	100%	>80%
T_{TARGET}	NA	NA	2070	2067	2062	2058	NA	2026	<2058
F rate	NA	0.0355	0.0173	0.0167	0.0161	0.0153	NA	0.0000	<0.0153

a/ The Council Interim alternative represents interim rebuilding measures adopted during the process to set annual specifications for these species. Preferred alternatives to be determined (TBD) by Council action during either the November 2003 Council meeting in Del Mar, California or the April 2004 meeting in Sacramento, California; except for the 2004 OY which is the Council adopted total catch OY for 2004 fisheries.

b/ Bocaccio harvest specifications and strategic rebuilding parameters are based on the STATc base model in the most recent rebuilding analysis by MacCall (2003b).

c/ Cowcod harvest specifications and strategic rebuilding alternatives are based on the most recent rebuilding analysis by Butler and Barnes (2000). The OYs in the rebuilding analysis are only for the Conception INPFC area. The GMT recommended the same OY for the Monterey INPFC area; therefore, the OYs depicted in the table are double those presented in the rebuilding analysis.

d/ Widow rockfish harvest specifications and strategic rebuilding alternatives are based on Model 8, the base model in the most recent stock assessment (He et al. 2003a) and rebuilding analysis (He et al. 2003b).

e/ Yelloweye rockfish harvest specifications and strategic rebuilding alternatives are based on the most recent rebuilding analysis by Methot and Piner (2002b).

The No Action Alternative

An EIS must consider the alternative of no action. This represents the conditions that would apply if the proposed action or one of its alternatives is not implemented. Although the Council has been managing overfished groundfish species using interim rebuilding plans, comparing the rebuilding strategies to how overfished stocks would be managed according to the existing framework in the FMP is more informative. Under this framework a precautionary management strategy to rebuild stocks to B_{MSY} decreases the optimum yield (OY or target harvest level) from the ABC (acceptable biological catch) using the 40-10 adjustment. The 40-10 adjustment is a linear decrease in the OY from the ABC for spawning stock biomass levels between $B_{40\%}$ (40% of the unfished biomass, a proxy for B_{MSY}) and $B_{10\%}$, at which point the OY is adjusted to zero. This results in a straight line, representing the precautionary reduction, intersecting the x-axis at $B_{10\%}$ and the line representing the ABC-biomass relationship at $B_{40\%}$ (Figure 1). Conversely, when the stock is rebuilt, or at $B_{40\%}$, the OY would be set equal to the ABC. The harvest control rule is, therefore, a variable harvest rate based on the stock's biomass relative to its initial, unfished biomass. The parameters used to describe rebuilding strategies can be computed for the harvest rates resulting from application of the 40-10 precautionary reduction, as shown below. In comparison to the other alternatives, the precautionary strategy can result in much lower OYs in the short term, if the overfished stock is at a low biomass level, but allow greater harvests at higher biomass levels, making full recovery less likely.

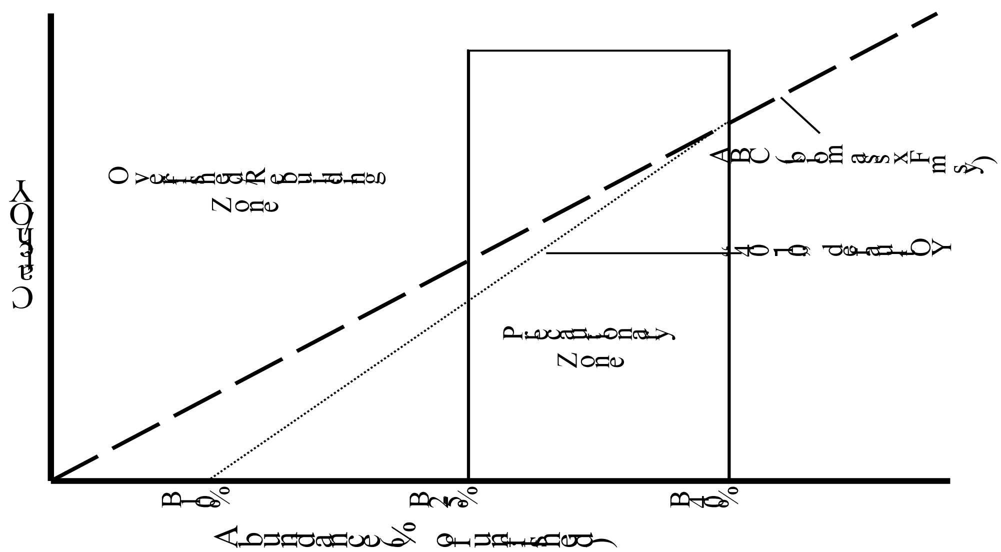

Figure 1. Graphic representation of the 40-10 rule to reduce OY from ABC for stocks below $B_{40\%}$ but above $B_{25\%}$.

The Maximum Conservation Alternative

Under this alternative no catches of the four stocks considered here would be allowed until the stocks are rebuilt. In other words, the harvest rate (F) would be set at zero, and T_{TARGET} would equal T_{MIN}. By definition, the stocks would rebuild fastest under this alternative, but at considerable socioeconomic cost. A zero harvest policy for these stocks, which together are caught in a wide range of fisheries, would likely result in the effective closure of many fisheries. On the other hand, stocks would rebuild more quickly, allowing higher, sustainable harvests at MSY once the target biomass was reached. However, given the long time periods involved to rebuild these stocks, even if fishing completely stopped—until 2027 for yelloweye rockfish, a species caught in many different fisheries—many current participants in the commercial fishery would likely go out of business. Recreational fishing and related support businesses would be similarly affected.

This alternative entails the lowest long-term risk: all four stocks are certain to rebuild within the maximum time period and are likely to rebuild in the shortest possible amount of time. It is judged the most environmentally beneficial in terms of the biological benefit of rapidly rebuilding stocks to a higher, target biomass level.

The Maximum Harvest Alternative

This alternative represents the other end of the range of possible rebuilding strategies from the *Maximum Conservation* alternative. The target year would equal T_{MAX} and P_{MAX} and would, thereby, equal 50% for each stock. As denoted by its name, the highest permissible harvest level would be allowed during the rebuilding period. This socioeconomic benefit represents a tradeoff against the time it would take for the stocks to rebuild.

Adopt Council Interim Rebuilding Plan Targets

These four stocks have been managed under interim rebuilding plans since they were declared overfished.[1] Under this alternative the targets they had identified in the interim plans would be used to continue managing these overfished stocks. Therefore, from a practical perspective, stock management under this alternative and current management would not differ very much.[2] In choosing targets for the interim plans, the Council evaluated the risk-benefit tradeoff for each stock. Unlike the previous two alternatives, the P_{MAX} values differ among the stocks. As shown in Table 3, these values fall generally in the mid-range of permissible values.

The Mixed Stock Exception Alternative

Many groundfish stocks co-occur, and it may be difficult or impossible for a fisherman to catch one species while avoiding others. Management measures must be structured to limit catches within OYs. Species with low OYs then become "constraining stocks" because they act to limit fishermen's ability to catch otherwise healthy target species. As discussed above, NMFS policymakers anticipated this situation and, as part of National Standard Guidelines, identified a mixed stock exception, which may be used if the three conditions (described above) are met. Of the four overfished stocks considered in this amendment, bocaccio, widow rockfish, and yelloweye rockfish are constraining stocks to which the mixed stock exception could be applied. This alternative is additive to the other alternatives: the harvest rates computed under this alternative could be substituted for the rate used for any one of these three species in any of the other alternatives. Application of the mixed stock exception for a given species under any of the other alternatives would likely allow greater access to healthy stocks in those fisheries where that species co-occurs than would otherwise be possible.

Other Intermediate Alternatives

In formulating the preferred alternative, the Council could have chosen targets intermediate to those identified in the preceding alternatives, representing a very large number of potential combinations. In support of decision making—while keeping the number of alternatives manageable (recognizing that the alternatives encompass the full range of reasonable alternatives)—these intermediate values are incorporated into the analysis, although socioeconomic impacts are not predicted. They are structured around 10% increments in P_{MAX} between 60% and 90% for each stock, recognizing that the other alternatives incorporate 50% and 100% and various intermediate values.

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[1]Bocaccio was declared overfished in 1999, cowcod in 2000, widow rockfish in 2001, and yelloweye rockfish in 2002.

[2]This alternative also could be considered a "no action" alternative because it reflects management prior to implementation of the proposed action. There is an important difference between the interim plans and the choice of the targets from those plans as a preferred alternative, which is represented by the framework implemented by Amendment 16-1. The framework and subsequent adoption of rebuilding plans obligates the Council to manage to targets that cannot be as easily changed.

Impacts of the Alternatives

In the EIS, Chapter 3 will describe the human environment affected by the proposed action. West Coast geography, bathymetry, ocean currents, and climate; the various stocks of groundfish and where they occur; and essential fish habitat will be described. The chapter will also describe the current status of the overfished stocks, as well as other stocks that are affected by actions contemplated for the West Coast groundfish fisheries. The affected socioeconomic environment will also be described, including all the affected fisheries and fishing communities. Groundfish fisheries include limited entry trawl, limited entry fixed gear, directed open access, incidental open access, charter, recreational, and tribal fisheries. Potentially affected markets and the structure and values of fishing communities also will be described. This represents the baseline. The impacts of the alternatives, including the no action alternative, will be evaluated in terms of this baseline.

This EIS will also evaluate the impacts of the alternatives. Potential impacts are summarized below according to the main human environment components that may be evaluated in the EIS. Impacts can be direct, occurring at the same time and in the same place as the proposed action; indirect, occurring at a different time or place; or cumulative. The cumulative effect is the total effect, including other past, present, and reasonably foreseeable future actions, even those not carried out by NMFS. Uncertainty makes predicting long-term effects very difficult. It is true that the rebuilding framework does include a measurement of risk (P_{MAX}, or the likelihood of stock rebuilding for a given rebuilding strategy), but there are other sources of uncertainty—such as measurement error and mis-specification of models. As a result, when new stock assessments are conducted the relationship between strategic rebuilding parameters can change such that, for example, the harvest control rule (expressed as a fishing mortality rate) takes on a new value for a given T_{TARGET}. For this reason evaluation of impacts over the long term (which realistically means more than two to five years) will likely be treated qualitatively.

Habitat and Ecosystem

Currently, the ability to assess impacts to habitat and ecosystem is limited. Fishing gear affects habitat when it contacts the bottom. For this reason, bottom trawl gear is presumed to have the greatest effect, while fixed gear, such as bottom longlines and traps are thought to have a more moderate effect. Fishing gear can disturb bottom substrate and uproot or break apart benthic macro fauna like corals and sea anemones. However, the degree to which these impacts affect ecosystem structure or stock productivity is not well understood. Cumulative effects also result from an array of non-fishing activities that contaminate marine waters and alter ecosystems, primarily in nearshore areas.

Climate change and climate cycles can affect ecological conditions; this in turn affects productivity, influencing the likelihood that a stock will rebuild. Changes in trophic structure, caused by fishery removal or other human activities, can also influence rebuilding prospects. For example, the disappearance of larger adult fish due to overfishing can have a depensatory effect whereby other, smaller species—normally prey of the adult fish—feed on juveniles of the overfished stock, slowing recovery of the overfished population.

The effects of the alternatives will depend on the types of management measures that are implemented to meet rebuilding targets and, in turn, how this affects the intensity and distribution of fishing effort. Extensive closed areas, based on the depth distribution of overfished species, have become a feature of groundfish management. Most commercial fishing, including bottom trawling, is prohibited in these areas. Fishing impacts are, therefore, minimized within these areas, and if they are kept in place over the duration of the longest rebuilding periods, could offer long-term habitat protection. However, because habitat protection is not the primary purpose of these areas, their duration and configuration cannot be guaranteed. For example, fishery managers could conceivably implement other measures that more effectively control bycatch, thereby eliminating the need for the closed areas.

Managed Groundfish Stocks, Including Overfished Species

Impacts to managed stocks will be mainly evaluated in terms of the effect on overfished groundfish species. Establishing rebuilding targets indirectly affects harvest levels through the harvest specification process. The relative effect of the alternatives on the four overfished species considered in this amendment can be evaluated in terms of the targets identified under the alternatives. OYs for the species considered in this amendment, determined from the targets chosen under a given alternative, will also affect other overfished and target groundfish species through any constraints on harvest over and above the OYs that might be chosen for those species. (For example, choosing the *Maximum Conservation Alternative*, which requires no harvests of the four species considered here, would require management measures which would also substantially constrain—or totally prevent—harvests of other overfished and target groundfish species, even if the OYs chosen for these species were greater than zero.) Essentially, the management framework can be used as an evaluation tool. Alternatives that rebuild stocks more slowly would thus be considered to have a greater impact on the stocks in question. Allowing overfishing (which would likely be the case under the *Mixed Stock Exception Alternative*) would be considered a significant impact. To the degree that effects to other stocks can be predicted, a similar set of criteria would be applied. Alternatives that are more likely to quickly return depressed non-overfished stocks to B_{MSY}, for example, would have a greater beneficial effect. (Taking the *Maximum Conservation Alternative* as an example again, depressed non-overfished stocks would likely benefit from reduced fishing mortality under this alternative, returning to the target biomass more rapidly than would otherwise be the case.)

The Management Regime

Adoption of any alternative would require implementation of management measures to keep harvests to the levels needed to meet the adopted rebuilding targets in each rebuilding plan. Management measures are implemented as part of the biennial harvest levels and management measures specifications process. Through this process harvest limits are periodically respecified as new stock assessments and rebuilding analyses become available. As part of the same process, management measures can be adjusted to meet any of these re-specified OYs. In addition, the FMP may be amended to improve the management regime and increase the number of available management measures. The kinds of management measures currently available include depth-based restrictions, used to prohibit fishing in areas where there is a high bycatch of overfished species; seasonal restrictions, intended to restrict fishing during those times of year when bycatch is higher; trip limit management; and requiring gear modifications to limit bycatch.

Socioeconomic Impacts

Socioeconomic impacts are closely related to biological impacts, although in the short term an adverse biological impact may translate into a beneficial socioeconomic impact. This is because socioeconomic impacts are related to the revenue generated from the sale of commercially landed groundfish and the direct non-monetary and indirect monetary benefits derived from recreational fishing. Alternatives that constrain fishing mortality more—while having a biological benefit—would likely reduce overall revenues. Of course, over the long term returning stocks to a size capable of supporting MSY should increase potential socioeconomic benefits. Socioeconomic impacts will be evaluated, first, in terms of the effect on different fishery sectors. These sectors can be defined very broadly in terms of commercial and recreational sectors. Further subdivision is possible within these sectors based on regulatory categories and geographic location.

Commercial Fisheries

Commercial fisheries are divided into limited entry trawl, limited entry fixed gear, and the so-called open access sector. Open access fisheries include fishers targeting groundfish with legal gear (excluding those gear types for which a groundfish limited entry permit is required—trawl, longline, and fish pots) and vessels catching groundfish incidentally while targeting other species. This second category of fishers are for the most part also managed under plans, policies, or regulations related to the species they are targeting. Table 4 shows 1998 landings by commercial vessels in these three categories (the limited entry trawl sector is further subdivided between the target whiting fishery and other groundfish trawl fisheries). (No groundfish species had yet been declared overfished in 1998. Since the information represents landed catch, using this earlier data should give a better picture of the distribution of overfished species catch among sectors. Subsequently, regulatory discards have increased, making the data less representative. At the same time, the absolute amounts given in Table 4 are not comparable to the current situation for this reason.) Table 4 also divides these categories between landings north of 40º 10' N latitude and south of that line. This line, near Cape Mendocino, California, represents a major geographic boundary in terms of management measures applied to commercial fisheries.

It can be seen that yelloweye rockfish landings are distributed across these regulatory/geographic categories, with no one category dominating. Management measures intended to rebuild this stock are likely to have wide-ranging socioeconomic impacts as a result. Widow rockfish landings, in contrast, were mainly landed by trawl fisheries in the northern area. It is also the only one of these four overfished species caught in appreciable quantities by the targeting whiting trawl fishery. Bocaccio is more common in the southern area, and in 1998 a large proportion was caught in the open access sector (representing a diverse array of fisheries), with the limited southern area entry trawl sector posting the bulk of the remaining share. Cowcod was caught in relatively small quantities, almost exclusively in the southern area, with open access fisheries dominating. Currently, this species is managed under a very low OY, primarily by closing areas of higher abundance.

Recreational Fisheries

All of these species have been caught in Rebuilding these two stocks will require recreational catch restrictions, with bag and size limits the most common measures to date. California has also limited the recreational fishing season, mainly in response to the need to rebuild overfished groundfish species. Lingcod are predicted to recover quickly, so limits could be relaxed after a relatively short period of time. But the need to limit recreational catches of other overfished species is likely to require restrictive measures—such as bag limits on total recreational catch or closed seasons—even after the lingcod stock recovers. Canary rockfish are a case in point; their projected recovery time is more than 70 years under the *Council Preferred* alternative.

The Tribal Fishery

The Makah, Quileute, Hoh, and Quinault Indian tribes, which are located in Washington state, have treaty rights to catch up to half of the harvest in their "usual and accustomed" (U and A) fishing areas. These tribes participate in the Pacific whiting fishery, which accounts for most of their groundfish landings. As shown in Table 4, widow rockfish is the only one of these four species caught in appreciable quantities in this fishery. The midwater trawls used in this fishery also catch relatively small amounts of canary and darkblotched rockfish. In 2004 the Makah tribe is planning to prosecute a midwater trawl fishery for yellowtail rockfish. Yelloweye rockfish bycatch will monitored and will be a management concern. More limited bottom trawl fishing by these tribes, and ocean salmon fishing, also catch overfished species, including yelloweye and widow rockfish. Generally, managing for bycatch of the four species considered in this amendment will have a modest effect on tribal fisheries, unless the zero mortality target under the *Maximum Conservation* alternative is chosen.

Fishing Communities

Because of the distribution of the overfished species considered in this amendment, and the fishing fleets most commonly catching them, ports coastwide are likely to be affected by rebuilding measures for one species or another. As noted above, widow rockfish are primarily caught in northern areas, with a center of distribution off of Oregon. Yelloweye rockfish is caught in fisheries on the continental shelf in Washington, Oregon, and Northern California. Limiting bocaccio and cowcod catches will primarily affect fisheries off of Central and Southern California. Recreational fishing is also an important part of the local economy in many of these ports. In addition to the income and employment generated by charter boats, allied support businesses (like bait and tackle shops) also depend on recreational fishing. Harvest restrictions aimed at rebuilding overfished groundfish will by no means eliminate marine recreational fishing opportunities. Salmon, for example, are more important recreational target species, but from Monterey northwards. Limiting recreational catches of bocaccio and cowcod would have relatively large impact on recreational fisheries in Southern California. While difficult to quantify, restrictions could devalue the ocean recreational experience in this region and indirectly affect demand for recreational products and services.

Table 4. 1998 commercial landings of overfished species considered under Amendment 16-3, in metric tons and by major fishery sectors.

	Limited Entry Trawl- Whiting	Limited Entry Trawl		Limited Entry Fixed Gear		Open Access		Total
	North	North	South	North	South	North	South	
Bocaccio	0	36.1 (11.82%)	105.1 (34.4%)	1.7 (0.6%)	14.9 (4.9%)	4.2 (1.4%)	143.4 (47.0%)	305.4 (100%)
Cowcod	0	0.1 (0.2%)	2.6 (10.0%)	0	3.3 (12.7%)	0	19.9 (77.1%)	25.8 (100%)
Widow	811.6 (8.8%)	6,802.1 (74.0%)	980.4 (10.7%)	10.6 (0.1%)	13.4 (0.2%)	292.2 (3.2%)	275.9 (3.0%)	9,186.1 (100%)
Yelloweye	0	1.3 (3.3%)	3.1 (8.2%)	4.9 (12.8%)	9.1 (23.6%)	5.8 (15.1%)	14.2 (37.0%)	38.4 (100%)

GROUNDFISH FISHERY MANAGEMENT PLAN AMENDMENT 16-3: REBUILDING PLANS FOR BOCACCIO, COWCOD, AND WIDOW AND YELLOWEYE ROCKFISH

Situation: There are nine overfished groundfish species on the West Coast managed under Council rebuilding plans adopted under Groundfish Fishery Management Plan (FMP) Amendment 16-2 or interim rebuilding measures adopted in the annual specifications process. Rebuilding plans for canary rockfish, darkblotched rockfish, lingcod, and Pacific ocean perch were adopted as part of FMP Amendment 16-2 earlier this year. Bocaccio, cowcod, widow rockfish, and yelloweye rockfish rebuilding plans will be analyzed in an Environmental Impact Statement under FMP Amendment 16-3. Amendment 16-3 will be considered in a two-meeting process, with this Council meeting being the first; final Council action to decide a preferred alternative is scheduled for the April 2004 Council meeting. A rebuilding plan for Pacific whiting, the last of the nine overfished species, awaits development, review, and adoption of a rebuilding analysis and is contemplated under Amendment 16-4.

The task under this agenda item is to adopt rebuilding alternatives for bocaccio, cowcod, widow rockfish, and yelloweye rockfish for analysis and public review. Exhibit D.14, Attachment 1 is a scoping information report for Amendment 16-3 and was used during a 3 P.M. November 2, 2003 scoping session. This scoping information report will also help the Council decide the important rebuilding plan elements under consideration in Amendment 16-3. The strategic rebuilding alternatives T_{TARGET}, the target rebuilding year; and the harvest control rule (F) are those parameters guiding rebuilding under the Council-adopted framework provisions of Amendment 16-1. The probability of successful rebuilding by T_{MAX} (P_{MAX}) is a reasonable index of rebuilding risks and, as such, provides the structure for rebuilding alternatives analyzed under Amendment 16-3. Guidance on which of these stocks to analyze under the mixed stock exception alternative would also be particularly useful.

Council Action:

1. Adopt elements of Amendment 16-3 for public review.

Reference Materials:

1. Exhibit D.14, Attachment 1: *Amendment 16-3 to the Pacific Coast Groundfish Fishery Management Plan: Rebuilding Plans for Bocaccio, Cowcod, Widow Rockfish, and Yelloweye Rockfish; Scoping Information Document.*

Agenda Order:

a. Agendum Overview — John DeVore
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Adopt Elements of Amendment 16-3 for Public Review

PFMC
10/22/03

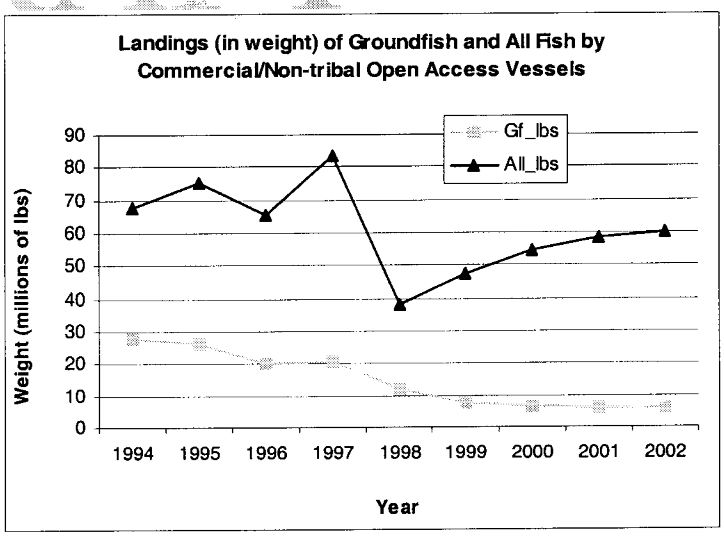
Exhibit D.15
Attachment 1 - Purpose and Need
November 2003

****Note for November 2003 Readers: This document is structured as the first chapter of a National Environmental Policy Act analysis of a potential Council action and, at this point, is intended only to be a discussion aid.****

1.0 PURPOSE AND NEED FOR ACTION

1.1 Introduction

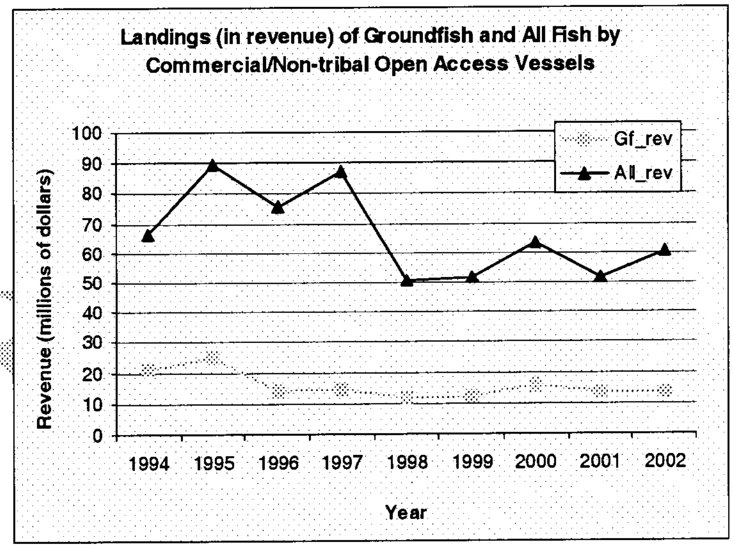
The Pacific Coast Groundfish Fishery Management Plan (FMP) provides management principles and guidance for the federal waters fisheries for over 80 groundfish species, a broad species group that primarily includes rockfish, flatfish, and roundfish. The area managed under the FMP is the entire U.S. West Coast Exclusive Economic Zone (EEZ), which encompasses marine waters 3-200 nautical miles offshore of the shoreline. A wide variety of fisheries occur within these waters, including many fisheries that either target groundfish directly, or which take groundfish incidentally while targeting other species of fish and shellfish.



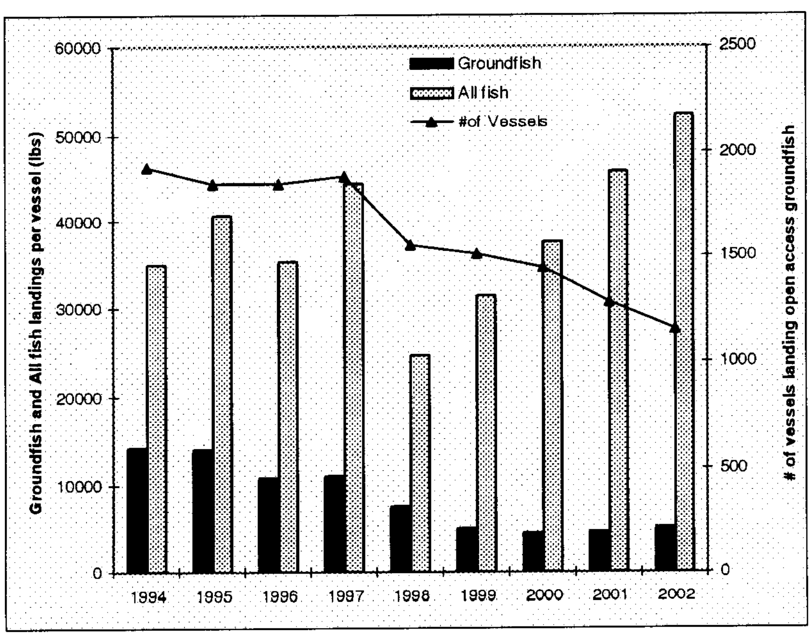
In 1994, NOAA Fisheries implemented a limited entry program for the West Coast groundfish fisheries, which created a permitting program to restrict the number of vessels allowed to directly target groundfish. The Pacific Fishery Management Council (Council) had discussed and developed this limited entry program as Amendment 6 to the FMP in the early 1990s. At that time, West Coast fisheries as a whole were perceived as overcapitalized, meaning that fishing effort (number of vessels participating and fishing power of individual vessels) far exceeded potential West Coast fish and shellfish biological yields. In the Environmental Impact Statement (EIS) for Amendment 6, the Council expressed concern that vessels looking for opportunities to expand their fishing operations would begin to enter the groundfish fishery, which had only recently had converted from partial foreign harvest to complete domestic harvest. To prevent this anticipated migration to the groundfish fisheries, the Council adopted the Amendment 6 limited entry program, which essentially capped the number of groundfish fisheries participants to those vessels with historic participation in the groundfish fisheries.

The limited entry program has been successful in restricting the number of vessels participating in the limited entry fishery. Regulatory amendments subsequent to Amendment 6, including the Amendment 14 permit stacking program for limited entry, fixed gear sablefish endorsement holders, have further decreased the number of vessel participating in the limited entry fishery. NMFS initially issued 629 limited entry permits in 1994. In 2003, this total number has been reduced to 498 permits, largely due to consolidation: 268 trawl permits, 194 longline permits and 27 trap/pot permits, plus 9 permits with two gear endorsements. Of the 164 permits with sablefish endorsements, 58 permits were stacked for use in the primary sablefish fishery as of May 2003 (Ford, May 2003).

Because the limited entry program did not encompass all vessels landing groundfish, it ultimately failed to check the number of vessels landing groundfish in the years since its implementation, 1994 to the present. Amendment 6 specified that percentages of annual allowable groundfish catch that had been taken by vessels that did not qualify for limited entry permits would be set aside for an open access fishery. This fishery was left unlimited in participation to ensure that vessels participating in state-managed fisheries and landing groundfish incidentally would continue to have access to the groundfish resource. The fishery was also left unlimited to allow smaller vessels to directly target groundfish at lower landings rates than in the limited entry fishery. Since 1994, any vessel without a limited entry permit and using gear other than trawl gear has been allowed to directly target and land groundfish under open access fishery regulations and limits. Additionally, vessels using trawl gear in non-groundfish fisheries, such as shrimp and prawn fisheries, have been allowed to land groundfish taken incidentally in those fisheries under open access fishery regulations and limits.



Allowable groundfish landings have been declining in recent years, primarily in response to requirements in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) that NOAA Fisheries and the fishery management councils implement measures to rebuild overfished fish stocks. As of 2003, nine groundfish species have been declared overfished. All of these species co-occur with more abundant groundfish stocks, which means that harvest of both the overfished stocks and their more abundant co-occurring stocks has been severely restricted to protect



the overfished stocks. Despite these overall harvest restrictions, participation in the open access sectors of the groundfish fisheries remains unrestricted. In 2002, 1,149 vessels landed groundfish in the open access fisheries, taking 6,014,772 lb (2,728 mt) of groundfish, with a total all-vessel revenue of $13,508,976 from that groundfish.

1.2 Purpose of and Need for the Proposed Action

The purposes of the proposed action are to:

- For the open access fisheries, meet the Council's Strategic Plan goals of reducing capacity in the groundfish fisheries and the Council's commitment to an open access permitting program
- For the open access fisheries, implement a regional capacity management or reduction program to meet the United States National Plan of Action for the Management of Fishing Capacity
- Ensure that federal management of the open access fisheries is compatible with state license limitation programs for nearshore fisheries

The needs for the proposed action include:

- All of the West Coast groundfish fisheries are overcapitalized, including the open access fisheries, and need to have reductions in number of vessels participating in order to better match harvest capacity to resource availability.
- The West Coast states have or are creating new management programs for their nearshore groundfish fisheries. License limitation in these nearshore fisheries may push unlicensed vessels into federal waters, increasing fishing pressure there. Fishing capacity in federal waters needs to be managed to ensure that state management programs do not inadvertently result in increasing capacity and/or effort in federal waters.
- Management measures to protect overfished groundfish species have, in recent years, included large area closures. Enforceability of these and other management measures (such as observer program implementation) would be improved by managers and enforcement officials being able to identify which vessels are permitted to participate in the groundfish fisheries.

1.3 Background to the Purpose and Need

Council Strategic Planning and Open Access Capacity Reduction Planning In November 1998, the Council decided that it wished to begin a strategic planning process to look at long-term planning for West Coast groundfish management. The Council's strategic planning discussions and the drafting of the Strategic Plan itself continued throughout 1999 and into 2000, with the final Strategic Plan being completed in October 2000. Early in this development process, the Ad-Hoc Groundfish Strategic Plan Committee members quickly determined that overcapacity in all sectors of the groundfish fishery was a problem that affected all of the Council's groundfish management activities. The Council initially addressed this concern by setting a "control date" for license limitation in the open access fisheries. In November 1999, the Council stated that if it were to develop a license limitation program for open access groundfish fisheries that used catch history as a basis for future participation in the fisheries, the Council would likely not allow landings made after November 5, 1999 to count toward future groundfish allocations or participation in the groundfish fisheries (65 FR 6577, February 10, 2000).

Upon learning that the Council and Strategic Plan Committee wished to look at overcapacity as a problem to be addressed in the Strategic Plan, the Economic Subcommittee of the Council's Scientific and Statistical Committee (SSC) volunteered to investigate overcapitalization in West Coast groundfish fisheries. The SSC's Economic Subcommittee presented the results of its study and concurrent public workshop at the April 2000 Council meeting. In that report, the Economic Subcommittee found that all sectors of the groundfish fishery were overcapitalized. The Economic Subcommittee had calculated "capital utilization rates" for the groundfish fisheries, a calculation of the minimum number of vessels in a particular fishery that would be needed to take all of the groundfish available to that fishery. For the open access fisheries, the Economic Subcommittee calculated that 6-13% of the vessels landing groundfish in the open access fisheries could harvest all of the groundfish available to those fisheries in 2000 (PFMC Economic Subcommittee, March 2000.) Although this calculation was based on the harvest capacity of the most efficient vessels in the open access fleet, the Economic Subcommittee's conclusions were clear that the open access fisheries landing groundfish were overcapitalized.

The Strategic Plan discusses the SSC Economic Subcommittee's recommendations on reducing overcapacity in the groundfish fisheries and sets a Strategic Plan goal for capacity reduction:

> *"To have a level of harvest capacity in the [groundfish] fishery that is appropriate for a sustainable harvest and low discard rates, and which results in a fishery that is diverse, stable, and profitable. This reduced capacity should lead to more effective management for many other fishery problems. For the short term, adjust harvest capacity to a level consistent with the allowable harvest levels for the 2000 fishing year, under the assumption that [overfished] stock rebuilding will require reduced harvests for at least the next two decades. Maintaining a year-round fishery may not be a short-term priority."* (PFMC October 2000)

Beyond this general goal, the Strategic Plan explores potential capacity reduction programs for the different sectors of the groundfish fishery. Ideas for reducing capacity in the open access fishery primarily focus on requiring participants to hold a federal permit for landing groundfish from West Coast waters, with the possibility of different permit classes for those vessels taking groundfish directly and those taking groundfish incidentally.

Following the completion of its Strategic Plan, the Council convened a Strategic Plan Oversight Committee to monitor the Council's progress toward the goals of the Strategic Plan. A subcommittee of this new Oversight Committee was formed to look at open access capacity reduction issues, the Ad-Hoc Open Access Permitting Subcommittee. This Permitting Subcommittee first met in January 2001 and continued with a series of meetings through March 2002, as described in Section 1.5, below. These meetings ceased for the remainder of 2002 because the Council's workload on other issues forced it to delay further work. However, the Council reviewed its progress with Strategic Plan recommendations in November 2002 and decided at that point that it would begin developing an open access permitting program and drafting the associated analysis for such a program in 2003. This proposed FMP amendment is intended to meet the Strategic Plan goal of reducing capacity in the open access fisheries landing groundfish and to meet the Council's commitment to an open access permitting program.

United States National Plan of Action for the Management of Fishing Capacity In February 2003, NOAA Fisheries completed a draft plan of action for managing fishing capacity in response to the nation's commitment to the United Nations' Food and Agriculture Organization's (FAO's) Code of Conduct for Responsible Fisheries (NOAA Fisheries 2003.). In implementing its Code of Conduct for Responsible Fisheries, FAO member nations, including the United States, have committed to an International Plan of Action for the Management of Fishing Capacity. The "urgent actions" called for in this International Plan are:

- Assess and monitor national fishing capacity

- Prepare and implement national plans to manage and, if required, reduce fishing capacity nationwide
- Participate in international agreements to manage capacity in high seas fisheries
- Determine which international fisheries require urgent fishing capacity reduction measures and take immediate action to manage capacity in those fisheries (FAO 1999/2000)

The first two items on this list apply to domestic fisheries within federal waters as well as to U.S. nationals fishing in international waters. In its Draft National Plan of Action, NOAA Fisheries plans to complete assessments of excess capacity in U.S. fisheries in 2003 and of overcapacity in 2004. The Draft Plan identifies the following initial qualitative indicators of overcapacity:

- The biological status of the fishery – are stocks overfished?
- Management category of the fishery – is the fishery open access, limited access, or rights-based?
- Relationship between harvest levels and total allowable catch levels – do catches exceed quotas?
- Fishery season lengths – is the fishing season duration increasing or decreasing?
- Total allowable catch levels and their allocations – how contentious is the quota-setting process?
- Latent permit existence – what is the ratio of active to total permits?
- Catch-per-unit-of-effort – are catch rates increasing or declining?

> **"Excess capacity is the difference at a point in time between what a fisherman can actually produce and what could potentially be produced if all restrictions on his operation were removed.**
>
> **Overcapacity may be defined as the difference between the fishing firm's potential level of production (individual vessel's catch) and the target level of production (total allowable harvest) that has been established for that particular fishery" (Kirkley et al June 2002, parentheses contents added)**

NOAA Fisheries plans to assess excess capacity and overcapacity using quantitative methods as part of its continuing evaluation of nationwide overcapacity issues; however, the agency noted in the Draft Plan that, based on the above qualitative indicators, the following West Coast fisheries could be considered to be overcapitalized: 1) limited entry fixed gear sablefish, 2) limited entry fixed gear non-sablefish groundfish, 3) limited entry trawl non-whiting groundfish, 4) open access groundfish, and 5) Pacific coast salmon. Nationwide, NOAA Fisheries identified 42 fisheries with qualitative indicators of overcapacity. Through its participation in the FAO, the United States has a goal to "eliminate or substantially reduce overcapacity in 25 percent of U.S. federally managed fisheries by 2009" and in a substantial majority of U.S. fisheries by 2015 (NOAA Fisheries 2003). Depending on the results of the quantitative analysis of overcapacity, fisheries that have been qualitatively assessed as overfished will likely receive national attention as needing capacity reduction. As discussed above, the SSC's Economic Subcommittee has already quantitatively assessed West Coast groundfish fisheries as having excess capacity. This FMP amendment is intended to meet the National Plan of Action for the Management of Fishing Capacity goal of managing or reducing excess capacity nationwide in part by reducing capacity within the open access fisheries.

State Fisheries Groundfish Management in Nearshore Waters Each of the states has jurisdiction over management of fisheries occurring within 0-3 nautical miles from their respective shorelines. Some federally managed groundfish species are found both within and outside of state waters, and are taken by fisheries targeting groundfish and incidentally in non-groundfish fisheries. Fisheries overcapacity is not only a federal problem – many of the fisheries in state waters around the nation are overcapitalized. The three West Coast states have three different approaches to groundfish management and overcapacity in state waters. As the states work to reduce capacity in their nearshore fisheries, fishing vessels no longer permitted to fish in nearshore waters could move their effort farther offshore to federal waters. Capacity management in the federal open access fisheries for groundfish will need to be compatible with and complementary to state license limitation programs to ensure that offshore groundfish species are not subject to increased fishing pressure.

WASHINGTON The State of Washington prohibits directed commercial fishing for groundfish in state waters. Further, the salmon troll fishery is the only commercial fishery in which incidentally taken groundfish may be landed in Washington State (WAC 220-44). Washington State also prohibits the landing of live fish, a practice that has greatly expanded participation in the open access fisheries off Oregon and California in recent years (WAC 220-20). About 7.4% of the 1,1,49 non-tribal vessels that landed groundfish in the open access fisheries coastwide in 2002, made those landings in Washington State ports. Although Washington State has restrictive management measures for groundfish fishery participants inside state waters, vessels participating in the open access groundfish fisheries off Washington have access to groundfish stocks, including overfished species, in federal waters.

Members of the four groundfish treaty tribes operating off Washington state (Makah, Quileute, Hoh, and Quinault) may fish for groundfish within their Usual and Accustomed (U&A) fishing areas. These U&A areas include both state and federal waters. A tribal vessel's participation in the groundfish fisheries is at the discretion of that vessel owner's tribe and tribal participation in groundfish fisheries would not be managed by this action.

OREGON The State of Oregon began to look more closely at nearshore groundfish management in mid-2001. Oregon's Fish and Wildlife Commission (OFWC) met several times in 2001 and 2002 to develop priorities for nearshore groundfish management. As a result of these meetings, the OFWC has recommended restricting overall nearshore groundfish harvest levels and has recommended new management measures for both recreational and commercial fisheries occurring in nearshore waters (ODFW 2003). For commercial fisheries, ODFW staff has drafted "An Interim Management Plan for Oregon's Nearshore Commercial Fisheries" in support of the OFWC's nearshore management discussions (ODFW October 2002). This interim plan sets the following priorities for Oregon's commercial nearshore fishery:

- Sustain biological resources at optimal levels;
- Minimize the number of commercial nearshore vessels fishing off central and northern coastal waters in areas of high recreational use;
- Allow continuation of black rockfish open access fishery;
- Avoid additional effort shifting from open access fishery to nearshore fishery;
- Reduce effort by at least 50%;
- Gather information needed for management using mandatory logbooks and sampling, and;
- Develop a cap on harvest levels of nearshore species.

In crafting management alternatives to meet the goal of 50% capacity reduction, ODFW staff recommended that the OFWC focus capacity reduction efforts on those groundfish species primarily taken in state waters most of which are landed in the live fish fishery. ODFW has recommended that fisheries for the following species be managed under a capacity reduction program, some of which are also managed under the Council's groundfish FMP:

State-Managed Species	Federal FMP Species
Buffalo sculpin, *Enophrys bison* Brown Irish Lord, *Hemilepidotus spinosus* Red Irish Lord, *Hemilepidotus hemilepidotus* Painted greenling, *Oxylebius pictus* Rock greenling, *Hexagrammos lagocephalus* Whitespotted greenling, *H. stelleri*	Cabezon, *Scorpaenichthys marmoratus* Kelp greenling, *Hexagrammos decagrammus* Black & Yellow rockfish, *Sebastes chrysomelas* Brown rockfish, *S. auriculatus* Calico rockfish, *S.dalli* China rockfish, *S.nebulosis* Copper rockfish, *S. caurinus* Gopher rockfish, *S. carnatus* Grass rockfish, *S.rastrelliger* Kelp rockfish, *S. atrovirens* Olive rockfish, *S.serranoides* Quillback rockfish, *S.maliger* Tiger rockfish, *S.nigrocinctus* Treefish, *S. serriceps* Vermilion rockfish, *S.miniatus*

For 2003, the Council adopted large rockfish conservation areas, in which groundfish fishing is either restricted or closed entirely. These rockfish conservation areas primarily protect continental shelf species, several of which have been designated as overfished. One impetus for Oregon's consideration of a nearshore capacity reduction plan is the state's expectation that federal continental shelf closures will push more fishing vessels into the nearshore area. Conversely, a federal concern with a license limitation program in the Oregon nearshore fisheries is that such a program may push unlicensed vessels farther offshore. About 31.3% of the 1,149 West Coast vessels that participated in the open access fisheries in 2002 made open access groundfish landings in Oregon ports. Oregon's nearshore commercial fisheries management plan could become an important component of the Council's efforts to both protect overfished species and to restrict capacity in the open access fisheries.

Oregon took its first step toward limiting nearshore fishery participation in December 2002, when the OFWC approved an Oregon Nearshore Permit. To qualify for the nearshore permit, a vessel would have to have made a minimum of 750 lb (340 kg) non-trawl caught black rockfish, blue rockfish or nearshore fish in any one calendar year between January 1, 1995 and July 1, 2001 to a licensed Oregon fish processor, or; have been issued a nearshore permit under the Interim Nearshore Fisheries Plan through the Developmental Fisheries Program. ODFW issued nearshore permits to 72 vessels based on these qualifications. The permit was required for vessels to target the 21 nearshore species during 2003. A fleet of approximately 100-125 vessels, depending on the year, had operated in this fishery prior to the permitting program. Vessels that did not qualify for the permit were limited to an incidental catch of 15 lb (6.8 kg) of these species per trip.

The nearshore permit was issued for 2003 only and ODFW had intended to develop a similar permit system for 2004. Before the agency could complete development of the second year's permit program, legislative action via Oregon House Bill 3108 established a nearshore limited entry program for Oregon beginning in 2004. All vessels in possession of a 2003 nearshore permit are included in the Nearshore Limited Entry program for 2004, with an additional 120 vessel likely to qualify for the limited entry permit via a requirement to have landed 750 pounds of black rockfish, blue rockfish, or nearshore fish in any calendar year between January 1, 1995, and July 1, 2001. The initial nearshore fleet will be approximately 170 vessels. The permitting program includes planned attrition, in that participants must make at least five commercial fish landing sin any year in order to qualify for the subsequent year's permit. Oregon's target fishery participation levels will be 50 vessel with nearshore species permits (group of species listed above,) plus an additional 80 vessels that target black rockfish and blue rockfish. (Saelens 2003)

In developing a federal license limitation program, the State of Oregon, the Council and NOAA Fisheries will need to ensure that state and federal capacity reduction programs are compatible with each other and that together the programs ultimately result in less fishing pressure on both overfished and more abundant groundfish species. The Council process will provide a forum for this cooperation, as all three West Coast states and NOAA Fisheries have seats on the Council.

CALIFORNIA The State of California hosts the largest of the open access groundfish fleets; about 61.4% of the vessels landing open access groundfish coastwide in 2002 made open access landings in California ports. In January 1999, the Marine Life Management Act (MAMA) became law in California and significantly changed the way that the state managed its living marine resources. The MAMA set a state-wide marine resource management policy to: "ensure the conservation, sustainable use, and, where feasible, restoration of California's marine living resources for the benefit of all the citizens of the state" (Cal. Fish & Game Code, Div. 6, Part 1.7, Chap 5, Sec. 7050.) Under the MAMA, the California Department of Fish and Game (CDFS) was required to evaluate the status of its marine species and their fisheries and to determine which of those species should be managed under a fishery management plan (Cal. Fish & Game Code, Div. 6, Part 1.7, Chap 5, Sec. 7070-7074.) One of the initial species groups chosen for management under a new fishery management plan was the "nearshore fishery," a broad group of primarily bottomfish species, most of which are included in the Federal FMP. Priority for management of this species group was based on the emergence of a high-value live-fish fishery for these species in the 1990s, coupled with their substantial importance to the state's recreational fisheries. Additionally, these species are valued as important and diverse components of many nearshore kelp and rocky reef ecosystems and food webs.

State-Managed Species	Federal FMP Species
California sheephead, *Semicossyphus pulcher* Monkeyface prickleback, *Cebidichthys violaceus* Rock greenling, *Hexagrammos lagocephalus*	Cabezon, *Scorpaenichthys marmoratus* Kelp greenling, *Hexagrammos decagrammus* Black rockfish, *Sebastes melanops* Black-and-yellow rockfish, *S. chrysomelas* Blue rockfish, *S. mystinus* Brown rockfish, *S. auriculatus* Calico rockfish, *S.dalli* China rockfish, *S.nebulosis* Copper rockfish, *S. caurinus* Gopher rockfish, *S. carnatus* Grass rockfish, *S.rastrelliger* Kelp rockfish, *S. atrovirens* Olive rockfish, *S.serranoides* Quillback rockfish, *S.maliger* Treefish, *S. serriceps* California scorpionfish, *Scorpaena guttata*

The August 2002 California Nearshore Fishery Management Plan (NFMP) identifies the above nineteen species for management, ten of which were further identified as needing a restricted access program for their fisheries, as they were the species primarily targeted by the commercial live-fish fishery: cabezon, rock and kelp greenling, black-and-yellow, china, grass, gopher, and kelp rockfishes, California sheephead, California scorpionfish (Cal. Fish & Game Code, Div. 6, Part 2, Chap 2, Sec. 8588.) License limitation for these shallow water fisheries grew out of CDFS's initial post-MAMA efforts to license participants in the nearshore fisheries. CDFS sold licenses to anyone who wished to participate in the fishery, issuing 1,100 licenses in 1999-2000, and then 750 in 2001-2002 (CDFS 2002). California's permit year begins on April 1 and ends on March 31, spanning two calendar years. CDFS and its guiding Commission considered the 1999-2000 permits to be "moratorium permits," or the maximum pool of participants who could be eligible for further capacity reductions. For 2002-2003, the California Fish and Game Commission (CFGC) introduced a requirement that fishermen have landed at least 100 lb (45.4 kg) of these shallow water nearshore fish species over 1994-2000 in order to qualify for a nearshore fishery permit, ultimately reducing the number of permittees for the 2002-2003 period to 525. These permits were non-transferable and are valid only for the fishing year for which they are issued, thus they have no monetary value to the permit holder other than the value of the fish taken in association with the privilege of holding the permit.

For the 2003-2004 fishing year, the CFGC has codified new regulations for the shallow nearshore species group and California scorpionfish, which divide the state's coast into four regions and set differing permit qualification thresholds for each region. The permit qualifications require landings both in the 1994-1999 period and in the 2000-2001 period. In each region, landings were required both during the 1994-99 and 2000-2001 time periods, but the landings and/or price requirements differ in each of the four regions. No person may hold a nearshore fishery permit in more than one of the four regions. The permits are transferable within each region and any person wishing to become a new entrant to the fishery must purchase and then consolidate two permits in order to do so. California has set the following capacity goals for its nearshore fishery permits: 14 permits in the North Coast Region (Oregon border to Cape Mendocino); 9 permits in the North-Central Coast Region (Cape Mendocino to Año Nuevo); 20 permits in the South-Central Region (Año Nuevo to Point Conception) and; 18 permits in the South Coast Region (Point Conception to Mexico border) (CCR Title 14, Section 150). California is expecting some consolidation of permits, as it has issued substantially greater numbers of permits than its capacity goals: 28 in the North Coast, 37 in the North-Central Coast, 64 in the South-Central Coast, and 72 in the South Coast. (Bishop 2003) In addition to these directed fishery permits, the state has issued 26 bycatch permits to persons with shallow water nearshore species landings history with trawl or gillnet gear. Directed fishery permits are restricted to fishers using hook-and-line or trap gear.

With the license limitation program for shallow water nearshore species and scorpionfish in place, CFGC has begun to look at also requiring permitting for the nine deeper nearshore species managed under the NFMP: black, blue, brown, calico, copper, olive, quillback, and treefish rockfishes. CFGC is proceeding in a similar fashion to its development of a license limitation program for the shallow water nearshore species, with an initial pool of moratorium permit holders who qualify for the moratorium permit based on 200 lb (90.7 kg) of landings in the 1994-1999 period. To date, CDFS has issued 221 Deeper Nearshore Species Fishery Permits; those permits are required beginning April 1, 2003. The permit program for deeper nearshore species in not currently regional and permits are not transferable. There are 113 individuals who hold both a shallow and a deeper nearshore fishery permit.

It is important to note that recent actions to restrict nearshore fishing activity and limit opportunity to participants with catch history over the 1994-1999 time period were taken in concert with Council activities to severely limit shelf fishing activities both for limited entry and open access fishery participants. In addition to these programs for state and federal groundfish species, CDFS has proposed or implemented several other new restricted access commercial fishery programs or curtailed other commercial opportunities (market squid, rock crab, spot, ridgeback, golden prawn). Without restrictions on shelf and slope groundfish fishing activities, CDFS believes that vessels restricted from fishing in the nearshore area could have a substantial effect on continental shelf and slope species. (Yaremko 2003)

As part of its efforts to more effectively manage commercial fisheries in nearshore waters, California has asked that the Council and NMFS transfer management authority over the sixteen federally-managed species under the NFMP to the state of California. This issue has been relatively low on the Council's workload priority list, but may rise in importance as the Council considers open access permitting issues that will affect fisheries for the same species managed under California's NFMP.

1.4 Environmental Review Process

Public Scoping The Council has been conducting scoping on the issue of requiring permitting in the open access fisheries since January 2001. Both the scoping activities and public issues and concerns regarding this action that were conducted or expressed prior to the preparation of the draft EIS and those associated with the development of this EIS are described herein.

JANUARY 2001 The Open Access Permitting Subcommittee (OAPS) of the Strategic Plan Oversight Committee (SPOC) had its first meeting via teleconference on January 18, 2001. The OAPS initially identified two fishery strategies wherein open access vessels were directly targeting groundfish: directed hook-and-line fisheries and directed setnet fisheries. Additionally, the OAPS identified the following gear types as being used to take groundfish incidentally in the open access fisheries: exempted trawl gear (non-groundfish trawl gear), salmon troll, halibut longline, non-directed setnet fisheries. The OAPS also noted that several of these fisheries are geographically distinct, which should be taken into account when developing initial permitting and allocation strategies. Finally, the OAPS recommended that the Council form a policy group to explore developing a restricted access program for the open access fisheries.

APRIL-MAY 2001 At the April 2001 Council meeting, the Council provided guidance for the SPOC on capacity reduction issues, but only briefly discussed license limitation in the open access fisheries. The OAPS met in April 2001 and the SPOC in May 2001, with both groups providing minutes to the Council at the Council's June 2001 meeting. At this meeting, the OAPS discussed setting a priority for introducing permitting for the directed fisheries for groundfish, with permitting for the incidental fisheries being a lower priority. The OAPS also reviewed Dr. James Hastie's "Analysis of Open Access Fishery," an analysis of groundfish landings data, which provides a profile of groundfish catches occurring in the open access fisheries (Hastie 2001). Following this review of Hastie's fleet profile, the OAPS composed six questions that it felt the Council should consider before embarking on a permitting program for the directed open access fisheries. OAPS recommendations from this meeting were reviewed by the SPOC at its May 2001 meeting, but the SPOC made no recommendations on this issue other than that the OAPS material should be provided to the Council and public at the June 2001 Council meeting.

JUNE 2001 At the June 2001 Council meeting, the Council discussed the results of the meetings of the OAPS and the SPOC and the various priority actions in the Strategic Plan. During Council discussions, members of the Council recommended that the Council proceed first with developing a directed groundfish permit for those vessels currently in the open access fisheries that target groundfish directly, and then look at fisheries that take groundfish incidentally. Council members further commented that one of the most important issues in considering a license limitation program for the open access fisheries is allocation between the different fisheries. There was some concern from Council members that this program might take too much time in an already overburdened schedule. The Council's Groundfish Advisory Subpanel (GAP) also commented on this issue at this meeting, noting that limiting access in the open access fisheries will take a lot of time and effort and that the states are already proceeding with license limitation in their nearshore fisheries. However, both of the open access fishery representatives on the GAP were in favor of proceeding with license limitation for the open access fisheries.

JULY - AUGUST 2001 The OAPS met on July 31, 2001 to discuss the Council's recommendations from their June meeting. At that meeting, the OAPS reviewed Dr. Hastie's analysis of historical fishing activities within the open access fleets, discussed whether the states could help with developing this program by providing state-level profiles of their open access fisheries, discussed whether it would be more or less complicated to include fisheries that incidentally take groundfish in the whole-fleet profile, discussed whether the program should include an allocation between directed and incidental open access groundfish fisheries, and provided outlines of nearshore groundfish management off each of the three states. The SPOC met on August 30, 2001, and discussed all of the Strategic Plan's priorities, including license limitation in the open access fisheries and the July OAPS meeting. The SPOC made the following recommendations for the Council's consideration at its September meeting: Council staff's Executive Director to provide a report on funds available for Strategic Plan implementation at the Council's October/November meeting; a meeting of the OAPS should be held after the October/November meeting; Dr. Hastie should continue development of an historical analysis of participation and catch in open access fisheries; the SPOC will re-consider whether to develop an incidental groundfish permit (for non-targeting open access fisheries) after the historical analysis is complete.

SEPTEMBER 2001 The Council discussed the results of the OAPS and SPOC meetings held over the summer, but did not address open access license limitation beyond recommending that the OAPS hold another meeting after the October/November Council meeting. The Council's GAP commented only that work on this issue should be delayed until after the October/November Council meeting.

JANUARY 2002 The OAPS met January 30-31, 2002 and reviewed the FMP's goals for the original limited entry fishery, modifying it for license limitation in the open access fisheries so that it reads, "The primary objective of the limited entry program will be to match harvest capacity in the West coast groundfish fishery with the productivity of the resource." The OAPS also detailed objectives for a new license limitation program: to allow sustainable prosecution of fisheries for non-groundfish species without groundfish waste; and to set qualification criteria for a license limitation program high enough to reduce the number of vessels being licensed, then to bring both the current open access harvest allocations and the newly licensed vessels into the limited entry program. The OAPS also provided further data requests to NOAA Fisheries analysts for dividing historical open access landings data by fishery, geographic area, and gear type.

MARCH 2002 At its March 2002 meeting, the Council discussed Strategic Plan implementation, including license limitation in the open access fisheries. The OAPS report to the March Council meeting was intended to be a draft report, with the final available at the April 2002 Council meeting.

APRIL 2002 During its April 2002 meeting, the Council again discussed Strategic Plan implementation, with a more full report from the OAPS January meeting. At this meeting, a Council member recommended including a qualification criteria option proposed by a member of the public: that open access vessels be allowed to join the limited entry fishery based on landings made by gears other than the three limited entry gears (trawl, fishpot, longline) during the limited entry qualifying period of 1984-1988. At this meeting, the GAP commented only that the issues and alternatives associated with open access license limitation had not been fleshed out well enough for a comprehensive analysis on the effects of a new license limitation program.

<u>NOVEMBER 2002</u> At its November 2002 meeting, the second anniversary of the Council's adoption of the Strategic Plan, the Council reviewed all of its Strategic Plan priorities. On the issue of open access license limitation, the Council recommended that an open access permitting development team meet to develop options for a moratorium permit for directed open access groundfish fisheries. Permits would be based on minimum historic participation, non-transferable, renewable, interim until a formal limited entry program were developed. At this meeting, the Council's Groundfish Management Team (GMT) commented that converting the directed open access fishery to a limited entry fishery has been a priority of the GMT for many years; however, the GMT also noted that there were ongoing state efforts to limit commercial groundfish fisheries participation. With state license limitation programs in place, only groundfish occurring outside of the three-mile state boundary, primarily sablefish and southern slope rockfish, would remain directed open access fisheries. Finally, the GMT noted that converting open access vessels to a permitted fleet would offer other management benefits, particularly because it would allow managers and enforcement agencies to better identify fleet participants for vessel monitoring system and observer program coverage. The GAP noted the state license limitation efforts could reduce open access directed groundfish fisheries participation coastwide and recommended that the Council continue regular meetings of its OAPS.

<u>*Public Issues and Concerns Raised Through Public Scoping*</u>

<u>APRIL - MAY 2001</u> The Council held a discussion and public comment session at its April 2001 meeting for the activities of the SPOC, which included discussions of license limitation for the open access fisheries. Public comment during that session included: an offer by a non-profit organization to create a fleet effort profile of where fishing activities take place; concern expressed that reduction of the groundfish fleet as a whole would require allocation between different users; observation that, under the Strategic Plan, all sectors of the fleet are to be reduced by 50%; comment that Council's current advisory committee structure might not be the most useful for moving the Council forward through SPOC priorities. Public comment at the May 2001 SPOC meeting was limited to a request that OAPS materials be provided to the Council's advisory bodies and the public prior to the June Council meeting.

<u>JUNE 2001</u> During the public comment session at the Council's June 2001 meeting, public comment addressed open access fisheries license limitation: participation in the open access fisheries be not merely capped, but be reduced by 50%, as recommended in the Strategic Plan; if effort is only capped in the open access fisheries, not reduced, groundfish trip limits will remain at such low levels that groundfish will not provide reasonable income levels for participants; people come and go in open access fisheries all the time, many part-timers get involved who then fail; a license limitation program will be politically challenging for the Council and the fishing communities, but it is essential nevertheless; permits should be issued to vessels, rather than to persons as is done in the California nearshore plan; qualification criteria should be sufficiently high enough to cut the fleet down to about 300-350 boats, with consideration for the years before the control date, 1994-1999, perhaps some combination of annual or cumulative landings levels along with participation in at least 4 out of 6 years, or similar; salmon fishermen do encounter groundfish and they would like to continue to have access to groundfish, regardless of how the open access license limitation program comes out, perhaps by limiting groundfish take by allowing so many pounds of groundfish per pounds of salmon taken.

<u>JULY - AUGUST 2001</u> Public comment at the OPAS meeting in July 2001: why is the OPAS considering accommodating directed groundfish fishing in the open access fisheries when those vessels never

qualified for the original limited entry permit? Allocation of open access groundfish harvest levels between the directed and incidental open access sectors will result in lower landings limits for all and result increases in discards. Latent capacity will result from this program because Council will be permitting vessels that never had much of a participation level, and then you'll have to figure out how to get those vessels out of the fishery. Members of the public attending the August 2001 SPOC meeting did not comment on open access license limitation issues.

SEPTEMBER 2001 - MARCH 2002 At the September 2001 Council meeting, the public did not have specific recommendations on license limitation in the open access fishery, although there were comments on other aspects of the Strategic Plan. Similarly, the public did not specifically provide comments on open access license limitation at the March Council meeting, except that one commenter expressed disappointment that capacity reduction issues seem to be falling lower and lower on the Council's priority list.

APRIL 2002 Public comments at the April 2002 Council meeting on license limitation for the open access fisheries: knowing the time it took to implement the original limited entry permit program, it doesn't seem possible to implement a new license limitation program for another five years; if there's going to be a new license limitation program for the boats now in the open access fisheries, all of the fish allocated to the open access fisheries with the original limited entry program should be shifted to the limited entry fisheries; failing to eliminate the open access fishery in 1994 was a mistake and fixing it with another limited entry program would be a bigger mistake – the Council should consider the option of closing the directed portion of the open access fleet by 2004, allocating the necessary portion of the open access quota to the open access incidental fisheries and redistribute the remainder of the open access quota to the existing limited entry fleet and recreational fisheries; coupled with the alternative of eliminating the directed open access fleet altogether would be an FMP amendment that would allow vessels using gears other than the three limited entry gears to purchase a limited entry permit and convert that permit's gear endorsement to their non-limited entry gear, additionally, new "A" permits should be issued to groundfish targeting vessels that met the original limited entry qualifying criteria during the qualifying period with gear other than the three limited entry gears; finally, the goals and objectives that you've set for yourself cannot be met with limited entry programs and trip limit management alone.

NOVEMBER 2002 At the November 2002 Council meeting, the public did not have specific recommendations on license limitation in the open access fishery, although there were comments on other aspects of the Strategic Plan.

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DRAFT

Federal Register / Vol. 65, No. 28 / Thursday, February 10, 2000 / Proposed Rules 6577

for one area might be different from those in another area.

Comments Requested

The Council and the Commission are particularly interested in answers to the following questions:

(1) Should there be a limited entry or controlled access system in the Atlantic herring fishery?

(2) If there is a limited entry or controlled access system, should it be adopted for the entire fishery or only for certain management areas?

(3) When should the limited entry or controlled access system become effective? Should it become effective on different dates in different areas?

(4) In a limited entry or controlled access system, what type of qualification criteria should be used to determine who receives a limited entry permit? For example, should permits be issued based on past landings or on a vessel holding another permit?

(5) If past landings are used to determine who qualifies for a permit, what should the level of landings be to qualify? What is the appropriate time period to be examined?

(6) What types of permit categories should be considered? For example, should there be directed fishery permits and incidental catch permits, or different permits for different gear types?

(7) Should permits be freely transferable, or should they be subject to limits?

(8) Should there be upgrading restrictions on permits?

(9) What other management measures, if any, should be included in the limited entry or controlled access system? For example, should days-at-sea limits, trip limits, or gear restrictions be used to further control effort?

(10) Should an individual quota system be part of the controlled access program? (Under current law, an individual quota system may not be submitted to the Secretary for approval and implementation before October 1, 2000.) If an individual quota system is considered,—

(a) How should individual fishing quotas be allocated?

(b) Should they be allocated to vessels, individuals, or communities?

(c) Should there be limits on the transferability of individual fishing quotas?

(d) Should there be limits on how much quota can be obtained by one permit holder?

(e) How should present and historical participation in the fishery be considered?

(f) If an individual fishing quota program is developed, how should effective enforcement, management, and observer coverage be provided, and how should fees to recover actual enforcement and management costs be structured?

(g) If an individual fishing quota is developed, how should a portion of the annual harvest be allocated to entry level fishermen, small vessel owners, and crew members who do not qualify for individual quotas?

(11) What communities do you think would be most affected by a limited entry program for Atlantic herring? How would they be affected?

(12) What social and/or cultural factors within these communities should the Council consider when developing a limited access program for Atlantic herring?

(13) What do you think are the potential social impacts (negative and/or positive) of a limited access program for Atlantic herring?

Scoping Process

All persons affected by or otherwise interested in herring fisheries management are invited to participate in determining the scope and significance of issues to be analyzed by submitting written comments (see **ADDRESSES**) or by attending one of the scoping hearings. Scope consists of the range of actions, alternatives, and impacts to be considered. Alternatives include the following: Not amending the management plan (taking no action), developing an amendment that contains such management measures as the ones previously mentioned in this notice, or other reasonable courses of action. Impacts may be direct, individual, or cumulative. The scoping process will also identify and eliminate from detailed study issues that are not significant. If, after the scoping process is completed, the Council proceeds with the development of an amendment to the FMP, the Council will prepare an SEIS or Environmental Assessment, as appropriate, depending on the nature of the amendment to be developed. The Council and the Commission will hold public hearings to receive comments on the draft amendment and on the analysis of its impacts on the human environment.

Public Hearing Schedule

The Council and the Commission will discuss and take scoping comments at public meetings as follows:

Tuesday, February 22, 2000, 7 p.m., Cape May County Extension Office, 355 Courthouse–South Dennis road, Cape May Courthouse, New Jersey. Telephone (609) 465–5115.

Wednesday, February 23, 2000, 1 p.m., Trade Winds Hotel, 2 Park Drive, Rockland, ME 04841. Telephone (207) 596–6661.

Thursday, February 24, 2000, 3 p.m., Radisson Airport Hotel, 2081 Post Road, Warwick, RI 02886. Telephone (401) 739–3000.

Tuesday, February 29, 2000, 3 p.m. King's Grant Inn, Trask Road, Route 128, Exit 21N, Danvers, MA 01923. Telephone (978) 774–6800.

Special Accommodations

The meetings are physically accessible to people with disabilities. Requests for sign language interpretation or other auxiliary aids should be directed to Paul J. Howard (see **ADDRESSES**) at least 5 days prior to this meeting date.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: February 4, 2000.

Bruce C. Morehead,

Acting Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. 00–3005 Filed 2–9–00; 8:45 am]

BILLING CODE 3510–22–F

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 660

[Docket No. 000124018–0018–01; I.D. 122999A]

RIN 0648–AN38

Fisheries off West Coast States and in the Western Pacific; Pacific Coast Groundfish Fishery; Advance Notice of Proposed Rulemaking to Establish a Control Date

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Advance notice of proposed rulemaking; request for comments.

SUMMARY: The Pacific Fishery Management Council (Council) is considering management measures to reduce harvest capacity in the open access portion of the Pacific Coast groundfish fishery in Federal waters off Washington, Oregon, and California. NMFS has previously made a similar announcement relating to the limited entry and recreational portions of the fishery. This document announces a control date for the open access portion of November 5, 1999, and is intended to promote awareness of potential eligibility criteria for future access to the

open access portion of the Pacific Coast groundfish fishery. The announcement is intended to discourage new entries into this fishery and increased fishing effort based on economic speculation while the Council contemplates whether and how access should be controlled.

Vessels entering the fisheries after November 5, 1999, may be subject to restrictions different from those that apply to vessels in the fishery prior to November 5, 1999. If catch history is used as a basis for future participation or allocation, it is likely that participation in the fishery after November 5, 1999, would not count toward future allocations or participation in a limited access scheme. Because potential eligibility criteria for future management measures may be based on historical participation, fishery participants may need to preserve records that substantiate and verify their participation in the groundfish fishery in Federal waters.

DATES: Comments may be submitted in writing by March 13, 2000.

ADDRESSES: Comments may be mailed to Jim Lone, Chairman, Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland OR 97201.

FOR FURTHER INFORMATION CONTACT: The Pacific Fishery Management Council at 503–326–6352; or Bill Robinson at 206–526–6140; or Svein Fougner at 562–980–4000.

SUPPLEMENTARY INFORMATION: The Pacific Coast Groundfish Fishery Management Plan (FMP) was approved on January 4, 1982 (47 FR 43964, October 5 1982), and has been amended 11 times. Implementing regulations for the FMP and its amendments are codified at 50 CFR Part 660. On November 16, 1992, NMFS published final regulations implementing Amendment 6 to the FMP. Amendment 6 and its implementing regulations established a license limitation program and divided the Pacific Coast commercial groundfish fishery into limited entry and open access segments. The limited entry fishery is comprised of permitted vessels using trawl, longline and/or trap (pot) gear. The open access fishery is comprised of unpermitted vessels that use all other gear, as well as vessels that do not have limited entry permits endorsed for use of longline or trap gear but make small landings with longline or trap gear.

NMFS had previously made an announcement that the Council is considering additional management measures to further limit harvest capacity or to allocate between or within the limited entry commercial and the recreational groundfish fisheries. In order to discourage fishers from intensifying their fishing efforts for the purpose of amassing catch history for any allocation or additional limited access program developed by the Council, the Council announced on April 9, 1998, that any program would not include consideration of catch landed after that date. NMFS announced that the Council was planning to consider catch history through the 1997 season (63 FR 53637, October 6, 1998).

At its April 1999 meeting, the Council reviewed a proposal to create a limited entry program to limit new entrants into the open access fishery. At this same meeting, the Council's Groundfish Advisory Subpanel (GAP) encouraged the Council to move toward the development of an individual quota (IQ) program for the limited entry and open access fisheries as a means of managing harvest capacity. Under Section 303(d)(1)(A) of the Magnuson-Stevens Fishery Conservation and Management Act, the Council cannot submit recommendations for an IQ program to the Secretary of Commerce before October 1, 2000, however, the Council is not prohibited from developing such a program.

At its June 1999 meeting, the Council further examined the proposal to create a limited entry program to limit new entrants into the open access fishery. Members of the Council expressed concerns that restricting new entrants into the fishery would not adequately address harvest capacity concerns. Even though the need to limit new entrants into the open access fleet was recognized, this measure did not go forward for further development. Limited access and participation in the open access fisheries were further discussed at the November 1999 Council meeting, resulting in this document.

Because the document published on October 6, 1998, refers specifically to management measures to restrain harvest capacity in the limited entry fishery, the Council saw a need to establish a control date for the open access fishery while management measures to restrain harvest capacity throughout the entire groundfish fishery are being considered. At its November meeting, the Council unanimously recommended that a control date of November 5, 1999, be established and the public be notified that the Council is considering the need to impose additional management measures to restrain harvest capacity in the open access fishery. The Council announced this control date for the open access portion of the Pacific Coast groundfish fishery in its November 1999 newsletter. The newsletter was distributed to the public in the middle of November.

Vessels entering the fishery after November 5, 1999, may be subject to restrictions different from those that apply to vessels in the fishery prior to November 5, 1999. If catch history is used as a basis for participation or allocation, it is likely that participation in the fishery after the control date would not count toward future allocations in a limited access scheme. Fishers are not guaranteed future participation in the groundfish fishery, regardless of their date of entry or level of participation in the fishery.

This action does not commit the Council to develop any particular management regime or to use any specific criteria for determining entry to the fishery. The Council may choose a different control date, or may choose a management program that does not make use of such a date.

Implementation of any management measures for the fishery will require amendment of the regulations implementing the FMP, and may require amending the FMP. Any action will require Council development of a regulatory proposal with public input and a supporting analysis, NMFS approval, and publication of implementing regulations in the **Federal Register**.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: February 4, 2000.

Penelope D. Dalton,

Assistant Administrator for Fisheries, National Marine Fisheries Service.

[FR Doc. 00–3150 Filed 2–9–00; 8:45 am]

BILLING CODE 3510–22–F

Exhibit D.15
Situation Summary
November 2003

OPEN ACCESS LIMITATION DISCUSSION AND PLANNING

Situation: Conversion of the current open access groundfish fishery to a limited entry management system has been a Council priority since development of the groundfish strategic plan. As with many management issues needing Council attention, work on this issue has been delayed due to other high priority issues in front of the Council.

Recent Progress: This summer, based on the groundwork laid by the Ad Hoc Groundfish Strategic Plan Implementation Oversight Committee (SPOC) Open Access Conversion Subcommittee, National Marine Fisheries Service (NMFS) staff lead a joint Council/NMFS working session to identify key issues and concerns that would need to be addressed in developing a plan amendment for conversion of the open access fishery. Based on these discussions, the NMFS staff began initial drafting of an Environmental Impact Statement (EIS) to support deliberations on this issue. The first chapter of that document is provided here as background information (Exhibit D.15, Attachment 1 - Purpose and Need).

Origin of the Open Access Fleet: In 1994, when the license limitation program was implemented for vessels using groundfish trawl, longline, and fishpot gear; vessels not qualifying for permits were allowed to continue fishing in an "open access" segment of the fishery. This open access fishery was allocated a small portion of the groundfish quota. Nonlicensed vessels are allowed to fish against that quota with any gear except groundfish trawl gear. Vessels with limited entry permits are allowed to use any nontrawl gear for which they are not licensed, however, their catch counts against the limited entry quota and they are restricted to trip limits that apply for vessels using the gear in the open access fishery.

Control Dates: Control dates put fishermen on notice that landings after the control date may not be counted toward qualification for a limited entry program. Control dates for license limitation programs are intended to discourage increased participation during deliberation on the new program. Increased participation during deliberations can deteriorate conditions in the fishery. Additionally, if new entrants must be given permits, the effectiveness of the license limitation program would be decreased. By announcing a control date, it is easier to justify not including new entrants among those receiving a permit in the initial allocation. If the Council begins to establish a pattern of announcing but not using control dates, the value of control dates in discouraging future entry may be diminished. In the extreme, the first announcement of a control date could start to have the opposite of the intended effect, becoming a signal to start fishing harder. Control dates do not require the Council to not consider landings after the date, but provide the Council with a more defendable position if it should decide to do so. The current control date for the open access fishery is November 5, 1999 (Exhibit D.15, Attachment 2 - Control Date).

Scope: The SPOC Open Access Subcommittee has recommended the open access fleet be divided into a directed segment and an incidental harvest segment. For the purpose of analysis, the directed landings have been identified as those landings in which the majority of trip revenue is from groundfish. Another approach has been to use 50% of weight. Early on in the development of this program, it will be important to decide if one of these criteria or some other criteria should be used to determine which vessels must hold a limited entry permit when making a landing with groundfish in it.

Council Task:

1. **Discuss priority and possible next steps for conversion of the open access fishery to limited entry.**

Reference Materials:

1. Exhibit D.15, Attachment 1 - Purpose and Need: Preliminary Draft Chapter 1 for Open Access EIS.
2. Exhibit D.15, Attachment 2 - Control Date: *Federal Register* notice on control date for the open access fishery, 65(28)6577-6578.

Agenda Order:

a. Agendum Overview — Jim Seger
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. Council Discussion and Guidance in Planning Future Open Access Limitation Actions

PFMC
10/22/03

Exhibit D.1.a
Supplemental Letter from Robert Lohn
November 2003

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

OCT 21 2003

1504-13-WOC-OB-010

RECEIVED
OCT 23 2003
PFMC

Mr. Donald Hansen, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place
Portland, OR 97220

Dear Mr. ~~Hansen~~ Don:

Based on new information obtained since the September 8-12, 2003 Pacific Fishery Management Council (Council) meeting, I have decided not to implement the Council's recommendation to increase commercial minor deeper nearshore rockfish trip limits inseason south of 40°10' N. lat in the Pacific Coast groundfish fishery. As you'll recall, the Council recommended the increase because commercial landings of minor deeper nearshore rockfish south of 40°10' N. lat. were lower than expected in 2003. Subsequent to the Council meeting, the Groundfish Management Team (GMT) held a meeting in Seattle, WA, October 14-16, 2003. The GMT discussed new information from the Recreational Fisheries Information Network (RecFIN) at that meeting. The RecFIN data showed that landings of minor nearshore rockfish (which includes minor deeper nearshore rockfish[1]) in the recreational fishery south of 40°10' N. lat. during July and August, the first two months open to recreational groundfish fishing, have exceeded the projected recreational landings of minor nearshore rockfish for the remainder of the year. The GMT raised concerns over the accuracy of RecFIN's catch estimates, since the estimates for July and August were substantially higher than in recent years and has requested that the RecFIN program review its estimates reported for the 2003 California recreational fishery.

While landings in the commercial sector south of 40°10' N. lat. continue to remain lower than expected in 2003 (landed catch data through October 10, 2003, indicate that minor deeper nearshore rockfish catch was at 44 percent of the annual target– 21 mt landed out of a 48 mt commercial total catch OY), combined recreational and commercial landings are still estimated to have exceeded the minor nearshore harvest guideline, even if RecFIN estimates are adjusted downward. The state of California intends to close recreational fishing for nearshore rockfish at the beginning of November.

---

[1] As you know, minor deeper nearshore rockfish are managed within an overall harvest guideline for minor nearshore rockfish. The minor nearshore rockfish harvest guideline is shared between the commercial and recreational sectors. In addition, the minor nearshore rockfish harvest guideline is included as a subset of the minor rockfish OY. There are two minor rockfish OYs, one for the area north of 40°10' N. lat. and one for the area south of 40°10' N. lat.

In light of this new information, I can no longer concur with the Council's September recommendation to increase minor deeper nearshore rockfish trip limits for the commercial sector (limited entry fixed gear and open access) south of 40°10' N. lat. The National Marine Fisheries Service (NMFS) will implement all of the groundfish inseason actions recommended at the September Council meeting, except for the recommendation to increase minor deeper nearshore rockfish trip limits. Minor deeper nearshore rockfish limits for limited entry fixed gear and open access fisheries south of 40°10' N. lat. will remain as previously scheduled for the remainder of the September through October cumulative limit period at 300 lb per 2 months. During the months of November through December, the limited entry fixed gear and open access minor deeper nearshore rockfish limit south of 40°10' N. lat. will also remain as previously scheduled at 200 lb per 2 months.

In the interim before the November Council meeting in San Diego, CA, NMFS will review any additional information on the nearshore rockfish fishery and may take inseason action to conform with the state of California's closure of the recreational fishery. Any further adjustments to the nearshore rockfish fisheries will need to be discussed in more detail during the agenda item on inseason groundfish management at the upcoming November Council meeting.

Sincerely,

William L Robinson

for D. Robert Lohn
Regional Administrator

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic Atmospheric Administration
National Marine Fisheries Service
Sustainable Fisheries Division
7600 Sand Point Way N. E., Building. 1, Bin C15700
Seattle, WA 98115-0070

DATE: October 30, 2003

TO: DISTRIBUTION

FROM: F/NWR2 -Becky Renko

SUBJECT: PRELIMINARY Report #9 -- 2003 Pacific Whiting Fishery

This report consolidates preliminary state, federal, and tribal data for the 2003 Pacific whiting fishery off Washington, Oregon, and California.

	Allocation		Catch * (mt)	Thru [date]	Status of Primary season	Percent of allocation taken
	Percentages	Metric Tons				
California (south of 42° N lat.)	(5% shore alloc'n; included in WOC shore allocation)	2,545	1,741	9/13	CA season started April 1; 5% alloc'n	
Oregon	--	NA	36,576	9/13		
Washington	--	NA	12,901	9/13		
WOC shoreside	42% commercial OY	**50,904**	51,218		started 0001 hrs 6/15/03 ended noon 7/14/03	100.6%
Mothership (n. of 42 ° N. lat.)	24% commercial OY	**29,088**	26,021	6/7	started 0001 hrs 5/15/03	89.5%
Catcher/processor (n. of 42 ° N. lat.)	34% commercial OY	**41,208**	41,210	10/24	started 0001 hrs 5/15/03 ended noon 10/24/03	100.0%
Total nontribal	the commercial OY is 82% of the total catch OY	121,200	118,449		--	97.7%
Tribal (Makah)	17% of the total catch OY	**25,000**	22,274	9/1	started 6/13/03	89.1%
Total directed fishing		146,200	140,723			96.3%
Other (research & incidental catch in non-groundfish fisheries)	1% of the total catch OY	**2,000**	unknown at this time			
Total	OY=optimum yield	148,200	140,723	--	--	95.0%

* Catch includes discards from at-sea processors; weigh-backs from shore-based catcher vessels; and small amounts landed under the trip limit between the seasons. The data for at-sea processing (catcher/processors and motherships) are preliminary and are based on reports from NMFS-certified observers. Data for shoreside processors also are preliminary and are provided by each State to NMFS for the purpose of monitoring the fishery. If you have questions on shoreside landings, please contact the appropriate state fishery management agency. Preliminary data for the Makah fishery is from NMFS-trained observers and shore-based samplers. All weights are round weight (the weight of the whole fish before processing) or round-weight equivalents. One metric ton is 2,204.6 pounds.

Exhibit D.1.a
Supplemental NMFS Report 2
November 2003

from the NVCASE Program Manager at the contact information noted above. Further information for the evaluation process can be obtained from the NVCASE Program Handbook, NISTIR 6440; 2002 ED, available at *http://ts.nist.gov/nvcase*. The fees are estimated upon submission of the application on an individual basis. NIST will announce the recognition of qualified accreditation bodies on the NVCASE web site at *http://ts.nist.gov/nvcase*.

This notice contains a collection of information requirement subject to the Paperwork Reduction Act. This collection of information has been approved by the Office of Management and Budget (OMB) under the following control Number: 0693–0019. Notwithstanding any other provision of law, no person is required to respond nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act unless that collection of information displays a currently valid OMB Control Number.

Dated: October 28, 2003.

Arden L. Bement, Jr.,

Director.

[FR Doc. 03–27606 Filed 11–3–03; 8:45 am]

BILLING CODE 3510–13–U

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[Docket No. 030509119–3269–03; I.D. 103003B]

Magnuson-Stevens Act Provisions; Fishing Capacity Reduction Program; Pacific Coast Groundfish Fishery; California, Washington, and Oregon Fisheries for Coastal Dungeness Crab and Pink Shrimp

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration, Commerce.

ACTION: Notice of fishing capacity reduction payment tender.

SUMMARY: NMFS issues this notice to inform the public about tendering reduction payments under the Pacific Coast groundfish fishing capacity reduction program. NMFS has accepted reduction bids. A successful referendum has approved the reduction loan repayment fees. NMFS is ready to tender reduction payments to accepted bidders.

ADDRESSES: Send questions about this notice to Michael L. Grable, Chief, Financial Services Division, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3282.

FOR FURTHER INFORMATION CONTACT: Michael L. Grable, (301) 713–2390.

SUPPLEMENTARY INFORMATION:

I. Background

Congress enacted the Pacific Coast groundfish fishing capacity reduction program ("program") on February 20, 2003. The program's objective is reducing the fishery's harvesting capacity. This helps financially stabilize this limited-entry fishery.

NMFS implemented the program by **Federal Register** notification. It published the initial notification on May 28, 2003 (68 FR 31653) and the final notification on July 18, 2003 (68 FR 42613). Persons wanting further program details should refer to these notifications.

This is a voluntary program. Program participants permanently relinquish their fishing permits. Their vessels can never fish again. The Program also involves the California, Washington, and Oregon fisheries for Dungeness crab and pink shrimp. Bidders who have these permits relinquish them along with their groundfish trawl permits.

The program's maximum cost is $46 million. A 30-year loan finances $36 million. Future fish landing fees repay the loan. Each of the seven fisheries involved pays fees at different rates. Congress appropriated the remaining $10 million of the program's cost.

Groundfish permit holders bid for reduction payments. NMFS scores each bid amount against the bidder's past ex-vessel revenues. A reverse auction accepts bids whose amounts are the lowest percentages of revenues. This creates reduction contracts.

A referendum about the fees follows the bidding process. The reduction contracts become void unless the majority of votes cast in the referendum approve the fees. All seven fisheries vote in the referendum. A statutory formula assigns different weights to each fishery's votes.

II. Present Status

NMFS invited program bids on July 18, 2003. The bidding period opened on August 4, 2003, and closed on August 29, 2003. One hundred eight groundfish permit owners submitted bids. These totaled $59,786,471. NMFS accepted 92 bids. These totaled $45,752,471. The next lowest scoring bid would have exceeded the program's maximum cost. The accepted bids involved 92 fishing vessels as well as 240 fishing permits. Ninety two of the permits were groundfish trawl permits. One hundred twenty one were crab and shrimp permits. The remaining 27 were other Federal permits.

NMFS mailed ballots to referendum voters on September 30, 2003. The voting period opened on October 15, 2003. It closed on October 29, 2003. NMFS received 1,105 timely votes. After weighting, 85.85 percent of the votes approved the fees. The referendum was successful. The reduction contracts are in full force and effect.

III. Purpose

NMFS publishes this notification to inform the public before tendering reduction payments to the 92 accepted bidders. On December 4, 2003, accepted bidders must permanently stop all further fishing with the reduction vessels and permits. NMFS will revoke the relinquished Federal permits. NMFS will advise California, Oregon, and Washington about the relinquished state permits. NMFS will notify the National Vessel Documentation Center to revoke the reduction vessels' fisheries endorsement. NMFS will also notify the U.S. Maritime Administration to restrict these vessels' transfer to foreign ownership or registry.

This notification begins the 30-day period and puts the public (including vessel or permit creditors) on notice. See the adjacent table for accepted bidders, vessels, and permits.

IV. Accepted Bidders, Vessels, and Permits

Accepted bidder	Vessel		Permit	
	Name	Official No.	Fishery	Number
AMBITION, INC	EUROCLYDON	913987	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0636
AMBITION, INC	EUROCLYDON	913987	SHRIMP in CA	41581
AMBITION, INC	EUROCLYDON	913987	SHRIMP in OR	90107
AMBITION, INC	EUROCLYDON	913987	SHRIMP in WA	57343

Accepted bidder	Vessel		Permit	
	Name	Official No.	Fishery	Number
AMY LYNN FISHERIES, INC	AMY LYNN	616194	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0415
AMY LYNN FISHERIES, INC	AMY LYNN	616194	HIGH SEAS in HSF	616194
AMY LYNN FISHERIES, INC	AMY LYNN	616194	SHRIMP in WA	57505
AMY LYNN FISHERIES, INC	AMY LYNN	616194	CRAB in WA	58177
AMY LYNN FISHERIES, INC	AMY LYNN	616194	SHRIMP in OR	90100
ANDERSON, MICHAEL B	PACIFIC MAID	973740	ENDORSEMENT WITH TRAWL GEAR IN NWR.	GF0267
ANDERSON, MICHAEL B	PACIFIC MAID	973740	SHRIMP in CA	43150
ANDERSON, MICHAEL B	PACIFIC MAID	973740	CRAB in CA	43150
B & J FISHERIES, INC	CAPTAIN WES	508593	ENDORSEMENT WITH TRAWL GEAR IN NWR.	GF0047
B & J FISHERIES, INC	CAPTAIN WES	508593	SHRIMP in CA	32867
B & J FISHERIES, INC	CAPTAIN WES	508593	SHRIMP in OR	90027
BERGERSON, DARRYL	SARA FRANCES	245569	ENDORSEMENT WITH TRAWL GEAR IN NWR.	GF0368
BERGERSON, DARRYL	SARA FRANCES	245569	HIGH SEAS in HSF	245569
BERGERSON, DARRYL	SARA FRANCES	245569	SHRIMP in OR	90180
BISCHOP, DONALD D AND BISCHOP, CHARMAINE	MERLUCCIUS	551451	ENDORSEMENT WITH TRAWL GEAR IN NWR.	GF0117
BISCHOP, DONALD D AND BISCHOP, CHARMAINE	MERLUCCIUS	551451	SHRIMP in CA	22888
BLUE PACIFIC BLUE FISHERIES, INC	BLUE HORIZON	598179	ENDORSEMENT WITH TRAWL GEAR IN NWR.	GF0079
BLUE PACIFIC FISHERIES, INC	BLUE HORIZON	598179	HIGH SEAS in HSF	598179
BOSCHKE, CHARLES A AND BOSCHKE, NANCY LEE	CARLA R	541450	HIGH SEAS in HSF	541450
BOSCHKE, CHARLES A AND BOSCHKE, NANCY LEE	CARLA R	541450	ENDORSEMENT WITH TRAWL GEAR IN NWR.	GF0217
BOY, GREG N AND BOY, SUSAN A	SUSAN NICOLE	605313	ENDORSEMENT WITH TRAWL GEAR IN NWR.	GF0330
BOY, GREG N AND BOY, SUSAN A	SUSAN NICOLE	605313	SHRIMP in OR	90104
BRADLEY, STEVEN W AND BRADLEY, JOELLE M	PACIFIC CRIER	517902	ENDORSEMENT WITH TRAWL GEAR IN NWR.	GF0442
BRADLEY, STEVEN W AND BRADLEY, JOELLE M	PACIFIC CRIER	517902	HIGH SEAS in HSF	517902
BRADLEY, STEVEN W AND BRADLEY, JOELLE M	PACIFIC CRIER	517902	CRAB in CA	18224
BRADSHAW, CALVIN W	DAPHNE	245872	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0444
BRADSHAW, CALVIN W	DAPHNE	245872	CRAB in CA	5773
BREEN, ROBERT AND DOHERTY, JOHN	JONATHAN	587508	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0743
BREEN, ROBERT AND DOHERTY, JOHN	JONATHAN	587508	SHRIMP in CA	43101
BRISCOE JR, ROBERT AND BRISCOE, CAROL	STARLIGHT	900453	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0738
BRISCOE JR, ROBERT AND BRISCOE, CAROL	STARLIGHT	900453	HIGH SEAS in HSF	900453
BRISCOE JR, ROBERT AND BRISCOE, CAROL	STARLIGHT	900453	CRAB in WA	59966
BROOK HARBOR INC	PAM BAY	509492	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0311
BROOK HARBOR INC	PAM BAY	509492	SHRIMP in CA	19663
BROOK HARBOR INC	PAM BAY	509492	CRAB in CA	19663
BROOK HARBOR INC	PAM BAY	509492	SHRIMP in OR	90040
BROWN, CHARLES S	FRIENDSHIP	562427	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0061
BROWN, CHARLES S	FRIENDSHIP	562427	HIGH SEAS in HSF	562427
BROWN, CHARLES S	FRIENDSHIP	562427	SHRIMP in WA	57545
BROWN, RALPH H AND STAGG, LINDA K	ALOMA	623611	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0193
BROWN, RALPH H AND STAGG, LINDA K	ALOMA	623611	SHRIMP in OR	90217
BURNS ENTERPRISES, INC	SLEEP ROBBER	591482	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0862
BURNS ENTERPRISES, INC	SLEEP ROBBER	591482	HIGH SEAS in HSF	591482
BURNS ENTERPRISES, INC	SLEEP ROBBER	591482	CRAB in OR	96013
BURNS ENTERPRISES, INC	SLEEP ROBBER	591482	SHRIMP in CA	44008
BURNS ENTERPRISES, INC	SLEEP ROBBER	591482	SHRIMP in OR	90187
CAL-ALASKA FISH, INC	RESTLESS C II	555025	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0237
CAPT JACK, INC	CAPT JACK	516976	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0028
CAPT JACK, INC	CAPT JACK	516976	SHRIMP in OR	90188
CAPT JACK, INC	CAPT JACK	516976	CRAB in OR	96469
CROWLEY, DANIEL T AND CROWLEY, DEBORAH E	CHEROKEE	264573	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0703
DMJ, INC	DAKOTA	246957	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0753

Accepted bidder	Vessel		Permit	
	Name	Official No.	Fishery	Number
EVANOW, KARL M	CAPTAIN BRADLEY	505444	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0660
EVANOW, KARL M	CAPTAIN BRADLEY	505444	SHRIMP in CA	24177
EVANOW, KARL M	CAPTAIN BRADLEY	505444	CRAB in CA	24177
EVANS, PHILLIP NORMAN AND EVANS, WANDA SUE.	KINCHEL'OE	240804	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0592
EVANS, TRAVIS O AND EVANS, KATHERINE R	SIERRA MADRE	522508	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0037
F/V CAITO BROS, INC	CAITO BROS	238136	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0067
F/V CAITO BROS, INC	CAITO BROS	238136	SHRIMP in CA	1
F/V CAITO BROS, INC	CAITO BROS	238136	CRAB in CA	1
F/V CHRISTIE R, INC	CHRISTIE R	553235	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0448
F/V GABRIELE, INC	GABRIELE	947061	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0554
F/V GABRIELE, INC	GABRIELE	947061	HIGH SEAS in HSF	947061
F/V GABRIELE, INC	GABRIELE	947061	CRAB in OR	96337
F/V GABRIELE, INC	GABRIELE	947061	CRAB in CA	42671
F/V GABRIELE, INC	GABRIELE	947061	SHRIMP in OR	90177
F/V HIGH SEA, INC	HIGH SEA	532504	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0535
F/V HIGH SEA, INC	HIGH SEA	532504	SHRIMP in CA	20308
F/V HIGH SEA, INC	HIGH SEA	532504	CRAB in CA	20308
F/V ROSE MARIE, INC	CATHERINE ANN	634144	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0970
F/V ROSE MARIE, INC	CATHERINE ANN	634144	SHRIMP in CA	38037
FEMLING, ARTHUR O AND FEMLING, ETHEL M	LUCKY STRIKE	254713	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0690
FINZER FISHING, INC	ST. JANET	516881	BERING SEA GROUND-FISH in AKR.	LLG1629
FINZER FISHING, INC	ST. JANET	516881	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0912
FINZER FISHING, INC	ST. JANET	516881	HIGH SEAS in HSF	516881
GALLAWAY, WILLIAM H	ALIBI	250516	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0483
GALLAWAY, WILLIAM H	ALIBI	250516	SHRIMP in CA	8435
GALLAWAY, WILLIAM H	ALIBI	250516	CRAB in CA	8435
GAVIN-YOUNG, GP	TWO SISTERS	572657	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0304
GAVIN-YOUNG, GP	TWO SISTERS	572657	SHRIMP in CA	28939
GAVIN-YOUNG, GP	TWO SISTERS	572657	CRAB in CA	28939
GAVIN-YOUNG, GP	TWO SISTERS	572657	SHRIMP in OR	90013
GHERA, MICHAEL J	AQUARIUS	250385	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0608
GHERA, MICHAEL J	AQUARIUS	250385	SHRIMP in CA	2633
GHERA, MICHAEL J	AQUARIUS	250385	CRAB in CA	2633
GUNNARI, ROY E AND GUNNARI, ALICE I AND GREEN, DONALD WESLEY.	BILLIE JEAN	505917	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0162
GUNNARI, ROY E AND GUNNARI, ALICE I AND GREEN, DONALD WESLEY.	BILLIE JEAN	505917	SHRIMP in OR	90022
HODGES, MICHAEL E	KANGAROO	501228	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0413
HODGES, MICHAEL E	KANGAROO	501228	SHRIMP in OR	90134
HODGES, MICHAEL E	KANGAROO	501228	CRAB in OR	96474
HODGES, MICHAEL E	BETTY A	526744	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0404
HODGES, MICHAEL E	BETTY A	526744	HIGH SEAS in HSF	526744
HODGES, MICHAEL E	BETTY A	526744	SHRIMP in OR	90096
HOLM, HERBERT L AND HOLM, PHILOMENA M	JO-ELLEN	507051	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0165
HUNTER, WILLIAM C AND HUNTER, G A	TRAVIS WM	645476	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0264
HUNTERS OFFSHORE ENTERPRISES, INC	EL CERRITO	242928	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0299
HUNTERS OFFSHORE ENTERPRISES, INC	DENNIS GAYLE	252763	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0259
HUNTERS OFFSHORE ENTERPRISES, INC	WINGA	238849	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0266
HUNTERS OFFSHORE ENTERPRISES, INC	WINGA	238849	CRAB in CA	6850
HUNTERS OFFSHORE ENTERPRISES, INC	ALLEN CODY	255400	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0258

Accepted bidder	Vessel		Permit	
	Name	Official No.	Fishery	Number
HUNTERS OFFSHORE ENTERPRISES, INC	OREGON FLYER	601255	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0260
JACKSON, ROBERT D AND JACKSON, SHIRLEY L	JOHN ALLEN	564289	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0097
JACKSON, ROBERT D AND JACKSON, SHIRLEY L	JOHN ALLEN	564289	CRAB in OR	96411
JACKSON, ROBERT D AND JACKSON, SHIRLEY L	JOHN ALLEN	564289	SHRIMP in OR	90055
JAMES, FRANK AND JAMES, SYLVIA	LIMIT STALKER	299016	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0817
JAMES, FRANK AND JAMES, SYLVIA	LIMIT STALKER	299016	SHRIMP in WA	58003
JAMES, FRANK AND JAMES, SYLVIA	LIMIT STALKER	299016	SHRIMP in OR	90195
JOHNSON, CARROLL R	OUTLAW	512922	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0474
JOHNSON, CARROLL R	OUTLAW	512922	SHRIMP in CA	19278
JOHNSON, CARROLL R	OUTLAW	512922	CRAB in CA	19278
KRIZ, MICHAEL L	MERRICK LYNN	600712	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0147
KRIZ, MICHAEL L	MERRICK LYNN	600712	SHRIMP in OR	90006
LARKIN, MARION	LARKIN	599703	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0135
LARKIN, MARION	LARKIN	599703	HIGH SEAS in HSF	599703
LARKIN, MARION	LARKIN	599703	SHRIMP in WA	59642
LICATA, FRANCESCO AND LICATA, CATERINA	GENERAL PERSHING	229344	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0531
LUDAHL JR, ERNEST LEROY	CC & GLORIA	505269	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0785
M/V STEPHANIE, INC	STEPHANIE	215869	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0575
MCGEE, WAYNE F	MI–LO	503972	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0742
MCLAUGHLIN, LYNNE S	CANDI B	600669	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0329
MCLAUGHLIN, LYNNE S	CANDI B	600669	SHRIMP in CA	32727
MISS LINDA FISHERIES, INC	MISS LINDA	944169	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0088
MISS LINDA FISHERIES, INC	MISS LINDA	944169	HIGH SEAS in HSF	944169
MISS LINDA FISHERIES, INC	MISS LINDA	944169	SHRIMP in CA	40924
MISS LINDA FISHERIES, INC	MISS LINDA	944169	SHRIMP in WA	57908
MISS LINDA FISHERIES, INC	MISS LINDA	944169	SHRIMP in OR	90205
MORRISON, THOMAS H	PACIFIC QUEEN	249564	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0034
NEW WASHINGTON FISHERIES, INC	NEW WASHINGTON	236389	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0153
NEW WASHINGTON FISHERIES, INC	NEW WASHINGTON	236389	HIGH SEAS in HSF	236389
NYHUS, RICHARD E AND NYHUS, TRINA M	CATHY G	538806	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0134
NYHUS, RICHARD E AND NYHUS, TRINA M	CATHY G	538806	SHRIMP in WA	57388
NYHUS, RICHARD E AND NYHUS, TRINA M	CATHY G	538806	SHRIMP in OR	90199
NYLANDER, CHERYL	SEA SIREN	588685	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0089
NYLANDER, CHERYL	SEA SIREN	588685	HIGH SEAS in HSF	588685
OLYMPIC FISHERIES, INC	OLYMPIC	590263	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0077
OLYMPIC FISHERIES, INC	OLYMPIC	590263	HIGH SEAS in HSF	590263
OLYMPIC FISHERIES, INC	OLYMPIC	590263	SHRIMP in WA	57984
OLYMPIC FISHERIES, INC	OLYMPIC	590263	SHRIMP in OR	90093
PACIFIC STORM, INC	PACIFIC STORM	604146	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0354
PACIFIC STORM, INC	PACIFIC STORM	604146	HIGH SEAS in HSF	604146
PACIFIC STORM, INC	PACIFIC STORM	604146	CRAB in OR	96412
PACIFIC STORM, INC	PACIFIC STORM	604146	SHRIMP in OR	90074
PACIFIC SUN FISHERIES, INC	PACIFIC SUN IV	558072	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0502
PACIFIC SUN FISHERIES, INC	PACIFIC SUN IV	558072	HIGH SEAS in HSF	558072
PACIFIC SUN FISHERIES, INC	PACIFIC SUN IV	558072	SHRIMP in WA	57453
PACIFIC SUN FISHERIES, INC	PACIFIC SUN IV	558072	CRAB in WA	59937
PACIFIC SUN FISHERIES, INC	PACIFIC SUN IV	558072	SHRIMP in OR	90165
PANDALUS, INC	GINNY & JILL	299098	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0045
PANDALUS, INC	GINNY & JILL	299098	CRAB in OR	96197
PANDALUS, INC	GINNY & JILL	299098	SHRIMP in CA	34788
PANDALUS, INC	GINNY & JILL	299098	SHRIMP in OR	90003

Accepted bidder	Vessel Name	Vessel Official No.	Permit Fishery	Permit Number
PARKER, DANNY D AND PARKER, SHERRIE R	SEA EAGLE	924174	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0455
PARKER, DANNY D AND PARKER, SHERRIE R	SEA EAGLE	924174	SHRIMP in OR	90125
PERSISTENCE FISHERIES, INC	PERSISTENCE	581823	ALEUTIAN ISLANDS GROUNDFISH in AKR.	LLG1663
PERSISTENCE FISHERIES, INC	PERSISTENCE	581823	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0255
PERSISTENCE FISHERIES, INC	PERSISTENCE	581823	SOUTHEAST OUTSIDE GROUNDFISH in AKR.	LLG1663
PERSISTENCE FISHERIES, INC	PERSISTENCE	581823	SHRIMP in OR	90128
PETTINGER, BRADLEY G	CASSIE	554975	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0822
PETTINGER, BRADLEY G	CASSIE	554975	SHRIMP in CA	36891
PETTINGER, BRADLEY G	CASSIE	554975	SHRIMP in OR	90224
PETTINGER, DAVID W	CHANTAL C	514043	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0558
PETTINGER, DAVID W	CHANTAL C	514043	CRAB in OR	96066
PETTINGER, DAVID W	CHANTAL C	514043	SHRIMP in OR	90139
PINTO, KEVIN AND PINTO, CAROL LEE	JENNA LEE	298016	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0085
POMILIA, VICTOR	SPIRIT OF '76	571021	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0312
POMILIA, VICTOR	SPIRIT OF '76	571021	SHRIMP in CA	27095
POMILIA, VICTOR	SPIRIT OF '76	571021	CRAB in CA	27095
POMILIA, VICTOR	SPIRIT OF '76	571021	SHRIMP in WA	60913
POMILIA, VICTOR	SPIRIT OF '76	571021	SHRIMP in OR	90228
RETHERFORD, MICHAEL S AND RETHERFORD, KELLEY S.	KELLEY GIRL	527001	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0253
RETHERFORD, MICHAEL S AND RETHERFORD, KELLEY S.	KELLEY GIRL	527001	SHRIMP in WA	59355
RETHERFORD, MICHAEL S AND RETHERFORD, KELLEY S.	KELLEY GIRL	527001	SHRIMP in OR	90133
RIPKA, GARY A AND RIPKA, SHERRI	PACIFIC BREEZE	560081	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0668
RIPKA, GARY A AND RIPKA, SHERRI	PACIFIC BREEZE	560081	CRAB in OR	96281
RIPKA, GARY A AND RIPKA, SHERRI	PACIFIC BREEZE	560081	SHRIMP in WA	57439
RIPKA, GARY A AND RIPKA, SHERRI	PACIFIC BREEZE	560081	SHRIMP in OR	90101
ROSAAEN, TERRY M	TATIANA	632123	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0343
ROSAAEN, TERRY M	TATIANA	632123	HIGH SEAS in HSF	632123
ROSAAEN, TERRY M	TATIANA	632123	SHRIMP in CA	35814
ROSAAEN, TERRY M	TATIANA	632123	CRAB in CA	35814
SCHNAUBELT, RICHARD AND SCHNAUBELT, EDWARD.	CAPELLA	611508	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0526
SCHNAUBELT, RICHARD AND SCHNAUBELT, EDWARD.	CAPELLA	611508	SHRIMP in CA	34114
SCHNAUBELT, RICHARD AND SCHNAUBELT, EDWARD.	CAPELLA	611508	CRAB in CA	34114
SEA TOI FISHERIES, INC	CAP'N OSCAR	549436	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0170
SEA TOI FISHERIES, INC	CAP'N OSCAR	549436	SHRIMP in WA	57467
SEA TOI FISHERIES, INC	CAP'N OSCAR	549436	SHRIMP in OR	90115
SEATTLE FIRST NATIONAL BANK	PACIFIC O'RYAN	608197	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0792
SHEPHERD, RICK	SUNSET	225721	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0151
SHEPHERD, RICK	SUNSET	225721	SHRIMP in CA	687
SHEPHERD, RICK	SUNSET	225721	CRAB in CA	687
SMITH, J STANLEY AND SMITH, JANETTE AND SMITH, RANDY J.	MISS JO ANNE	529690	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0440
SMITH, J STANLEY AND SMITH, JANETTE AND SMITH, RANDY J.	MISS JO ANNE	529690	SHRIMP in CA	33034
SMITH, J STANLEY AND SMITH, JANETTE AND SMITH, RANDY J.	MISS JO ANNE	529690	CRAB in CA	33034
SMITH, J STANLEY AND SMITH, JANETTE AND SMITH, RANDY J.	MISS JO ANNE	529690	SHRIMP in WA	57416
SMITH, J STANLEY AND SMITH, JANETTE AND SMITH, RANDY J.	MISS JO ANNE	529690	SHRIMP in OR	90075
SMOTHERMAN, SALLY R	SEA BLAZER	588240	ENDORSEMENT TRAWL GEAR in NWR.	GF0139
SMOTHERMAN, SALLY R	SEA BLAZER	588240	HIGH SEAS in HSF	588240
SMOTHERMAN, SALLY R	SEA BLAZER	588240	SHRIMP in OR	90084

Accepted bidder	Vessel Name	Vessel Official No.	Permit Fishery	Permit Number
STAFFENSON, DARRELL AND STAFFENSON, KERLYN.	JULEAN II	536809	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0123
STAFFENSON, DARRELL AND STAFFENSON, KERLYN.	JULEAN II	536809	SHRIMP in OR	90079
STAR POLARIS FISHERIES, INC	STAR POLARIS	522618	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0774
STAR POLARIS FISHERIES, INC	STAR POLARIS	522618	HIGH SEAS in HSF	522618
STAR POLARIS FISHERIES, INC	STAR POLARIS	522618	SHRIMP in OR	90225
THOMPSON, JERYL D	LINDA ELLEN	243269	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0506
THOMPSON, JERYL D	LINDA ELLEN	243269	SHRIMP in CA	7201
THOMPSON, JERYL D	LINDA ELLEN	243269	CRAB in CA	7201
TORACCA, GIOVANNI AND LEE, GORDON AND LEE, SHARON.	DAY DREAM	505277	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0110
VENTURE WEST, INC	VENTURE WEST	606361	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0114
VENTURE WEST, INC	VENTURE WEST	606361	SHRIMP in OR	90118
VENTURE WEST, INC	VENTURE WEST	606361	SHRIMP in CA	33398
VERNA JEAN, GP	MISS HEATHER	507945	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0302
VERNA JEAN, GP	MISS HEATHER	507945	HIGH SEAS in HSF	507945
VOUGHT, TROY KENT	DANDY BILL	585095	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0102
VOUGHT, TROY KENT	DANDY BILL	585095	HIGH SEAS in HSF	585095
VOUGHT, TROY KENT	DANDY BILL	585095	SHRIMP in CA	32468
WATERS, LARRY	MARIE ANN GAIL	209773	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0282
WESTERN PACIFIC TRAWLERS, INC	PACIFIC RAIDER	613704	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0356
WESTERN PACIFIC TRAWLERS, INC	PACIFIC RAIDER	613704	SHRIMP in OR	90152
WILLIAMS, CHARLES J	YUROK	607931	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0431
WILLIAMS, CHARLES J	YUROK	607931	CRAB in OR	96354
WILLIAMS, CHARLES J	YUROK	607931	SHRIMP in CA	34251
WILLIAMS, CHARLES J	YUROK	607931	CRAB in CA	34251
WILLIAMS, CHARLES J	YUROK	607931	SHRIMP in OR	90150
WOODEN, FORREST D	INTREPID	605553	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0096
WOODEN, FORREST D	INTREPID	605553	HIGH SEAS in HSF	605553
WOODEN, FORREST D	INTREPID	605553	SHRIMP in CA	34566
WOODEN, FORREST D	INTREPID	605553	CRAB in CA	34566
WOODEN, FORREST D	INTREPID	605553	SHRIMP in OR	90071
YAQUINA BAY, INC	AJA	587243	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0081
YAQUINA BAY, INC	AJA	587243	SHRIMP in OR	90056
YOUNG, RICHARD D AND YOUNG, MARY L	WILLOLA	591628	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0098
YOUNG, RICHARD D AND YOUNG, MARY L	WILLOLA	591628	SHRIMP in CA	31325
YOUNG, RICHARD D AND YOUNG, MARY L	WILLOLA	591628	CRAB in CA	31325
YOUNG, RICHARD D AND YOUNG, MARY L	CITY OF EUREKA	241896	ENDORSEMENT WITH TRAWL GEAR in NWR.	GF0099
YOUNG, RICHARD D AND YOUNG, MARY L	CITY OF EUREKA	241896	SHRIMP in CA	5601
YOUNG, RICHARD D AND YOUNG, MARY L	CITY OF EUREKA	241896	CRAB in CA	5601

Authority: Pub. L. 107–206, Pub. L. 108–7, 16 U.S.C. 1861a(b–e), and 50 CFR 600.1000 *et seq.*

Dated: October 30, 2003.

William T. Hogarth,

Assistant Administrator for Fisheries, National Marine Fisheries Service.

[FR Doc. 03–27712 Filed 11–3–03; 8:45 am]

BILLING CODE 3510–22–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[I.D. 102803C]

Fisheries of the Northeastern United States; Atlantic Surfclam and Ocean Quahog Fisheries; Notice that Vendor Will Provide Year 2004 Cage Tags

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice of vendor to provide year 2004 cage tags.

SUMMARY: NMFS informs surfclam and ocean quahog allocation owners that they will be required to purchase their year 2004 cage tags from a vendor. The intent of this notice is to comply with regulations for the surfclam and ocean quahog fisheries and to promote efficient distribution of cage tags.

ADDRESSES: Written inquiries may be sent to Douglas W. Christel, National Marine Fisheries Service, Northeast

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON MAKAH ROCKFISH ENHANCEMENT PROJECT

The Groundfish Advisory Subanel (GAP) received a presentation from the Makah Tribe and the NMFS Northwest Fisheries Science Center on research being conducted to provide enhancement for rockfish stocks.

In general, the GAP supports the research being conducted and urges that it be continued, although the GAP questions why this has to be undertaken as a private enterprise by the Makah Tribe rather than by federal or state governments. Given the amount of money and personnel that have been dedicated to salmon enhancement, the GAP wonders why groundfish is once again being given short shrift.

GAP members raised questions abut some of the possible effects of artificial propagation of rockfish, but recognized that these same questions were being addressed in the research activities currently being undertaken.

The GAP strongly recommends that - before enhancement activities proceed to the point of having cultivated rockfish released into the wild - NMFS adopt a clear policy on how these fish will be treated in regard to harvest levels and stock assessments. The GAP does not wish to see a situation analogous to Columbia River salmon, where commercial and recreational fishing is curtailed in order to protect wild stocks in spite of the abundance of hatchery stocks. If rockfish are to be released into the wild, they must be considered identical with “natural” stocks and appropriately accounted for in stock assessments.

PFMC
11/04/03

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON FEASIBILITY OF USING REAL-TIME ELECTRONIC LOGBOOK DATA IN GROUNDFISH FISHERY MANAGEMENT

The Groundfish Advisory Subpanel (GAP) received two presentations on electronic logbooks that are being developed. The GAP appreciates Mr. Patrick Simpson and Mr. Larry Cotter and their associates taking the time to present reports on their activities.

The GAP agrees that information being accurately gathered and made available in a timely manner is crucial to improving the management of groundfish fisheries. The GAP notes that it has on previous occasions supported development and use of an electronic “card swipe” system similar to that used in certain Alaskan fisheries as a means of providing accurate, up-to-date information on landings. Electronic logbook programs could, in certain circumstances, complement a card swipe system.

Nevertheless, the GAP has concerns about logbooks - electronic or paper - being used as a proxy for real-time management. Unfortunately, logbooks and observer reports continue to be merely estimates of catch and discard. While we believe that information needs to be provided to NMFS and the states on a real-time basis, we question whether directing time, money and effort towards an electronic logbook system - as opposed to other systems - is the best use of our scarce resources at this time.

PFMC
11/04/03

Current Status of electronic logbooks in the North Pacific fisheries: November 2003

The following is an overview of the electronic data collection program for the catcher vessel trawl fleet in the North Pacific. It includes a brief history of the electronic logbook development, two projects in which the electronic logbook was involved and the lessons learned from those projects.

Brief history of Electronic LogBook (ELB) development

2000:

- OceanLogic receives private contract for data visualization project
  - GIS based data collection and interpretation project for harvest enhancement
- Electronic logbooks are developed as a need for data standardization arises
  - Several iterations of ELB's occur

2001

- Fishermen request that the ELB be compliant with NMFS data collection standards in order to avoid double entry of harvest data

2002

- OceanLogic starts working with NMFS: Sustainable Fisheries (for their specific data needs) and NMFS/OLE (in order to develop evidence-grade data collection standards)
- During 2001 and 2002 we enjoyed tremendous support from fishermen at WFC and NMFS
- Receive waivers for ELB to use as alternative to DFL (Daily Fishing Log, paper log)
- ELB Prototype in 2002 and expanded into the GOA

2003

- NMFS approves ELB
  - OceanLogic conducts training for Industry and Enforcement agencies
    - USCG
    - NMFS/OLE
  - The dynamics of "Acceptance" changes
    - In general, the change is positive giving our work a high degree of legitimacy within the fleet
    - However, to some who were very supportive of our work, the legitimacy brings about a deepening sense of "Big Brother"

Two NMFS Projects: (1) General ELB distribution for economic study - fifty stand-alone ELB licenses distributed to fishermen in the catcher vessel trawl fleet in the Bering Sea/Aleutian Islands fisheries and (2) Evaluation of Observer coverage in the Gulf of Alaska Rockfish fishery

Alaska Fisheries Science Center buys 50 Licenses:

- The AFSC was looking for an efficient way to collect economic data from the catcher vessel fleet
- The paper logbook contains enough raw data that when properly matched to a fish ticket and queried can yield valuable economic data. The ELB provides that access to the logbook data much faster and accurately that the paper DFL.
- AFSC and PSMFC purchase 50 licenses
    - We install ~ 35 (mostly in the BSAI)
    - ~ 80% use them regularly and continue to use them
    - ~ 30% send data to NMFS

NMFS/AKR initiates Gulf of Alaska Rockfish Project:

- AKR purchases ~25 ELB licenses and OceanLogic services to install and maintain software and provide training to ELB users in order to evaluate fleet fishing patterns in the GOA rockfish fishery
- We install ~25 copies
    - ~90% use them

Note worthy to both projects:

- Almost all vessels have to spend additional financial resources in order to use ELB
    - Biggest financial installation issue: GPS-to-computer hardware hookup. Some expenses included (from most common to least common):
        - Signal splitter
        - New COM ports
        - More memory
        - New GPS
        - New computer

Achievements and Challenges:

- Achievements…
    - Fishermen are using the ELB because they want to, they see value in it:
    - They are taking ownership of their data
    - They are collecting better data
    - For most skippers, it is easy to use (buttons & reports)
    - Electronic access to vessel harvest data
        - Catch database
        - Vessel management
        - Fleet management

        - Fishing history with fish ticket augmentation
        - More efficient at-sea boardings
    - EFH (…and other Council issues)
        - Where fishermen fish
        - When they fish
        - How they fish

    - NMFS is using the ELB data
        - Timely information
        - Accurate catch information
            - Set & Haul positions and times
                - Effort & location
            - Est. Weights
            - Accurate ADF&G stat areas attribution
                - Percentage of time and catch in area

- <u>Challenges…</u>
    - Technical
        - Old computers
            - (Proposed solution: New computers or upgrades)
        - Overloading computer systems
            - (Proposed solution: New computers or upgrades)
        - Boat electricity infecting computer software
            - (Proposed solution: Automate computer software maintenance to daily schedule)
        - Data transfers from the vessel
            - (Proposed solution: Move away from Standard C)
    - Social
        - Computer literacy
            - (Proposed solution: Industry specific training programs)
        - Understanding the regulations
            - (Proposed solution: Better outreach)
        - Big Brother stigma
            - (Proposed solution: Better outreach)
        - At-Sea Enforcement boardings
            - (Proposed solution: Better training at the USGC/NPFTC in Kodiak)
    - Sending data to NMFS
        - This proved to be a bigger issue than we anticipated. We expected that fishermen would email their data to NMFS once the reached shore. In most cases that happened, when fishermen were comfortable sending in their data. Here it is important to note that many fishermen were not comfortable sending in data. These reasons included:
            - Fear of mistakes: This was the biggest reason. Fishermen, who were not comfortable using a computer, knew that

NMFS was really going to look at their data for the first time on a consistent and regular basis. Data submission increased as fishermen's comfort levels grew.

- Not having access to email in some ports prevented fishermen from sending in catch data.
- In cases where data was to be dropped off for pick-up, the pick-up person did not always show up.

points during public comment.

- **Lessons Learned:**
  - ELB's collect better data than paper logbooks.
  - Management personnel have faster access to decision quality data with ELB's.
  - Fishermen will respond positively to electronic data collection programs when they are co-owners and users of the data.
  - Fishermen must trust that the data they collect will be used to benefit their fishery and assist them in their livelihoods
  - Data collection projects require initial investment of time and financial resources due to technical and social challenges that come with implementing an electronic data collection program. However, once rolling, they produce seamless, inexpensive, accurate data, in real and near-real time.
    - Our experience is similar with other projects around the country
  - Implementing an electronic data collection program is as much social science as it is computer science

For more information, slides or written report, please contact:
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Observer Data Flow 2004

	January	February	March	April	May	June	July	August	September	October	November	December
Trawl	Report available for year-2 data 1/30			Recommend-ations for data stratification and modeling are made, in conjunction with preliminary '05-'06 mgmt. measures		Final analysis of 2005-06 measures, based on the updated model and data, is presented to the Council			Debrief 9/03-8/04 data			
	Conduct evaluation of representativeness of year-2 data, using fishtickets									Reconcile observer data with fishtickets		
	Revise trawl model, as necessary										Internal review of bycatch data and model design	
		GMT receives overview of bycatch rate changes	SSC is briefed on bycatch rate and modeling developments									
				Model revisions are made, as necessary to address SSC comments, before final modeling of 2005-06 management measures begins								
Fixed Gear		GMT receives overview of fixed gear modeling	Recommend-ations are made for discard/bycatch accounting in the 2004 primary sablefish fishery	Model revisions are made, as necessary to address SSC comments, before final modeling of 2005-06 management measures begins							Debrief 11/03-10/04 data	Reconcile observer data with fishtickets

Observer Data Flow 2005

	January	February	March	April	May	June	July	August	September	October	November	December
Trawl	Report available for year-3 data Conduct evaluation of representativeness of year-3 data, using fishtickets Revise existing bycatch models, as necessary	GMT receives overview of bycatch rate and modeling changes	SSC is briefed on bycatch rate and modeling developments	Recommendations for changes in data stratification and modeling are made, as necessary, for 2005 inseason tracking					Debrief 9/04-8/05 data	Reconcile observer data with fishtickets	Internal review of bycatch data and model design	
Fixed Gear		If possible GMT receives overview of bycatch rate and modeling changes	SSC is briefed on bycatch rate and modeling developments								Debrief 11/04-10/05 data	Reconcile observer data with fishtickets
Open Access	Dependent on data availability, develop model for estimating bycatch in the open access fishery											

Clarke November 2003

Debrief 9/04-6/05 data

Presentation of data and modeling results

Exhibit D.4.c
Supplemental GAP Report
November 2003

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON OBSERVER DATA FLOW FOR FISHERY YEARS 2004-2006

The Groundfish Advisory Subpanel (GAP) met with Dr. Jim Hastie of the Northwest Fisheries Science Center to discuss observer data flow.

The GAP continues to express its frustration that observer data lags at least a year behind current fisheries management. You cannot drive a car by looking through the rear-view mirror; neither can you adequately manage a fishery by looking at what everyone did last year, when this year's circumstances have altered dramatically. For example, in 2004 we will be conducting a trawl fishery with substantially reduced effort resulting from a Council supported buyback, yet our discard estimates will be based on a significantly higher effort level. The model and reality do not match.

Similarly, we are concerned that the model - in spite of the efforts made by Dr. Hastie - still does not reflect the seasonality of bycatch. Fish are not uniformly distributed over time and space, and neither are bycatch or discards, regardless of gear used. Seasonality needs to be taken into account.

Finally, we remain concerned about the "rebuilding paradox" - as fish abundance increases while harvest levels remain low in order to comply with rebuilding dictates, bycatch and discards of non-target species will also increase. The observer discard model - and indeed, the Council's management program - has no way to deal with this frustrating phenomenon.

On a positive note, we recognize - and appreciate - the fact that the Northwest Fisheries Science Center is planning on revising its observer reporting program to provide data in synchronization with the Council's management process. We believe this is a helpful change which will prevent the sort of "April surprise" that we all suffered through this year.

PFMC
11/05/03

GROUNDFISH MANAGEMENT TEAM REPORT ON OBSERVER DATA FLOW FOR FISHERY YEARS 2004-2006

The Groundfish Management Team (GMT) received an update from Dr. Jim Hastie on the Northwest Fishery Science Center's proposed observer data flow for fishery years 2004-2006 and beyond. The GMT supports the schedule for observer data flow, as presented by the Northwest Fisheries Science Center. Beginning in 2005, the GMT recommends that the updated observer data be available for management consideration in November of each year for the following calendar year and two-year management cycle (i.e., observer data would be available in November 2005 for consideration for the 2006 fishing year and the 2007-2008 management cycle). Subsequently, updated observer data would then be provided in November 2006 for implementation in 2007, and so on. The GMT also recommends that observer data be applied to past landed catch data to provide enhanced estimates of total mortality, beginning with observer data collected during the 2002 fishing year. Finally, the actual species' encounter ratios in the observer data could be informative in crafting trip limits that minimize discard to the extent practicable.

PFMC
11/05/03

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON
OBSERVER DATA FLOW FOR FISHERY YEARS 2004-2006

Dr. Jim Hastie presented a report describing the proposed flow of observer data in fishery years 2004-2006 (Exhibit D.4.b, NMFS Report). Observer data are used both to develop management measures for Council deliberation and for inseason management. Although not covered in the report, observer-based discard estimates will also be important inputs to upcoming stock assessments. Under the proposed schedule, release of observer data will occur once a year. Data from the second year of the program, from September 2002 to August 2003, are currently being processed and will be made available in January 2004. Future releases of observer data will follow approximately the same annual schedule.

Under this schedule, observer data ending in August 2003 will be used to formulate management options for 2005-2006. Accordingly, there will be a lag of at least a year and a half between when the data are collected and when the management measures based on those data are implemented. While this lack of timeliness of observer data is of concern, the schedule adopted by the Council for multi-year management makes such lags unavoidable.

A clear distinction should be made between the use of observer data and the bycatch model to develop management measures for Council consideration and their use for inseason management. Inseason fisheries management is by its nature an adaptive process. Revision of management measures may be required when available data indicate that acceptable biological catches (ABCs) for target and bycatch species are likely to be exceeded by end of the year under existing measures. For inseason management in 2004, two options exist. The first is to reconcile model predictions with inseason landings data only. The second option is to use both inseason landings data and the second year of observer data that will be available in January 2004. The second option uses best available data, is likely to be more successful in preventing ABCs from being exceeded, but could result in more substantial revision of management measures during the year.

There are several other issues concerning the use of observer data that have not been resolved. The availability of several years of observer data raises the question of how much weight should be given to the more recent data, in comparison to the older data. A weighting scheme that gives less emphasis to older data, while likely to be somewhat *ad hoc*, may be warranted, due to the many recent changes in how West Coast groundfish are managed.

Another unresolved issue is how observer data will be used in future stock assessments. Stock assessments require estimates of total removals, which include both retained and discarded fish. Although observer data is appropriate to estimate current discard rates, estimation of historical discard rates will require use of other data sources. Rather than expecting each stock assessment author to develop their own method of combining data sources to estimate discard rates, consideration should be given to developing an approach that can be applied uniformly across species and makes best use of current and historical data sets. This could be accomplished in a number of ways, either by a workshop process, or by preparation of a report with summary tables of historical and current discard estimates. Fuller discussion of off-year workshops is found under SSC comments on Agenda Item D.9.

PFMC
11/05/03

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON CABEZON AND LINGCOD ASSESSMENTS AND LINGCOD REBUILDING ANALYSIS FOR 2005-2006

The Groundfish Advisory Subpanel (GAP) met jointly with the Groundfish Management Team (GMT) and the Scientific and Statistical Committee (SSC) to review the stock assessments and Stock Assessment Review (STAR) Panel reports for lingcod and cabezon.

In regard to lingcod, the GAP appreciates the effort put into model development by the Stock Assessment Team (STAT) Team under the lead of Mr. Tom Jagielo. However, the GAP is concerned the stock assessment did not use, and the STAR Panel did not insist on using, the observer-generated discard data and discard mortality rates developed by NMFS, approved by the GMT, and accepted by the Council for lingcod. The GAP points out that these same data and rates have been used - as a matter of Council policy - to manage harvest of species designated as overfished, of which lingcod is one. If these data are being used for management, they should also be used for assessment species. If they are not scientifically rigorous enough to be used in assessments, then they should not be used for management. You can’t have it both ways.

In addition, the GAP representative to the STAR Panel pointed out the very limited data that is available and was used to assess the southern component of the lingcod stock. The GAP suggests that - as has been done in the past - the northern area assessment be used and expanded to cover the entire stock of lingcod throughout its range.

The GAP also notes that conservation-based restrictions on lingcod harvest have been in place for several years. These restrictions, especially when viewed in light of fisheries-dependent data received from both commercial and recreational fisheries, should have resulted in substantial growth in the lingcod population, especially in the northern area.

In regard to cabezon, the GAP endorses the STAR Panel recommendation for a cooperative tagging study, but suggests the data underlying the stock assessment is so weak, the Council would be better off rejecting the stock assessment and continuing with its precautionary management approach until more data is acquired.

PFMC
11/05/03

Exhibit D.6.b
Supplemental SSC Report
November 2003

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON CABEZON AND LINGCOD STOCK ASSESSMENTS AND LINGCOD REBUILDING ANALYSIS FOR 2005-2006

Cabezon

The Scientific and Statistical Committee (SSC) reviewed the cabezon stock assessment document (Exhibit D.6, Attachment 1, November 2003) and the cabezon STAR Panel report (Exhibit D.6, Attachment 2, November 2003). First, it was noted that the panel report recommended incorporating "model" uncertainty into the stock projections by combining results from nine models that systematically varied the natural mortality rate (M = 0.20, 0.25, and 0.30) and stock productivity (h = 0.7, 0.8, and 0.9) parameters. The SSC endorses the cabezon stock projections that are based on the "Posterior distribution (nine analyses)" in Table 12 (page 53) of the stock assessment as a sensible attempt to integrate model uncertainty into the analysis. However, the committee notes that the calculation is an *ad hoc* solution to the problem, and a full Bayesian analysis would be much preferred.

It was further noted that the time series of California commercial passenger fishing vessel (CPFV) logbook data in the cabezon stock assessment model begins in 1960, which is the earliest year of data that was provided to the Stock Assessment Team (STAT) Team as they prepared for the assessment. However, the CPFV logbook data set actually begins at least as early as 1947, and an analysis of CPFV logbook records that was conducted by the SSC at the meeting shows that the highest recorded catch of cabezon in the CPFV fishery occurred prior to 1960 and that CPFV catch rates of cabezon were also highest prior to that date (see attached figure). The SSC was concerned that these data could have a considerable influence on the estimate of stock depletion and, as a consequence, recommends that the CPFV logbook data be re-assembled, evaluated, and, if appropriate, included in the assessment model. In particular, the total recreational catch of cabezon may have been trending down during the 1945-1960 period, rather than being a constant 25 mt per year as modeled in the assessment.

Two members of the cabezon STAT Team were present during the SSC's discussion, and they indicated a willingness to revise the analysis and submit their findings to the SSC Groundfish Subcommittee for review prior to the March Council meeting. In the interim, because of the increased uncertainty about the estimate of depletion from the cabezon model, the SSC recommends the Council adopt a preliminary optimum yield (OY) that would keep the spawning biomass stable over the medium term. Results presented in the right hand column of Table 12 (page 53) of the assessment document, under the heading $F_{50\%}$, show that median harvest levels for the next seven years (2004-2010) range from 80 mt to 85 mt. Because this "control rule" is a constant harvest rate option, with no precautionary adjustment, over that time frame cabezon stock size should not decline any further if harvested at this level.

Lingcod

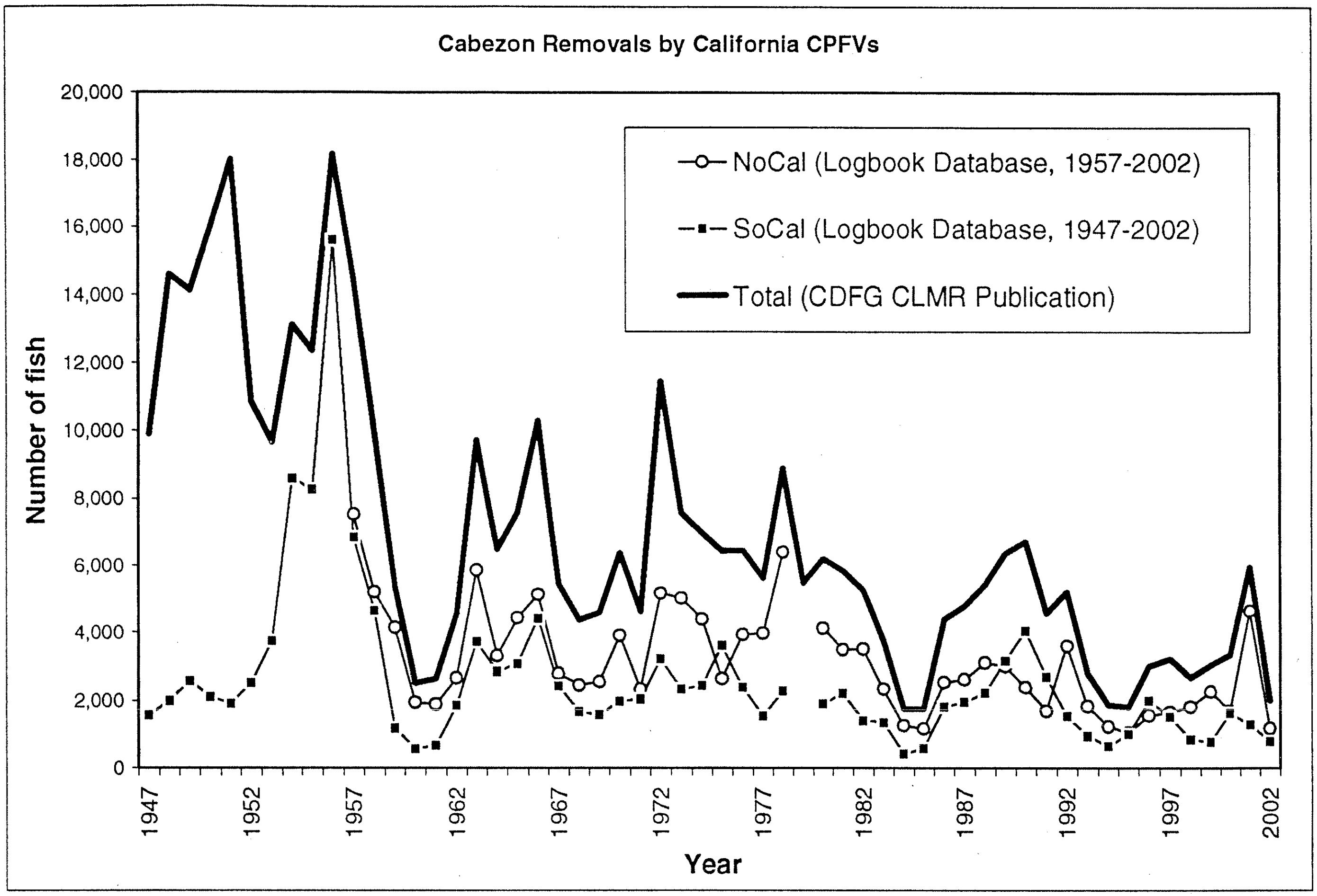
The SSC also reviewed the lingcod stock assessment document (Exhibit D.6, Attachment 3, November 2003) and the STAR Panel meeting report (Exhibit D.6, Attachment 3, November 2003). Based on an examination of the parameter files in the assessment document, it became apparent that a key parameter (recruitment variability) was mis-specified. As a consequence, recruitment variability was likely to have been too small in the rebuilding projections. If this parameter is re-specified, this would be expected to affect the OY values presented in the projections (e.g., Table ES2, page 7 of the assessment document).

Moreover, this parameter mis-specification could have influenced the decision of the STAR Panel to adopt a lingcod model that incorporated dome-shaped selectivity patterns, rather than asymptotic selectivity as in the 2000 assessment model. Consequently, the SSC recommends the current model be re-evaluated, specifically with respect to the recruitment variability parameter and the improvement in fit that accompanied the shift to dome-shaped selectivity curves. Likewise, stock rebuilding should be re-calculated using the revised model.

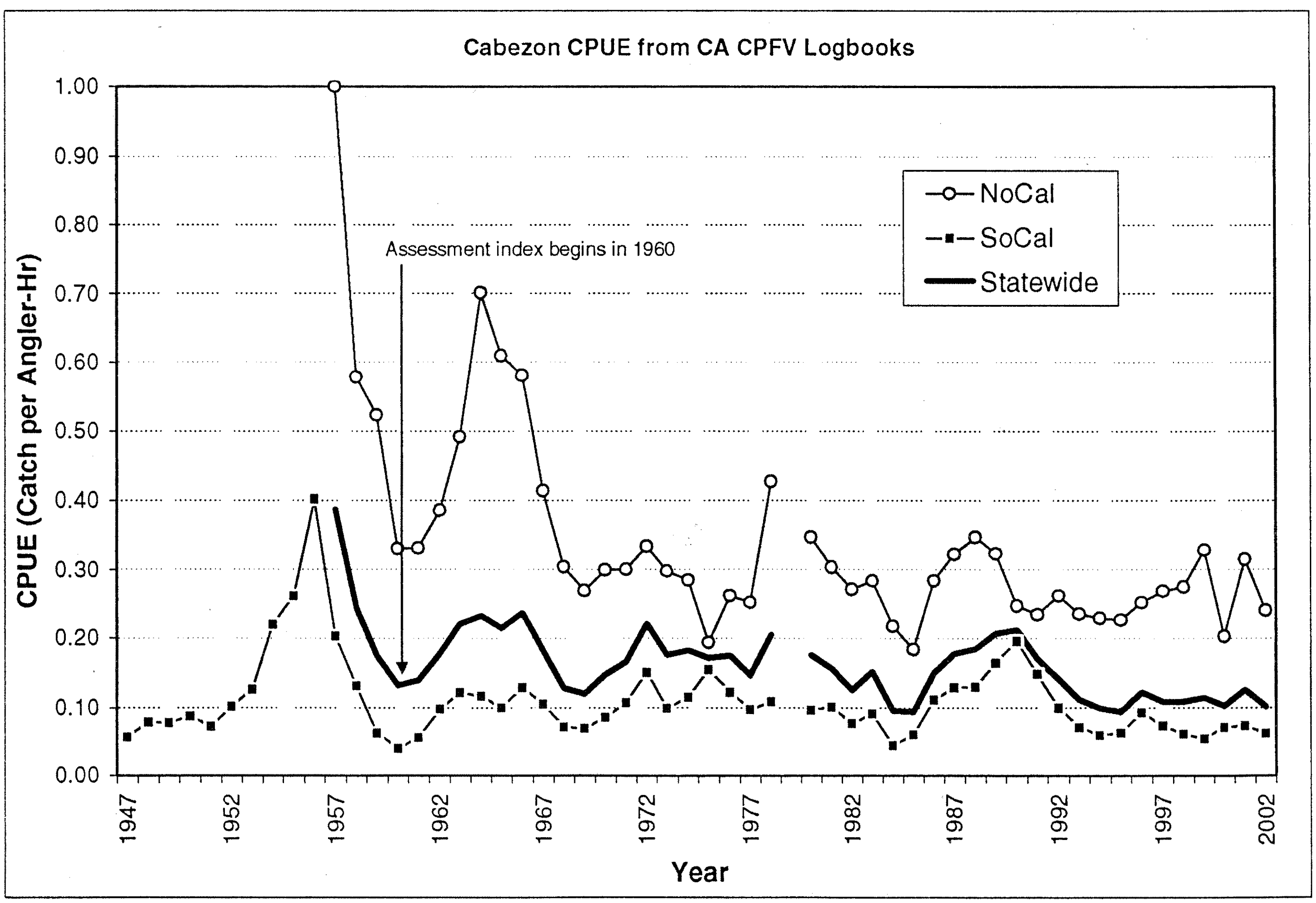
This will not be an inconsequential effort, although the lead assessment author indicated a willingness to evaluate the issues involved. As with cabezon, the SSC Groundfish Subcommittee agreed to review any revised analyses that may come forth prior to the Council's March 2004 meeting.

Lastly, the SSC discussed how to treat the lingcod results with respect to management areas (distinct north and south projections versus a "coastwide" projection). For the previous rebuilding analysis, the two separate lingcod models (LCN and LCS) were each used to project stock rebuilding in their respective areas, and the coastwide OY was simply calculated as the sum of the two components. The SSC continues to endorse the calculation of a coastwide OY as the sum of yield projections from the two area models because separate biological characteristics are maintained and explicitly incorporated into the modeling. Even so, the LCN and LCS models could be used individually to evaluate different management options for utilizing the combined coastwide OY. This approach might be particularly useful in accounting for different levels of depletion and/or productivity in the northern and southern areas.

PFMC
11/05/03



Cabezon Removals by California CPFVs
NoCal (Logbook Database, 1957-2002)
SoCal (Logbook Database, 1947-2002)
Total (CDFG CLMR Publication)
Number of fish
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1947
1952
1957
1962
1967
1972
1977
1982
1987
1992
1997
2002
Year



Cabezon CPUE from CA CPFV Logbooks
NoCal
SoCal
Statewide
Assessment index begins in 1960
CPUE (Catch per Angler-Hr)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1947
1952
1957
1962
1967
1972
1977
1982
1987
1992
1997
2002
Year

RECREATIONAL FISHERIES INFORMATION NETWORK
PACIFIC STATES MARINE FISHERIES COMMISSION
45 S.E. 82ND DRIVE, SUITE 100, GLADSTONE, OREGON 97027-2522
PHONE (503) 650-5400 FAX (503) 650-5426

RecFIN Update

Pacific Fishery Management Council Meeting
November 6, 2003

Major changes are being made in sampling methods for recreational fisheries that feed into the coastwide Recreational Fisheries Information Network (RecFIN) this year. As in the past, RecFIN remains the coastwide database that serves as a repository for recreational catch and effort data for California, Oregon and Washington. The 23+ year-old Marine Recreational Fisheries Statistics Survey (MRFSS) has or is being phased out in all three states under the following timeline:

California :	January, 2004
Oregon:	July, 2003
Washington:	July, 2003

California The MRFSS and the State Ocean Salmon Project are being replaced in January, 2004 by one all inclusive survey – the California Recreational Fisheries Survey (**CRFS**). It will sample all fisheries and modes.
Oregon In July, 2003, Oregon continued with its ongoing Oregon Recreational Boat Survey (ORBS) and replaced MRFSS with a new inland boat and shore survey using the states' angler license frame to estimate effort.
Washington In July, 2003, Washington maintained its Ocean Sampling Program (OSP) and replaced Puget Sound MRFSS boat and shore sampling with a new Puget Sound Boat Survey. The states' angler license frame will be used to estimate angler boat effort in Puget Sound. Shore sampling was discontinued in July, 2003.

RecFIN funds formerly used to conduct MRFSS in the three states have been redirected to support, along with state funding, the cost of these new programs. A brief description of the new programs in the three states follows:

CALIFORNIA

California Recreational Fisheries Survey (CRFS):

A Plan to Collect and Estimate Recreational Fishing Catch and Effort
California Department of Fish and Game

In recent years, many recreational management decisions for state nearshore species and federal groundfish species have been based on the Marine Recreational Fisheries Statistics Survey (MRFSS) data. Compared to other sources of recreational data for California, these data provide the most comprehensive coverage for all species and recreational fishing modes (man-made structures, beaches and banks, private and rental boats, and partyboats). However, constituents and fishery managers have expressed concern over the use of these data in making crucial management decisions, particularly in-season decisions for groundfish. In response, policy representatives from the West Coast recommended, and Dr. W. Hogarth, Assistant Administrator for Fisheries at the National Marine Fisheries Service (NMFS), approved the development of a new program.

The new recreational sampling program for California, the California Recreational Fisheries Survey (CRFS), was developed by staff from the California Department of Fish and Game (Department) and the Pacific States Marine Fisheries Commission (PSMFC). We recognized the importance of integrating the strengths of the current recreational programs into the design of this new program while also providing for new data needs. Thus, we designed this program to include both the comprehensive coverage of the MRFSS program and the field based effort sampling (for the private vessel mode) of California's Ocean Salmon Project. We also incorporated into the program design a single coordinated sampling effort by Department and PSMFC staff. In addition, we included the use of Commercial Passenger Fishing Vessel (CPFV) logbooks for comparison with the CPFV effort estimates.

The goal of California's new sampling program is to produce the timely fishery-based data needed to manage California's marine recreational fishery resources. However, the initial focus of the CRFS program will be to produce timely catch estimates with reasonable confidence limits for salmon, groundfish stocks declared overfished by NMFS, and for those stocks with a directed harvest.

The Department plans to fully implement the CRFS program beginning in January 2004. This program includes the following components.

All Fishing Modes

Reporting of catch and effort at a finer geographical resolution
California will be divided into six survey areas primarily along county lines.

Reporting of effort and catch estimates at monthly intervals
Estimates of catch and effort will be made monthly for each survey area for non-salmon species and biweekly for salmon. Estimates will include private access sites and night fisheries.

Estimation of angler effort using an angler license database
A California angler license database (ALD) will be developed by acquiring contact information from one in every 20 sport fish license buyers and a monthly telephone survey will be conducted to collect additional fishing effort information.

Increased creel sampling
Creel sampling levels will be increased for private and rental boats (PR) and CPFV vessels in all six survey areas within California.

Private and Rental Boat Survey (PR)
Three different methods will be used to sample the PR fishing mode: Primary PR, Secondary PR, and Private PR. Primary PR sites will be visited more frequently and will be sampled with an on-site survey for effort and catch. Secondary PR sites will be visited less often and will be surveyed by a roving sampler for effort and catch. Effort from private access PR sites will be surveyed through an ALD telephone survey while catch rates and species composition will be based on the catch from nearby primary and secondary PR sites. Primary sites also will be sampled at levels that are sufficient to meet ocean salmon management data requirements, including the collection of coded wire tags.

Commercial Passenger Fishing Vessel Survey
The three surveys of CPFV fishing currently used in California will continue. These are: the salmon survey for catch and effort; the on-board observer survey for catch rates; and a vessel telephone survey for effort. In addition, the CPFV telephone survey for effort will be compared with effort data collected directly from the landings and CPFV logbooks.

Beach and Banks Survey
Two techniques will be used to sample the Beach and Bank mode: a survey of catch collected at publicly accessible access sites during daylight hours by a field sampler; and the ALD telephone survey for all effort.

Man-made Structures Survey
Two techniques will be used to sample the Man-Made Structures: a survey of angler counts and catch collected at publicly accessible sites during daylight hours by a roving sampler; and the ALD telephone survey for effort at private access sites and during the night.

OREGON

Oregon Recreational Boat Survey (ORBS)
The Oregon Recreational Boat Survey (ORBS) will continue as the sampling program for all ocean boat trips during the fishing season (Mar-Oct). The catch for the Jan-Feb and Nov-Dec time periods (less than 5% of annual catch) are estimated based on the Mar-Oct sampling applied to temporal patterns observed during a recent three year study(1998-2001) of year round sampling. This survey uses exit counts at major ports to estimate fishing effort. Dockside interviews of

boats collect data on catch by species, target species, discards, lengths and weights, and to recover salmon tags. At sea ride-alongs are also used in summer to gather more specific data on discards. The state makes monthly catch and effort estimates and provides them to the RecFIN database.

Shore and Estuary Boat Survey (SEB)
Commencing in July, 2003 Oregon implemented it's new shore and inland boat survey (SEB). This survey uses the state's electronic angler license frame to call anglers to estimate fishing effort for these two modes. The angler phone survey for inland and shore effort is done bimonthly. Angler interviews at the fishing site provides information on catch, length data by species, discards, target species and other biological data. Sample data is provided to PSMFC for estimation of total catch and effort and loading into the RecFIN database. Catch and effort estimates are made by PSMFC on a bimonthly basis.

WASHINGTON

Ocean Sampling Program (OSP)
Washington is continuing to sample all ocean boat effort with their Ocean Sampling Program (OSP). The OSP estimates effort by exit counts of vessels at the ocean ports. Angler catch is collected from dockside angler interviews which provide data on catch and length by species, discards, target species, recovery of salmon tags and other biological data. Catch and effort estimates are made monthly and provided to PSMFC for loading into the RecFIN database.

Puget Sound Boat Survey
Commencing in July, Washington began a new Puget Sound boat survey that like Oregon uses their angler license frame to estimate fishing effort. An angler phone survey bimonthly estimates fishing effort for the previous two month period. Dockside interviews of anglers are used to collect information on catch, length data by species, discards, target species and other biological data. Washington makes bimonthly catch and effort estimates for Puget Sound boats and provides it to PSMFC bimonthly for loading into the RecFIN database.

Russell Porter, PSMFC
Debbie Aseltine-Neilson, CDFG

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON UPDATE ON RECREATIONAL FISHERY INFORMATION NETWORK

The Groundfish Advisory Subpanel (GAP) received a report on changes being made to California's marine recreational fisheries sampling program.

In general, the GAP is pleased to see the program is being re-focused on collecting information from actual anglers, rather than relying on random telephone surveys and expanded responses which have led to serious questions about data validity, not to mention, huge sampling errors. We hope these changes will result in better and more timely information being made available for fisheries management.

PFMC
11/05/03

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON UPDATE ON RECREATIONAL FISHERY INFORMATION NETWORK DATA IMPROVEMENTS

Mr. Russell Porter briefed the Scientific and Statistical Committee (SSC) on recent revisions in the data collection system for the West Coast recreational fishery. The system is undergoing significant change with modifications in both design and operational details. In particular, the 23-year-old Marine Recreational Fisheries Statistics Survey (MRFSS) is being phased out in all of the West Coast states. The greatest degree of change is occurring in California where previously, all catch and catch per unit effort (CPUE) estimates were based solely on MRFSS-collected data. Ms. Debbie Aseltine-Nelson provided the SSC with an overview of the new California Recreational Fisheries Survey (CRFS).

While the SSC did not review the new methodology, the general design and implementation strategy appear to be reasonable. At this juncture, the SSC offers two comments:

1. In general, it is desirable to record what has been observed in the field and to maintain these data in well-established databases. For example, the MRFSS practice of observing and recording discards in two categories (dead or alive when released) should be maintained in the new system.

2. Planning for transition from the MRFSS to the new system is critically important for ensuring continuity in the stock assessments that utilize these data (e.g., linking the old and new time series of catch and CPUE estimates. This may be a more time-consuming endeavor than currently envisioned, and adequate resources should be allocated to the task.

PFMC
11/05/03

PROPOSED PACIFIC FISHERY MANAGEMENT COUNCIL SCHEDULE AND PROCESS FOR DEVELOPING 2005-2006 GROUNDFISH FISHERY SPECIFICATIONS AND MANAGEMENT MEASURES[1/]

Option A: A November, March, April, and June Council Meeting Process

October 14-17, 2003	The Groundfish Management Team (GMT) and Council staff meet in Seattle, Washington to review new stock assessments and rebuilding analyses and draft a recommended range of 2005-2006 groundfish harvest specifications and preliminary management measures.
November 3-7, 2003	The Council and advisory bodies meet in Del Mar, California to adopt: 1. New stock assessments for cabezon and lingcod and a new lingcod rebuilding analysis. 2. The schedule and process for development of 2005-2006 groundfish fishery specifications and management measures. 3. A range of 2005-2006 harvest specifications and a preliminary range of management measures.
November 10, 2003-January 30, 2004	The Bycatch Model Work Group develops proposed methodologies to model bycatch in trawl and fixed gear fisheries based on data from the Observer Program.
January 14-16, 2004	The GMT and Council staff meet in La Jolla, California to complete a work plan to accomplish all the elements involved in the 2005-2006 groundfish fishery specifications and management measure process.
January 23, 2004	The NMFS Northwest Fisheries Science Center (NWFSC) releases the 2004 whiting stock assessment.
January 30, 2004	The NWFSC releases a report summarizing the second year of observer data and proposed methodologies to model bycatch in trawl and fixed gear fisheries.
February 2-4, 2004	Whiting Stock Assessment Review (STAR) Panel meets in Seattle, Washington.
February 5-6, 2004	The Bycatch Model Work Group briefs the GMT and Scientific and Statistical Committee (SSC) Groundfish Subcommittee on proposed methodologies to model bycatch in trawl and fixed gear fisheries; SSC Groundfish Subcommittee provides feedback as to any suggested improvements.

1/ Including 2004 whiting fishery management specifications and management measures.

February 17-19, 2004	The GMT and Council staff meet in Portland, Oregon to analyze the preliminary acceptable biological catches (ABCs), optimum yields (OYs), and management measures adopted at the November Council meeting, as well as the whiting STAR report, and prepare a report presenting the results.
February 26, 2004	Council staff distributes the GMT report on analysis of preliminary fishery specifications and management measures. (This is also the March Council Meeting Briefing Book distribution date.)
February 27- March 5, 2004	State and tribal agencies hold constituent meetings to obtain input on the analysis of preliminary management measures and recommendations for a range of refined management measures.
March 8-12, 2004	Council and advisory bodies meet at the Sheraton Tacoma Hotel in Tacoma, Washington to adopt: 1. New observer data and bycatch models for trawl and fixed gear fisheries. 2. Refined management measures for further analysis. 3. Whiting fishery specifications and management measures for 2004.
March 23-26, 2004	The GMT meets in Portland, Oregon to analyze the refined management measures, adopted at the March Council meeting, for presentation at the April Council meeting.
April 5-9, 2004	Council and advisory bodies meet at the Red Lion Hotel in Sacramento, California to adopt final 2005-2006 groundfish harvest specifications and a preferred alternative for 2005-2006 management measures.
April 13-16, 2004	The GMT meets in X to complete all remaining analytical tasks necessary for the preparation of a draft *Draft Environmental Impact Statement (DEIS) for the Proposed 2005-2006 Groundfish Harvest Specifications and Management Measures.*
May 21, 2004	Council staff completes a draft *DEIS for the Proposed 2005-2006 Groundfish Harvest Specifications and Management Measures.* • Document authoring completed by May 12, 2004. • Document proofing and printing completed by May 19, 2004. • Document distribution completed by May 21, 2004.
May 24- June 11, 2004	State and tribal agencies hold constituent meetings to obtain input on final recommendations for final management measures.
June 14-18, 2004	Council and advisory bodies meet at the Crowne Plaza Hotel in Foster City, California to take final action on a complete set of 2005-2006 groundfish fishery specifications and management measures.
July 16, 2004	Council staff completes and transmits final DEIS to NMFS. • Document authoring completed by July 6, 2004. • Document proofing and printing completed by July 13, 2004. • Document distribution completed by July 16, 2004.

July 19- December 31, 2004	NMFS conducts internal Magnuson-Stevens Fishery Conservation and Management Act (MSA) process and further National Environmental Policy Act (NEPA) processes, including notifying Council of approval or disapproval under MSA and Record of Decision signing under NEPA.
January 1, 2005	Groundfish fishery begins under adopted specifications and management measures.

PFMC
11/03/03

PROPOSED PACIFIC FISHERY MANAGEMENT COUNCIL SCHEDULE AND PROCESS FOR DEVELOPING 2005-2006 GROUNDFISH FISHERY SPECIFICATIONS AND MANAGEMENT MEASURES[1/]

Option B: A November, April, and June Council Meeting Process

October 14-17, 2003	The Groundfish Management Team (GMT) and Council staff meet in Seattle, Washington to review new stock assessments and rebuilding analyses and draft a recommended range of 2005-2006 groundfish harvest specifications and preliminary management measures.
November 3-7, 2003	The Council and advisory bodies meet in Del Mar, California to adopt: 1. New stock assessments for cabezon and lingcod and a new lingcod rebuilding analysis. 2. The schedule and process for development of 2005-2006 groundfish fishery specifications and management measures. 3. A range of 2005-2006 harvest specifications and a preliminary range of management measures.
November 10, 2003-March 5, 2004	The Bycatch Model Work Group develops proposed methodologies to model bycatch in trawl and fixed gear fisheries based on data from the Observer Program.
January 14-16, 2004	The GMT and Council staff meet in La Jolla, California to complete a work plan to accomplish all the elements involved in the 2005-2006 groundfish fishery specifications and management measure process.
January 30, 2004	The Northwest Fisheries Science Center (NWFSC) releases the 2004 whiting stock assessment.
January 30, 2004	The NWFSC releases a report summarizing the second year of observer data and proposed methodologies to model bycatch in trawl and fixed gear fisheries.
February 17-21, 2004	Whiting Stock Assessment Review (STAR) Panel meets in Seattle, Washington.
March 8-12, 2004	Council and advisory bodies meet at the Sheraton Tacoma Hotel in Tacoma, Washington. • The Bycatch Model Work Group briefs the GMT and Scientific and Statistical Committee (SSC) on proposed methodologies to model bycatch in trawl and fixed gear fisheries; SSC provides feedback as to any suggested improvements. • The Council adopts whiting fishery specifications and management measures for 2004.

1/ Including 2004 whiting fishery management specifications and management measures.

March 15- April 3, 2004	The Bycatch Model Work Group incorporates SSC-suggested improvements and finalizes models and methodologies for use in analyzing 2005 -2006 groundfish specifications and management measures.

April 5-9, 2004	Council and advisory bodies meet at the Red Lion Hotel in Sacramento, California.
	• The GMT analyzes the preliminary acceptable biological catches (ABCs), optimum yields (OYs), and management measures adopted at the November 2003 Council meeting and prepares a report presenting the results.
	  • The GMT briefs the Groundfish Advisory Subpanel (GAP).
	  • The states hold constituent meetings.
	• The Council adopts:
	  • Final ABC and OY levels.
	  • Refined management measures for further analysis.

May 3-7, 2004	The GMT meets in Portland, Oregon to analyze the refined management measures adopted at the April Council meeting and prepares a report for public review and presentation at the June Council meeting.
May 21, 2004	Council staff release a report for public review with an analysis of the refined management measures: • Document authoring completed by May 12, 2004. • Document proofing and printing completed by May 19, 2004. • Document distribution completed by May 21, 2004.
May 24- June 11, 2004	State and tribal agencies hold constituent meetings to obtain input on final recommendations for final management measures.
June 14-18, 2004	Council and advisory bodies meet at the Crowne Plaza Hotel in Foster City, California. • The Council provides the GMT with a draft preferred alternative, which the GMT analyzes and briefs the GAP on the results. • The Council takes final action on a preferred alternative for a complete set of 2005-2006 groundfish fishery specifications and management measures.
June 28- July 2, 2004	The GMT meets in X to complete all remaining analytical tasks necessary for the preparation of a draft *Draft Environmental Impact Statement (DEIS) for the Proposed 2005-2006 Groundfish Harvest Specifications and Management Measures.*
July 5- July 30, 2004	Council staff work with GMT members in drafting a complete DEIS document.
August 2-13, 2004	Council secretariate completes formatting, proofing, and printing of DEIS document.

August 16-20, 2004	GMT and NMFS regional staff review of final DEIS draft and transmittal to NMFS headquarters.
August 23-December 31, 2004	NMFS conducts internal Magnuson-Stevens Conservation and Management Act (MSA) process, further National Environmental Policy Act (NEPA) processes, and notice and comment under Administrative Procedures Act.
January 1, 2005	Groundfish fishery begins under adopted specifications and management measures.

PFMC
11/03/03

Scoping Session
2005-2006 Groundfish Harvest Specifications and Management Measures
Hilton Hotel - San Diego Del Mar
Boardroom 1100
15575 Jimmy Durante Blvd.
Del Mar, CA 92014
(858) 732-5200
November 2, 2003 1 P.M.-3 P.M.

Attendance:

Commercial fishing	1
Recreational fishing	4
Government agency	5
Conservation org.	1
Other	2
Total	13

Recreational Fishing

- Use California Recreational Fisheries Survey (CRFS) data program, not Marine Recreational Fisheries Statistics Survey (MRFSS).

- In previous analyses there is limited information about the economic impact of restrictions on the sports fishing sector; it should be recognized that the economic value per fish caught is greater in this sector compared to the commercial sector. An analysis could highlight the cost of limiting recreational fishing by estimating the economic value resulting from no restrictions on this sector, such that a greater proportion of the optimum yield (OY) was allocated to this sector. Such an analysis may show that we are"shooting ourselves in the foot" with management restraints on sports fishing. This analysis only needs to look at those species where there is an overlap between recreational and commercial sectors.

- Need to look more at the social impacts of management. This includes describing the culture of sports fishing and its relationship to tourism. Such an analysis would also show how sports fishing supports tourism.

- The social and cultural value of fishing is recognized if you are Indian; the socio-cultural value of recreational fishery resources to non-Indians also should be recognized.

Commercial Fishing

- The Council seems to only consider the economic value of processors.

- Spatial management is executed by depth, but not by bottom substrate, etc.; this affects fishing communities in different ways. It arbitrarily takes away fishing areas for a community that has fished that area in a selective way. The boundary lines of Rockfish Conservation Areas (RCAs) are established to make things easier for enforcement. But with the vessel monitoring system (VMS) could overlay species distribution with historic fishing grounds to make more complicated spatial management that has less impact on fishing communities.

- The RCA isn't really hurting communities as far as trawlers are concerned; its more of a problem of processors not wanting to buy the types of fish that can be caught cleanly. For example, the processors put the limit on petrale sole landings even when management regulations do not limit by landings of this species. Processors then offer a lower price for fish brought in over the limit. This forces fishermen to discard target species because the price is too low to make it economically worthwhile to land fish in excess of the limit established by the processor. January to December and November to December are the key times of year when this happens.

- Assuming behavior is to maximize profit, the analysis should look at fish processing as part of a system and ask whether you are maintaining the viability of processors in this system.

- Maybe look at alternative systems that would provide more benefits to fishermen.

<u>Recommendations for Groundfish Management</u>

- Move electronic data collection for as many sectors as possible. Even if electronic data collection is adopted for trawl fleet (as part of an individual trawl quota [ITQ] management system) such technologies need to be adopted for other sectors.

- There is insulation between sectors in terms of how management system deals with the effects of catches in a particular sector. Right now catches in one sector can blow the OY for the entire fishing industry coastwide. "Soft allocation" is okay (versus "hard" allocations), but if reporting in one sector has a long time lag, this causes problems because restrictions are then required on all sectors to compensate.

- Even if soft allocations continue, implement hard bycatch caps by sector.

- The Council needs to make the decision that is best for the fishery management and then tell enforcement what they need to do. Instead, management is constrained by what enforcement says is feasible. At the least, the environmental impact statement (EIS) should have an analysis of why some types of management can't be done because of enforcement limitations.

- When accounting for total mortality, look at the reasons for discard rates (derived from observer data). Discards could be occurring due to market conditions/processors, and such knowledge could inform the management system.

- Why are black rockfish OYs lower in 2005-2006 then in 2004?

EIS Methodology

- Describe and evaluate ecosystem impacts: look at ecosystem linkages and disclose what is known and not known about ecosystem linkages. Analyze ecosystem effects on the smallest spatial scale feasible.

- Use modern tools to better understand the fisheries: use groundfish fleet restructuring project (conducted by Ecostrust) as a framework for the analysis. (This tool can be updated with new data, such as from the observer program and the essential fish habitat [EFH] EIS. It is recognized that using this tool may take some time).

- Evaluate the impacts of fishery decisions on individual communities, not just fishery sectors.

- Commercial fishing.

- Find a better means to understand and express impacts. Present the results of analyses in graphical format; it is easier for the reader to understand.

- Create linkages between the different analyses being prepared by the Council/NMFS (e.g., EFH, bycatch, and overfished species EISs). None of the EIS analyses done by the Council/NMFS look at everything, but there is considerable overlap between them. Is there some way to bring these analyses together in the management measures EIS? Include a programmatic section in the document that describes the linkages between these EIS analyses. Also, the cumulative effects analysis should be used as a way to look at alternatives from EFH and bycatch program EIS in this EIS overtly.

- Previous economic analyses have under-estimated the economic costs of limiting catches in the January-February and November-February periods when petrale sole catch is not limited by management measures.

PFMC
11/05/03

Michele Robinson

Exhibit D.8.b
Supplemental GMT Report 3
November 2003

TABLE 1. Groundfish Management Team-recommended alternatives for acceptable biological catches (ABCs) and total catch optimum yields (OYs) (mt) for **2005**. (Overfished stocks in CAPS).

Stock	2004 ABCs/OYs		2005 ABC and OY Alternatives							
			Low OY		Med OY		High OY		Council OY a/	
	ABC	OY	ABC	OY	ABC	OY	ABC	OY	ABC	OY
LINGCOD	1,385	735	1,385	735	2,118	1,412	2,118	2,089		
Pacific Cod	3,200	3,200			3,200	1,600				
PACIFIC WHITING (Coastwide)	Decision deferred until March 2004				Decision deferred until March 2005					
Sablefish (Coastwide)	8,487	7,786	5,251	4,930	8,368	7,761	8,368	8,335		
North of Conception	8,185	7,510				7,486		8,040		
Conception area	302	276				275		295		
PACIFIC OCEAN PERCH	980	444			966	447				
Shortbelly Rockfish	13,900	13,900			13,900	13,900				
WIDOW ROCKFISH	3,460	284	3,076	0			3,909	587		
CANARY ROCKFISH b/	256	47	270	43	270	48	270	48		
Chilipepper Rockfish	2,700	2,000			2,700	2,000				
BOCACCIO	400	250	Most Pessimistic ABC/OY under Model STARb2				Most Optimistic ABC/OY under Model STARb1			
Splitnose Rockfish	615	461			615	461				
Yellowtail Rockfish	4,320	4,320			3,896	3,896				
Shortspine Thornyhead	1,030	983			1,055	999				
Longspine Thornyhead	2,461	2,461			2,461	2,461				
S. of Pt. Conception	390	195			390	195				
COWCOD (S. Concep)	5	2.4	5	0			5	2.4		
N. Concep & Monterey	19	2.4	19	0			19	2.4		
DARKBLOTCHED	240	240			269	269				
YELLOWEYE	53	22	55	18			55	~28		
Nearshore Species										
Black WA	540	540			540	540				
Black OR-CA	775	775			753	753				
Minor Rockfish North	3,680	2,250			3,680	2,250				
Remaining Rockfish North	1,612	1,216			1,612	1,216				
Bocaccio	318	239			318	239				
Chilipepper - Eureka	32	32			32	32				
Redstripe	576	432			576	432				
Sharpchin	307	230			307	230				
Silvergrey	38	29			38	29				
Splitnose	242	182			242	182				
Yellowmouth	99	74			99	74				
Other Rockfish North	2,068	1,034			2,068	1,034				
Minor Rockfish South	3,412	1,968			3,412	1,968				
Remaining Rockfish South	854	689			854	689				
Bank	350	263			350	263				
Blackgill	343	306			343	306				
Sharpchin	45	34			45	34				
Yellowtail	116	87			116	87				
Other Rockfish South	2,558	1,279			2,558	1,279				
Cabezon	Managed under "Other Fish"		48	41	96	82	144	123		
Dover Sole	8,510	7,440			8,510	7,440				
English Sole	3,100	3,100			3,100	3,100				
Petrale Sole	2,762	2,762			2,762	2,762				
Arrowtooth Flounder	5,800	5,800			5,800	5,800				
Other Flatfish	7,700	7,700			12,000	6,000				
Other Fish	14,700	14,700			15,000	7,500				

a/ Council OY is the Council's preferred harvest alternative for 2005.

b/ The canary rockfish ABC and OY are based on the Council's adopted rebuilding strategy that has a P_{MAX} (probability of successful rebuilding within the maximum allowable time period) of 60%. The OY varies by the commercial:recreational catch share due to the fact that the recreational fishery takes smaller fish and therefore has a greater "per ton" impact than the commercial fishery. The canary stock was not assessed in 2004.

TABLE 2. Pacific Fishery Management Council-recommended alternatives for acceptable biological catches (ABCs) and total catch optimum yields (OYs) (mt) for **2006**. (Overfished stocks in CAPS).

Stock	2004 ABCs/OYs		2006 ABC and OY Alternatives							
			Low OY		Med OY		High OY		Council OY a/	
	ABC	OY	ABC	OY	ABC	OY	ABC	OY	ABC	OY
LINGCOD	1,385	735	1,385	735	2,118	1,412	2,118	2,089		
Pacific Cod	3,200	3,200			3,200	1,600				
PACIFIC WHITING (Coastwide)	Decision deferred until March 2004				Decision deferred until March 2006					
Sablefish (Coastwide)	8,487	7,786	5,236	4,977	8,175	7,634	8,175	8,149		
North of Conception	8,185	7,510				7,363		7,860		
Conception area	302	276				271		289		
PACIFIC OCEAN PERCH	980	444			934	447				
Shortbelly Rockfish	13,900	13,900			13,900	13,900				
WIDOW ROCKFISH	3,460	284	2833	0			3,668	595		
CANARY ROCKFISH b/	256	47	279	45	279	51	279	51		
Chilipepper Rockfish	2,700	2,000			2,700	2,000				
BOCACCIO	400	250	Most Pessimistic ABC/OY under Model STARb2				Most Optimistic ABC/OY under Model STARb1			
Splitnose Rockfish	615	461			615	461				
Yellowtail Rockfish	4,320	4,320			3,681	3,681				
Shortspine Thornyhead	1,030	983			1,077	1,018				
Longspine Thornyhead	2,461	2,461			2,461	2,461				
S. of Pt. Conception	390	195			390	195				
COWCOD (S. Concep)	5	2.4			5	2.4				
N. Concep & Monterey	19	2.4			19	2.4				
DARKBLOTCHED	240	240			294	294				
YELLOWEYE	53	22	57	18			57	~29		
Nearshore Species										
Black WA	540	540			540	540				
Black OR-CA	775	775			736	736				
Minor Rockfish North	3,680	2,250			3,680	2,250				
Remaining Rockfish North	1,612	1,216			1,612	1,216				
Bocaccio	318	239			318	239				
Chilipepper - Eureka	32	32			32	32				
Redstripe	576	432			576	432				
Sharpchin	307	230			307	230				
Silvergrey	38	29			38	29				
Splitnose	242	182			242	182				
Yellowmouth	99	74			99	74				
Other Rockfish North	2,068	1,034			2,068	1,034				
Minor Rockfish South	3,412	1,968			3,412	1,968				
Remaining Rockfish South	854	689			854	689				
Bank	350	263			350	263				
Blackgill	343	306			343	306				
Sharpchin	45	34			45	34				
Yellowtail	116	87			116	87				
Other Rockfish South	2,558	1,279			2,558	1,279				
Cabezon	Managed under "Other Fish"		48	41	96	82	144	123		
Dover Sole	8,510	7,440			8,510	7,440				
English Sole	3,100	3,100			3,100	3,100				
Petrale Sole	2,762	2,762			2,762	2,762				
Arrowtooth Flounder	5,800	5,800			5,800	5,800				
Other Flatfish	7,700	7,700			12,000	6,000				
Other Fish	14,700	14,700			15,000	7,500				

a/ Council OY is the Council's preferred harvest alternative for 2005.

b/ The canary rockfish ABC and OY are based on the Council's adopted rebuilding strategy that has a P_{MAX} (probability of successful rebuilding within the maximum allowable time period) of 60%. The OY varies by the commercial:recreational catch share due to the fact that the recreational fishery takes smaller fish and therefore has a greater "per ton" impact than the commercial fishery. The canary stock was not assessed in 2004.

GROUNDFISH MANAGEMENT TEAM
PROPOSED PACIFIC FISHERY MANAGEMENT COUNCIL SCHEDULE AND PROCESS FOR DEVELOPING 2005-2006 GROUNDFISH FISHERY SPECIFICATIONS AND MANAGEMENT MEASURES[1/]

Option B: A November, April, and June Council Meeting Process

October 14-17, 2003	The Groundfish Management Team (GMT) and Council staff meet in Seattle, Washington to review new stock assessments and rebuilding analyses and draft a recommended range of 2005-2006 groundfish harvest specifications and preliminary management measures.
November 3-7, 2003	The Council and advisory bodies meet in Del Mar, California to adopt: 1. New stock assessments for cabezon and lingcod and a new lingcod rebuilding analysis. 2. The schedule and process for development of 2005-2006 groundfish fishery specifications and management measures. 3. A range of 2005-2006 harvest specifications and a preliminary range of management measures.
November 10, 2003-March 5, 2004	The Bycatch Model Work Group develops proposed methodologies to model bycatch in trawl and fixed gear fisheries based on data from the Observer Program.
January 14-16, 2004	**The GMT and Council staff meet in La Jolla, California (GMT Retreat) to discuss long-range management measures and ways to improve Team efficiency; also as part of agenda, GMT will develop** a work plan to accomplish all the elements involved in the 2005-2006 groundfish fishery specifications and management measure process.
February 3-6, 2004	**The GMT, Council staff, and Recreational Fishery Information Network (RecFIN) staff meet in X to review state recreational catch estimate models, review the updated observer data and modeling, and discuss RecFIN issues.**
January 30, 2004	The Northwest Fisheries Science Center (NWFSC) releases the 2004 whiting stock assessment.
January 30, 2004	The NWFSC releases a report summarizing the second year of observer data and proposed methodologies to model bycatch in trawl and fixed gear fisheries.
February 17-21, 2004	Whiting Stock Assessment Review (STAR) Panel meets in Seattle, Washington.

1/ Including 2004 whiting fishery management specifications and management measures.

March 8-12, 2004	Council and advisory bodies meet at the Sheraton Tacoma Hotel in Tacoma, Washington. · The Bycatch Model Work Group briefs the GMT and Scientific and Statistical Committee (SSC) on proposed methodologies to model bycatch in trawl and fixed gear fisheries; SSC provides feedback as to any suggested improvements. · The Council adopts whiting fishery specifications and management measures for 2004.
March 15- April 3, 2004	The Bycatch Model Work Group incorporates SSC-suggested improvements and finalizes models and methodologies for use in analyzing 2005 -2006 groundfish specifications and management measures.

April 5-9, 2004	Council and advisory bodies meet at the Red Lion Hotel in Sacramento, California.
	· The GMT analyzes the preliminary acceptable biological catches (ABCs), optimum yields (OYs), and management measures adopted at the November 2003 Council meeting and prepares a report presenting the results.
	  · The GMT briefs the Groundfish Advisory Subpanel (GAP).
	  · The states hold constituent meetings.
	· The Council adopts:
	  · Final ABC and OY levels.
	  · Refined management measures for further analysis.

May 3-7, 2004	The GMT meets in Portland, Oregon to analyze the refined management measures adopted at the April Council meeting and prepares a report for public review and presentation at the June Council meeting.
May 21, 2004	Council staff release a report for public review with an analysis of the refined management measures: · Document authoring completed by May 12, 2004. · Document proofing and printing completed by May 19, 2004. · Document distribution completed by May 21, 2004.
May 24- June 11, 2004	State and tribal agencies hold constituent meetings to obtain input on final recommendations for final management measures.
June 14-18, 2004	Council and advisory bodies meet at the Crowne Plaza Hotel in Foster City, California. · The Council provides the GMT with a draft preferred alternative, which the GMT analyzes and briefs the GAP on the results. · The Council takes final action on a preferred alternative for a complete set of 2005-2006 groundfish fishery specifications and management measures.
June 28- July 2, 2004	The GMT meets in X to complete all remaining analytical tasks necessary for the preparation of a draft *Draft Environmental Impact Statement (DEIS) for the Proposed 2005-2006 Groundfish Harvest Specifications and Management Measures.*

July 5- July 30, 2004	Council staff work with GMT members in drafting a complete DEIS document.
August 2-13, 2004	Council secretariate completes formatting, proofing, and printing of DEIS document.
August 16-20, 2004	GMT and NMFS regional staff review of final DEIS draft and transmittal to NMFS headquarters.
August 23- December 31, 2004	NMFS conducts internal Magnuson-Stevens Conservation and Management Act (MSA) process, further National Environmental Policy Act (NEPA) processes, and notice and comment under Administrative Procedures Act.
January 1, 2005	Groundfish fishery begins under adopted specifications and management measures.

GROUNDFISH MANAGEMENT TEAM REPORT ON PRELIMINARY 2005-2006 GROUNDFISH MANAGEMENT MEASURES

Based on the range of acceptable biological catches (ABCs) and optimum yields (OYs) that the Groundfish Management Team (GMT) is recommending the Council consider, the GMT discussed management measures for the 2005-2006 commercial and recreational groundfish fisheries with the Groundfish Advisory Subpanel (GAP), and recommends the following:

ABCs/OYs

The GMT notes that, for the most part, the proposed ABCs and OYs for 2005 and 2006 do not vary much from those adopted for 2004, as there have been only two new stock assessments for this management cycle. The GMT requests the Council provide guidance on the proposed ABCs and OYs to include, (1) further narrow the range of OYs, to what may be considered reasonable; (2) identify preferred OYs, if possible; and (3) provide preferred catch sharing regimes for the more constraining stocks between commercial and recreational fisheries; among limited entry trawl, fixed gear, open access, and exempted trawl fisheries; and among the three states. Based on that guidance, the GMT and the state representatives can further develop and refine management measure options that achieve the Council's preferred OYs. With regard to ABCs and OYs for widow, bocaccio, yelloweye, and cowcod, the GMT has included values for low and high scenarios that encompass the range of alternatives identified in the rebuilding plans for these species. The GMT recommends the Council narrow down the range of ABCs and OYs for these species after the Council has taken action on Amendment 16-3.

Precautionary Adjustments for Pacific Cod, Other Flatfish, and Other Fish

Additionally, the Council policy we have been operating under for some years regarding unassessed and poorly assessed stocks, which is not limited to rockfish, has been to take a precautionary approach. Specifically, for unassessed stocks, the Council has adjusted OYs to 50% of the historical average catch levels; for poorly assessed stocks, the Council has applied a 25% reduction to the assessment value. The GMT notes that this has been done for most of the stocks that fall into these categories; however, the GMT recently discovered the precautionary adjustment has not been made to Pacific cod and species in the other flatfish and other fish categories. Therefore, the GMT recommends the OYs for Pacific cod, other flatfish, and other fish be reduced by 50%.

Nearshore Rockfish Sharing Between Oregon and California

As in 2004, the GMT recommends carrying forward the black rockfish catch sharing recommendation of 58% to Oregon and 42% to California. It is our understanding that the states of California and Oregon have factored in precautionary approaches in managing to these black rockfish OYs. The states of California and Oregon will continue to discuss management strategies for cabezon, greenling, and other nearshore rockfish.

Cabezon Assessment and Resulting Harvest Levels

At the October GMT meeting, the Team discussed the results of the new cabezon stock assessment and the Stock Assessment Review (STAR) Panel report. Assessment author Dr. Kevin Piner presented the technical aspects of the results to the Team, and STAR Panel chair Dr. Han-Lin Lai was also present to answer questions about the findings and recommendations from the review. The assessment produced acceptable results for the southern stock (off California), but insufficient data were available to model the northern stock (off Oregon and Washington). Consequently, GMT discussions on cabezon focused on the southern stock, and management recommendations are confined to the southern stock.

The current stock size is about 35% of $B_{unfished}$, based on maximum posterior density results from the "new" base case that was recommended by the STAR Panel. However, base-case results for "point estimates" and "posterior distribution" were presented as equally likely for determining current stock status and ABC. Therefore, the GMT would like to refer this issue to the Scientific and Statistical Committee (SSC) to determine the best supported approach for determining the ABC.

The modeling scenario that uses the combined posterior distribution of all nine analyses was identified as the most appropriate for determining harvest and stock projections for 2004 and beyond. The STAR Panel determined that this type of Bayesian analysis captures sources of uncertainty in the assessment, and represents the best available science for management advice. Based on the projections presented in the assessment, an $F_{45\%}$ harvest policy using the 40-10 precautionary adjustment may be too aggressive, and could result in a decrease in stock size over the mid- to long-term. An $F_{50\%}$ harvest policy using a 60-20 precautionary adjustment is the default harvest policy in the California Nearshore fishery management plan (FMP), and it provides for continuous increase in stock size for the short to mid-term. However, the 60-20 precautionary adjustment has not been established as a groundfish harvest policy. An approach that has been previously used for other groundfish species is to explore incrementally more conservative spawners-per-recruitment (SPR) rates (including use of the 40-10 precautionary adjustment) in cases where a stock did not increase to $B_{40\%}$ under the default groundfish harvest policy. Therefore, the GMT requested that the Stock Assessment Team (STAT) Team analyze a $F_{50\%}$ SPR harvest rate with the 40-10 adjustment. It is expected that this may provide for an increase in stock size while conforming to established groundfish harvest policy. The GMT also requested the STAT Team provide biomass forecasts to go with the yield projections under the various harvest control rule options.

The GMT notes that the state of California has actively managed cabezon in recent years, and may choose to limit the fishery to a lower yield than is established by the Council. This approach has recently been adopted for black rockfish in both California and Oregon.

As a result of the SSC's discussion on the cabezon assessment, the GMT is recommending a range of ABCs and OYs that are within 50% of the medium ABC and OY as placeholders for the low and high ABCs/OYs for analysis purposes.

Lingcod Assessment and Resulting Harvest Levels

At the October GMT meeting, Dr. Han-Lin Lai, chair of the STAR Panel, presented the findings of the new coastwide lingcod assessment from the perspective of the STAR Panel as outlined in their report (Exhibit D.6, Attachment 4). This assessment treated the lingcod resource as two separate areas of the stock; a northern area (U.S./Vancouver, Columbia areas) and a southern area (Eureka, Monterey, Conception areas). Both stocks were assessed using the multiple fleet age and sex structured Coleraine model.

In both areas, the assessment model was found to be sensitive to the natural mortality rate (M) and, like many recent assessments, steepness. The STAR Panel agreed to a steepness of 0.9 for the base model. The base case assessment resulted in current depletion of 29% for the northern area (previous assessment indicated 14%), while for the southern areas the current depletion is estimated to be 16% (previous assessment indicated 9%). The consensus of the Panel was that the new lingcod assessment utilizes the best available data and that the results should be used for the Council's 2005-2006 harvest decisions. The Panel noted a degree of uncertainty in the current depletion level, but agreed that depleted lingcod stocks are now increasing.

The GMT underscores one of the STAR recommendations which states the importance of including estimates of discard mortality in future assessments. Observer data is available to estimate commercial and recreational discard. Mortality rates for these discards are available from Jagielo (1996), Albin and Karpov, and Parker *et.al* (2003).

The GMT requested the SSC discuss the following:

1. Which selectivity pattern is most appropriate, asymptotic, or domed? The STAR Panel notes that differential growth by sex and area, and other factors make this decision difficult.

2. Stock delineation: While no specific evidence is available that the southern and northern area lingcod stocks are different at a genetic level, it may be prudent to manage them as separate stocks based on other factors (i.e., the difference in depletion level, different growth rates, sustainability of a higher exploitation rate in the north, slow rate of stock mixing north and south, etc.).

3. Exploitation rate: The lingcod stock could be managed using exploitation rates that are similar in both areas. This may constrain harvest in the north more than is necessary, or it might result in the southern portion of the stock undergoing additional biological depletion. An alternative would be to manage using exploitation rates that fit the specific status of rebuilding in each area. Which case would best support meeting the goals of the coastwide rebuilding plan?

The GMT discussed management of lingcod as a combined coastwide stock, pending the view of the SSC regarding the above topics. If a coastwide OY is selected, the Council should consider setting subarea OYs or harvest guidelines (HG) to avoid the possibility of a disproportionate catch of lingcod coming from the southern or northern area. Since the division of these areas is at Cape Blanco, Oregon, a small adjustment to the subarea OY or HG could be made to allow for management at the Oregon/California border.

The GMT developed the following tables to capture our recommended harvest levels prior to the SSC's discussion. These harvest levels are based on the STAR Panel's preferred base model for the harvest of lingcod at a 60% probability for rebuilding using a coastwide domed selectivity model which is 2,089 metric tons (mt) and 2,098 mt for 2005 and 2006 respectively. The 40-10 management reference point is provided for comparison to the rebuilding output.

TABLE 1a. Recommended harvest (in metric tons) of lingcod for 2005 (areas are north and south of Cape Blanco).

Rebuilding Model	ABC Rule	40-10 Rule	Rebuilding @ P60%
Coastwide (OY)	2,118	1,966	2,089
North (HG)	1,195	1,198	1,464
South (HG)	858	618	629

TABLE 1b. Recommended harvest (in metric tons) of lingcod for 2006 (areas are north and south of Cape Blanco).

Rebuilding Model	ABC Rule	40-10 Rule	Rebuilding @ P60%
Coastwide (OY)	2,124	2,137	2,098
North (HG)	1,192	1,194	1,427
South (HG)	858	764	659

The GMT met with the SSC, following their review of the lingcod assessment and rebuilding trajectories. During their review, the SSC discovered the preferred base model may have over constrained the variability in predicted recruitment. The SSC recommended re-running the base model with relaxed variation in recruitment (Sigma R = 1.0). While it is not possible to predict what the outcome (allowed level of harvest under a rebuilding projection) of the revised model, it is highly likely to fall somewhere below the values recommended by the GMT prior to the SSC review.

The SSC also recommended that the sub-area models should be used, rather than the coastwide version. For the purposes of generating a coastwide OY, these sub-area models will be combined in the rebuilding forecasting tool. Elements such as differential growth can be accommodated, which is preferable over a coastwide projection, which tends to average the differences in sub-area stock status, growth, etc. The SSC agreed with the GMT that it is reasonable to ensure meeting the requirements of the coastwide rebuilding plan by using soft harvest targets (HGs) for the northern and southern areas; however, a large deviation from the ratio of catch to be taken in each area could stall future rebuilding efforts. Finally, the SSC agreed that because of the division of the northern and southern areas at Cape Blanco it would be acceptable from a management perspective to divide the areas at the Oregon/California border. An evaluation of the proportion of biomass or average catch in the zone from Cape Blanco south to the border would be used to adjust the HG for each area.

Because of the need to specify an OY range which will accommodate the results from the revised model (and to facilitate moving forward with development and analysis of harvest options) the GMT recommends using the previous assessment as the lower end of the range, the preferred STAR model as the upper end of the range, and an average of the both as the midpoint. These values are summarized in the ABC/OY table.

COMMERCIAL MANAGEMENT MEASURES

Because the range of ABCs and OYs does not differ much from those in 2004, the GMT believes that the same range of commercial management measure options considered for 2004 should be considered for the 2005-2006 process. Additionally, as a result of the trawl buyback, the upper bound of trawl trip limits should be 200% of the options analyzed for 2004. Further refinement of specific commercial management measures will occur over the winter months (including development of a new model for fixed gear fisheries and a trawl model based on changes resulting from the buyback program), and a preliminary suite of options will be available at the Council meeting in April.

Conversion of Exempted Fishing Provisions into Federal Regulations

During its meetings in September and October, the GMT discussed the conversion of fisheries conducted under past exempted fishing permits (EFPs) into federal regulations that would apply fleetwide. The GMT focused its discussion primarily on the former Oregon Selective Flatfish Trawl EFP and the current Washington Arrowtooth Flounder Trawl EFP. The GMT recommends the provisions and allowances provided for under these EFPs be adopted in federal regulations for the 2005-2006 management period. The GMT has received presentations and written reports on the results from both of these EFPs and, because the data seem to demonstrate that use of these gear configurations result in lower bycatch of overfished rockfish (particularly canary), the GMT would like to use these data for management purposes. To that end, the GMT requests the SSC review the available data to determine whether replacing the current bycatch rates in the bycatch model with those from the EFPs (when the selective gear is used) is warranted. The GMT would appreciate SSC review occur by the March 2004 Council meeting at the latest.

The application of the new EFP bycatch rates, which are significantly lower in some cases than what is currently used in the bycatch model, will likely result in allowing higher trip limits for targeted flatfish species. The Oregon Selective Flatfish Trawl EFP results rely heavily on the use of the prescribed selective flatfish trawl gear used both in research activities and by EFP participants. The Washington Arrowtooth Flounder EFP also experimented with rockfish excluder devices with demonstrated success. Both of these EFPs allowed fishing in the trawl Rockfish Conservation Area (RCA) using bycatch caps for overfished rockfish, 100% observer coverage, and mandatory rockfish retention as additional tools to ensure that the rockfish bycatch was measured and accounted for. The GMT recommends that, if fishing with these selective gears and/or excluders were provided for within the RCA, the Council adopt measures similar to the EFP provisions for bycatch caps, observer coverage, and rockfish retention.

If fishing were confined to the area outside the RCA (shoreward and/or seaward), then the GMT does not recommend additional observer coverage above what is provided by the NMFS West Coast Groundfish Observer Program. The GMT believes that monitoring of bycatch caps is not accomplishable without 100% observer coverage, and therefore, should also not apply while fishing outside the RCA. Mandatory rockfish retention could still be required, however, monitoring of rockfish retention would be limited. The GMT believes that fishing outside the RCA may work for the Selective Flatfish Trawl as some flatfish are available nearshore, however, this option is likely not feasible for targeted arrowtooth flounder fishing which occurs in deeper waters. The GMT also notes that providing a Selective Flatfish Trawl fishery will require an additional gear stratum to be added to the NMFS Observer Program data analysis. Lastly, the GMT recommends that a declaration process be implemented to estimate fishing effort using selective gear before fishing occurs, and the gear requirement language be developed in conjunction with Enforcement Consultants to ensure the specifications are measurable and enforceable.

The GMT would appreciate Council guidance at this meeting regarding whether to proceed with the development of regulations for allowing fishing within the RCA. If the Council decides to only allow fishing outside the RCA, then the process for converting these EFPs into regulations will be much simpler than the process needed to fully develop regulations for bycatch caps and 100% observer coverage. The GMT notes that the funding aspects for observer coverage costs have not been addressed and that a vessel-funded program at 100% coverage may not be economically feasible for some fishermen. The Selective Flatfish Trawl EFP was prosecuted primarily inside 150 fms and the Arrowtooth Flounder Trawl EFP occurred around 100 fms to 120 fms. The trawl RCA for 2004 has a shallow boundary of either 60 fms or 75 fms, depending on the period, which (if carried over into 2005-2006) would not offer much fishing opportunity for flatfish or arrowtooth.

The California Selective Flatfish EFP was conducted in 2003 and is planned for 2004; pending review of the results of the data collected, the GMT recommends that consideration be given to apply the Selective Flatfish Trawl provisions off California inseason in 2005.

Area-Specific Management Measures

The GMT believes that more refined area-specific management should be considered for 2005-2006. Information collected through the federal observer program, state-sponsored EFPs, and data collected through other fishery dependent and independent sources continue to further define the precise locations of both target species and species of concern. Focusing fisheries in areas of high abundance of target species with relatively lower incidence of overfished species may provide both better fishing opportunity as well as conservation benefits than coordinates approximating broad depth strata. Additionally, the implementation of VMS provides us with a tool to accurately manage where fishing occurs.

RECREATIONAL MANAGEMENT MEASURES

The GMT recommends that the same recreational management measure alternatives that were considered and analyzed for the 2004 process be considered again for 2005 and 2006. As in 2004, recreational fisheries measures for 2005 and 2006 should be intended to reduce take of overfished species, primarily bocaccio in the southern area, yelloweye rockfish in the northern area, and canary rockfish coastwide. Following advice received from the Council, the GMT recommends prohibiting retention of both canary and yelloweye rockfish. This prohibition is intended to discourage any targeting by recreational fisheries to reduce the potential of additional targeted catch of those species beyond true unavoidable catch, some of which would be expected to survive if encountered in shallow water. These prohibitions are recommended even in light of the fact that they result in creating some limited discard. This unavoidable discard mortality should be weighed against the benefit of removing incentives to target these species. The prohibitions are recommended to address the low and uncertain stock status of those species, the uncertainty in our ability to track actual removals in all fisheries and the disproportionate effects of recreational removals on rebuilding trajectories. Retention prohibitions for cowcod would also continue in 2005 and 2006. As noted above for commercial fisheries, further refinement of specific recreational management measures will also occur over the winter months, and a preliminary suite of options will be available at the Council meeting in April.

CA NEARSHORE MANAGEMENT

To simplify nearshore management and provide for a more stable fishery in 2005, it may be worthwhile to consider combining components of the shallow nearshore, deeper nearshore, and California scorpionfish complexes into a single nearshore rockfish complex. However, certain key species, such as black rockfish or black/blue rockfish may be considered for separate management. This would allow the nearshore fisheries to be managed on a finer geographic scale without creating an excessive number of harvest guidelines to track and manage.

Nearshore recreational fisheries in California have proved difficult to forecast in recent years, resulting in emergency actions by both state and federal jurisdictions. This has created a large workload for staff and has resulted in considerable confusion among the angling public. Inseason recreational management changes are difficult to convey to the public, resulting in low compliance with the modified regulations. Consequently, it may be advantageous to consider a season where the last two to four months of the year are closed. This could create a "buffer" against unexpectedly high inseason catches, provided that the open season was constructed, so the entire OY or HG was not expected to be taken within the proposed season. In this approach, if the fishery behaved as anticipated, and did not exceed expected catches, then an inseason action would be taken to open the year-end months. This helps eliminate the problem with non-compliance in regard to inseason closures and other actions and reduces staff workload compared to a closure.

Council Action:

4. ABCs/OYs - Provide guidance to GMT on:
   - Further narrow the range of OYs to what may be considered reasonable (e.g., sablefish low OY)
   - Further narrow the range of OYs for bocaccio, widow, yelloweye, and cowcod following consideration of Amendment 16-3 (on Friday)
   - Identify preferred OYs, if possible
   - Provide preferred catch sharing regimes for the more constraining stocks (e.g., canary, yelloweye, bocaccio, lingcod)
     - -- between commercial and recreational fisheries
     - -- among limited entry trawl, fixed gear, open access, and exempted trawl fisheries
     - -- among the three states (recreational)

2. Provide guidance to the GMT on whether to pursue allowing trawl fishing within the RCA using specified gear and/or excluder devices in 2005-2006.

PFMC
11/06/03

Exhibit D.8.c
Supplemental Tribal Recommendations
November 2003

TRIBAL RECOMMENDATIONS ON PRESEASON MANAGEMENT SCHEDULE AND PROCESS, ACCEPTABLE BIOLOGICAL CATCH, PRELIMINARY OPTIMUM YIELD, AND MANAGEMENT MEASURES FOR 2005--2006 FISHERIES

Mr. Chairman,

The Tribes recommend preliminary adoption of the range of harvest levels for 2005 and 2006 as specified in the ABC/OY tables in Exhibit D.8.b, Supplemental GMT Report 3. The Tribes also support analyzing the same management measures for 2005 and 2006 as were considered for 2004, including those measures proposed for Tribal fisheries. Finally, the Tribes support the proposed schedule and process for developing 2005-2006 management measures as outlined in Exhibit D.8.b, Supplemental GMT Report 1.

PFMC
11/06/03

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON PRESEASON MANAGEMENT SCHEDULE AND PROCESS, ACCEPTABLE BIOLOGICAL CATCH, PRELIMINARY OPTIMUM YIELD, AND MANAGEMENT MEASURES FOR 2005-2006 FISHERIES

The Groundfish Advisory Subpanel (GAP) reviewed a draft table - which we received after 5 p.m. last night - displaying recommended preliminary acceptable biological catch (ABC) /optimum yield (OY) levels and the Groundfish Management Team (GMT) statement on harvest levels and management measures which we received at 8:15 this morning. Rather than comment on every ABC/OY recommendation, the GAP will confine its comments to certain species.

In regard to sablefish and yellowtail rockfish, the ranges being presented to the Council are based on projections contained in the most recent stock assessments. However, in both cases, assessment projections assume removals due to fishery mortality. For the last two years, fishery mortality for both these species has been less than assumed in the stock assessments. Therefore, rather than decreasing, the ranges proposed for 2005 and 2006 should be increasing. Simply suggesting that "we'll fix it in the next stock assessment" does no good to those fishermen and processors whose livelihoods have been affected by substantial harvest decreases over a wide range of species. We suggest a higher range be established based on true fisheries mortality and not incorrect assumptions.

Further, we note the high OY level recommended for sablefish is based on an $F_{45\%}$ harvest policy applied to a stock influenced by a regime shift. The medium OY is based on a density-dependent stock. The majority of the GAP doesn't know what more evidence is needed to show the existence of a regime shift than that which the Council sees all around us.

In regard to chilipepper rockfish, an OY of 2,000 mt continues to be recommended. This OY is an artifact of concern for incidental take of bocaccio rockfish at a time when bocaccio stocks were declining. Not only are we seeing an increase in bocaccio as reflected in the latest stock assessment, but in addition, management measures have been enacted that reduce incidental take of bocaccio. The OY value should be increased to reflect these changed circumstances.

For other flatfish, other fish, and Pacific cod, the OY recommendation reflects a 50% "precautionary" cut applied to unassessed stocks. Not only is the ABC/OY table inconsistent in applying this precautionary reduction, but it makes no sense for these species groups. The 50% precautionary reduction has been applied by the Council to *Sebastes* species based on research done on similar species in Alaska. It reflects the slow growth and long lifespan of this genus. Equating this research to Pacific cod, for example, is absurd. This is a highly fecund, fast growing fish whose population in waters under the jurisdiction of this Council is a fringe of a larger population located primarily off Canada and Alaska. Cod stocks expand and contract based on ocean conditions; when they are available in our area - as they are in great numbers at the moment - they are harvested. Arbitrarily and capriciously halving the OY not only removes a potential source of fish for a fleet that is being pushed hither and yon by the need to avoid more

sensitive species, but it will also simply generate more discards - a situation the Council is supposed to avoid. The same is true for other species where a precautionary reduction of 50% is being recommended.
Arguments have been advanced in regard to Pacific cod that Canada has allegedly reduced its harvest limit, and so we should too. First of all, we have no evidence of if - or why - Canada may have taken such action. Second, if our policy is to follow Canada's lead in regard to transboundary stocks, then the GAP suggests we substantially raise the OY for the several transboundary species we are managing at much lower harvest levels.

Further, actions such as this create the impression in the public mind that fisheries managers are acting deliberately to punish harvesters. It is one thing to argue over stock assessment models; in that case, there is at least some rational reason that can be shown for reducing harvest. However, a so-called precautionary cut simply undermines public support for sound fisheries management.

The GAP recommends that for Pacific cod, other fish, and other flatfish a high OY alternative be included which sets the OY equal to the ABC.

In regard to rebuilding species, the GAP recognizes that OY recommendations reflect rebuilding plans. We believe this is an appropriate approach.

In regard to management direction, the GAP has several suggestions which we will outline below.

First, as was mentioned by the GAP earlier this week, we need to explore the option of area management. There is no consensus in the GAP as to whether this is the correct approach to take, but the recent inseason problem we faced underscores the need for at least a preliminary examination. However, the GAP wants to make absolutely clear that - because this can be a contentious issue involving allocation - GAP support for even a cursory look is contingent on the GAP being a full and equal partner with the GMT on any discussions and recommendations involving area management.

Second, in regard to retention of canary rockfish in the Oregon recreational fishery, it was the GAP's understanding following the September Council meeting that the issue of canary attention was to be re-addressed next year. The GAP believes it is premature to make final recommendations at this meeting.

Third, the GMT recommends that the 2005-2006 trip limits be analyzed at a level equivalent to 200% of the 2004 levels. While we agree that higher trip limits should be analyzed to reflect the effects of buyback, we are not sure there should be an arbitrary boundary set. What if the appropriate number is 210%? We recommend that constraints not be set on the analysis.

Finally, the GAP recommends that three shelf rockfish species - copper, brown, and olive - be removed from the California deeper nearshore complex. Starting in January, keeping them in the complex will prevent California limited entry vessels from harvesting these species, again leading to increased discards.

PFMC
11/06/03

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON PRESEASON MANAGEMENT SCHEDULE AND PROCESS, ACCEPTABLE BIOLOGICAL CATCH, PRELIMINARY OPTIMUM YIELD, AND MANAGEMENT MEASURES FOR 2005-2006 FISHERIES

The Groundfish Management Team (GMT) requested the Scientific and Statistical Committee (SSC) review whether bycatch rates from the Washington arrowtooth flounder exempted fishing permit (EFP) and Oregon flatfish EFP could be used in the bycatch model for these sectors for 2005/2006 management. The SSC can comment on this during the March 2004 Council meeting if information on bycatch rates and total catches, along with full documentation of the methodology used to estimate bycatch rates, are available for review.

The GMT requested the SSC review the methodologies used by the states to project inseason recreational catch. This methodology is being revised at present and will be completed by the GMT meeting in January 2004. Review of this methodology will, therefore, have to occur during a workshop in 2004. Although the SSC notes the importance of these projections in the management of groundfish species, the SSC is currently considering a number of other groundfish-related workshops (see Exhibit D.9). The ability of the SSC to dedicate its resources to this review will impact its ability to participate in other workshops during 2004 and review of the revised lingcod and cabezon assessments.

The SSC notes the table of preliminary optimum yield (OY) and acceptable biological catches (ABCs) for 2005/2006. The SSC comments on the revised assessments of lingcod and cabezon and the rebuilding analysis of lingcod provided under Exhibit D.6. The ABCs/OYs for these species will change, possibly to a substantial extent, when the assessments are updated based on the SSC comments.

PFMC
11/06/03

Exhibit D.9.b
Supplemental NMFS Report
November 2003

Proposed Stock Assessment Activities for 2004-2005

Elizabeth Clarke,
Division Director, FRAM Division, NWFSC
October 2004

This strawman for stock assessment activities has four main components:

1) A draft list of primary stock assessments to be conducted and delivered in 2005
2) A proposal to facilitate the assessment by coordinating authors into species groups which may have similar issues
3) A proposed list of workshop topics to be coordinated by the NWFSC
4) A proposed STAR panel schedule for 2005

Below is a table of stock assessments that could be conducted in 2005. We have marked the stock assessments for which agency leads have been identified. This list does not identify which assessments will be full assessments and which will be updates. Clearly, a significant number will have to be updated assessments if the full list of stocks proposed here is to be assessed.

Table 1. Proposed Stock Assessments for 2005

Species	Group Number*	Agency Lead
Whiting	1	NWFSC
Widow	4	SWFSC
Cowcod	6	
Darkblotched	5	NWFSC
Canary	4	NWFSC
Sablefish	2	NWFSC
Dover sole	2	NWFSC
Shortspine Thornyhead	2	NWFSC
Longspine Thornyhead	2	NWFSC
Yelloweye	6	
Bocaccio	4	SWFSC
Petrale Sole	3	NWFSC
Bank Rockfish	5	SWFSC
Chilipepper Rockfish	4	SWFSC

Table 1. Proposed Stock Assessments for 2005 (cont.)

Species	Group Number*	Agency Lead
English Sole	3	NWFSC
Arrowtooth flounder	3	NWFSC
Blackgill	5	
Yellowtail	4	NWFSC
Splitnose	5	SWFSC
Vermillion	5	SWFSC
POP	5	NWFSC
Lingcod	4	
Cabezon	6	NWFSC
California scorpionfish	6	CDFG

*Groups represent the Stock Assessment working groups proposed in the next section.

In order to facilitate discussion between stock assessment authors, we suggest that stock assessment authors be delegated to several working groups (Table 2). Membership of these groups should include the authors of stock assessments of similar species. One of the topics for discussions by these groups could include trends and biological information available on some as yet unassessed species. This will facilitate the eventual assessment of these unassessed species. These groups can meet during 2004 to discuss issues relevant to the stock assessments of species in the group.

Table 2. Proposed Stock Assessment Working Groups

Group Number	Title	Species
Group 1	Pacific Whiting	Pacific Whiting
Group 2	DTS	Sablefish, Dover sole, Shortspine Thornyhead, Longspine Thornyhead, Grenadier
Group 3	Shelf Flatfish	Petrale, English sole, Arrowtooth flounder, Sanddab, Rex Sole
Group 4	Shelf Rockfish	Canary, Yellowtail, Bocaccio, Chilipepper, Widow, Lingcod

Table 2. Proposed Stock Assessment Working Groups (cont.)

Group Number	Title	Species
Group 5	Slope Rockfish	Darkblotched, Bank, Blackgill, POP, Splitnose, Vermillion, Shortbelly
Group 6	Other Rockfish	Cowcod, Yelloweye, Cabezon, California scorpionfish

The multi-year management process specifies that the "off" years can be used to conduct workshops to refine modeling and stock assessment approaches. The NWFSC could coordinate three workshops in 2004 to facilitate the stock assessment process.

The first workshop would focus on data needs for stock assessment. We propose that discussions between authors and data managers and others regarding data needs for the stock assessments occur at this first workshop. In order to facilitate this discussion, Center will assign four staff with the role of coordinating the data needs of stock assessment authors in several areas: Observer information, NWFSC trawl survey information, Catch information and Ageing information.

The second workshop will focus on new models and modeling issues that are relevant to the following year's stock assessments. During such a workshop the NWFSC proposes to introduce a flexible ADMB model and other topics that could be discussed are: methods for communicating uncertainty and refinement of the terms of reference for the 2005 stock assessment review process.

The third workshop will review the methods for calculating recreational CPUE. The Council has suggested this review.

Table 3. Proposed Workshops coordinated by the NWFSC for 2004

Title	Timing	Location
Recreational CPUE Methods	March 2004	Santa Cruz
Stock assessment data workshop	June 2004	Newport
Stock assessment modeling workshop	August 2004	Seattle

Finally, the following is a proposed schedule for the review of stock assessments in 2005. A list of possible species for each panel is included in the table for discussion purposes only. A final list of species to be given updated assessment versus full assessments must be developed prior to finalizing the species to be included in each panel.

Table 4. Proposed Stock Assessment Review Schedule

Panel	Possible Species	Time	Location
STAR Full Assessment Panel One	Pacific Hake	February	Seattle
STAR Full Assessment Panel Two	Sablefish, Dover, Thornyheads	May	Newport
STAR Full Assessment Panel Three	Petrale, English, Sablefish	May	Seattle
STAR Full Assessment Panel Four	Chilipepper, Vermillion, Bank, Splitnose, Shortbelly	Late May	Santa Cruz
STAR Full Assessment Panel Five	Cowcod, California Scorpionfish	June	La Jolla
STAR Update Panel One		August	TBA
STAR Update Panel Two		August	TBA

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON PLANNING OF "OFF-YEAR" NON-REGULATORY SCIENCE ACTIVITIES

The Groundfish Advisory Subpanel (GAP) met with Dr. Elizabeth Clarke to discuss off-year science activities being coordinated by the Northwest Fisheries Science Center (NWFSC).

The GAP is pleased to see that the NWFSC considers the Magnuson-Stevens Act requirement for a two-year review of rebuilding to mean at least an assessment update. The GAP has previously testified that this is the proper way to approach this legal requirement, especially in view of our constantly changing fisheries and data inputs.

The GAP also generally concurs with the approach taken by the NWFSC, as illustrated in Supplemental NMFS Report D.9.b. However, the GAP is concerned the personnel and work requirements inherent in completing the large number of stock assessments and assessment reviews will overwhelm the capabilities of scientists and managers. The GAP, therefore, examined the list of proposed stock assessments provided in Table 1 of the report and suggested modifications based on the following criteria:

- a stock has been designated as overfished and requires a two-year review;
- a stock is commercially or recreationally important, and its status should be examined;
- concerns have been expressed about stock status, based on fishermen's knowledge; and
- the optimum yield for a stock has not been attained in recent years because of lack of harvest.

Using these criteria, the GAP proposes deleting seven stocks from the assessment list and adding one, as follows:
Petrale sole (delete)
Chilipepper rockfish (delete)
English sole (delete)
Arrowtooth (delete)
Yellowtail rockfish (delete)
Splitnose rockfish (delete)
Cabezon (delete)
Starry Flounder (add)

The GAP notes that shortbelly rockfish is also considered for an assessment in the Table 4 list. The majority of the GAP does not believe that resources need to be dedicated to shortbelly at this time. A minority of the GAP believes an assessment on shortbelly would serve as a good indicator of regime shifts.

The GAP appreciates Dr. Clarke consulting with us in regard to our views and we would be happy to provide a further justification for our recommendations.

PFMC
11/06/03

GROUNDFISH MANAGEMENT TEAM REPORT ON PLANNING OF "OFF-YEAR" NON-REGULATORY SCIENCE ACTIVITIES

The Groundfish Management Team (GMT) received an update from Dr. Jim Hastie on the status of the Northwest Fisheries Science Center's (NWFSC) plans for science activities during the "off year" under the new biennial management process adopted by the Council under fishery management plan Amendment 17. The NWFSC tentatively plans to prepare about 21 groundfish assessments in preparation for the 2007-2008 management period. Under the terms of Amendment 17, these assessments would need to be prepared, reviewed by a Stock Assessment Review (STAR) Panel, reviewed by the Scientific and Statistical Committee (SSC), and adopted by the Council by the November 2005 Council meeting. The GMT recommends all STAR Panels for these assessments be convened in 2005. Furthermore, while the Council process may benefit by parsing SSC review and Council adoption of new assessments and rebuilding analyses between the scheduled 2005 Council meetings, the GMT recommends that all assessments and rebuilding analyses be formally reviewed and adopted by the September 2005 Council meeting. This will allow the GMT and other Council advisors the time to digest the abundance of new scientific information and recommend a range of 2007-2008 harvest levels at the November 2005 Council meeting.

PFMC
11/06/03

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON
PLANNING OF "OFF-YEAR" NON-REGULATORY SCIENCE ACTIVITIES

Dr. Elizabeth Clarke presented a draft proposal (Exhibit D.9.b, Supplemental NMFS Report) for "off-year" (2004) science workshops and other non-regulatory activities to the Scientific and Statistical Committee (SSC). In order to motivate activities proposed in 2004, Dr. Clarke's presentation included a description of stock assessments and supporting activities (stock assessment review [STAR] panels, etc.) that would be conducted during 2005 (the "on-year").

Table 1 of the draft proposal lists 27 stock assessments (16 full assessments and 11 expedited). Proposed workshops for 2004 are listed in Table 3, and these are intended to alleviate the workload burden of the full assessment schedule in 2005. The first suggestion for streamlining the 2005 process, which the SSC endorses, is to divide the stock assessments among different work groups based on species type (Dover sole/thornyhead/trawl-caught sablefish complex [DTS], flatfish, rockfish, etc.). The second suggestion is to use data "stewards" for facilitating data acquisition by the stock assessment authors. The SSC highly recommends the use of data stewards in this role.

Dr. Clarke's proposal recommends a data workshop for 2004 to find new ways to improve the efficiency and implementation of different data sources to be used in the 2005 stock assessment process. The SSC considers this data workshop to be a high priority. The SSC also considers the development of standards and methodologies for incorporating new observer-based data to construct catch histories to be an important component of the proposed data workshop.

A second workshop proposed for 2004 is a stock assessment modeling workshop that could include, for example, a review of the new version of the Stock Synthesis Model ("Isabelle") as a standardized analysis tool for the 2005 assessments. The SSC also considers this workshop to be a high priority. While the Recreational Catch Per Unit Effort (CPUE) Workshop was not discussed in detail, the SSC also considers it to be a useful objective. Dr. Clarke indicated that three workshops in 2004 would likely be a maximum for administrative time and effort. Terms of Reference for the workshops will be needed, and the SSC is willing to participate in the drafting of these.

The SSC also discussed the possibility of a B_0/B_{MSY} workshop and also considers this to be worthwhile. Suggestions included coordinating a B_0 workshop with the North Pacific Council, or through the National Marine Fisheries Service (NMFS). Currently, NMFS is involved in an effort to develop environmentally explicit stock assessments, which may have a major impact on the calculation of reference points like B_0. Ecosystem-based management could be another area for coordination with the North Pacific Fishery Management Council.

The main obstacle for completing all the stock assessment objectives for 2005 appears to be scheduling and personnel for the stock assessment and review (STAR) panels that will be required for the full assessments (Table 4). The administrative maximum here is likely to be five full meetings. For logistical reasons, it appears these meetings would need to occur during the spring and fall of 2005. Even under this schedule, the SSC is concerned that all of the objectives listed in the proposal for 2005 cannot be satisfactorily completed under the current STAR process. The only alternatives appear to be conducting fewer assessments or revising the current STAR process, moving towards lighter reviews or more expedited assessments.

PFMC
11/05/03

Exhibit D.10.c
Supplemental NMFS Report
November 2003

result in a harvest well in excess of the established quota.

For the aforementioned reasons, the AA also finds good cause to waive the 30 day delay in the effectiveness of this action under 5 U.S.C. 553(d)(3).

This action is taken under 50 CFR 622.43(a) and is exempt from review under Executive Order 12866.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: October 29, 2003.

Bruce C. Morehead,

Acting Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. 03–27610 Filed 10–29–03; 4:43 pm]

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 660

[Docket No. 03043016–3258–02; I.D. 040103C]

RIN 0648–AQ58

Fisheries off West Coast States and in the Western Pacific; Pacific Coast Groundfish Fishery; Vessel Monitoring Systems and Incidental Catch Measures

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Final rule.

SUMMARY: NMFS issues a final rule to require vessels registered to Pacific Coast groundfish fishery limited entry permits to carry and use mobile vessel monitoring system (VMS) transceiver units while fishing in state or Federal waters off the coasts of Washington, Oregon and California. This action is necessary to monitor compliance with large-scale depth-based conservation areas that restrict fishing across much of the continental shelf.

This final rule also requires the operators of any vessel registered to a limited entry permit and any open access or tribal vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to declare their intent to fish within a conservation area specific to their gear type, in a manner that is consistent with the conservation area requirements. This action is intended to further the conservation goals and objectives of the Pacific Coast Groundfish Fishery Management Plan (FMP) by allowing fishing to continue in areas and with gears that can harvest healthy stocks while reducing the incidental catch of low abundance species.

DATES: Effective January 1, 2004.

ADDRESSES: Copies of the environmental assessment/regulatory impact review/ final regulatory flexibility analysis (EA/ RIR/FRFA) and the finding of no significant impact prepared for this action may be obtained from the Pacific Fishery Management Council (Council) by writing to the Council at 7700 NE Ambassador Place, Portland, OR 97220, phone: 503–820–2280, or may be obtained from William L. Robinson, Northwest Region, NMFS, 7600 Sand Point Way NE., BIN C15700, Bldg. 1, Seattle, WA 98115–0070. Copies of the small business compliance guide are available from D. Robert Lohn, Administrator, Northwest Region, NOAA Fisheries, Bldg. 1, 7600 Sand Point Way NE., Seattle, WA 98112–0070. Written comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this final rule may be submitted to NMFS at the address above and by e-mail to *David_Rostker@omb.eop.gov,* or faxed to (202) 395–7285.

FOR FURTHER INFORMATION CONTACT: Becky Renko or Yvonne deReynier at the Northwest Region, NMFS, phone 206–526–6140; fax: 206–526–6736; and e-mail *becky.renko@noaa.gov* or *yvonne.dereynier@noaa.gov;* or Svein Fougner (Southwest Region, NMFS), phone: 562–980–4000; fax: 562–980–4047; and e-mail: *svein.fougner@noaa.gov.*

SUPPLEMENTARY INFORMATION:

Electronic Access

This rule is accessible via the Internet at the Office of the Federal Register's Web site at *http://www.access.gpo.gpv/su-docs/aces/aces140.htm.* Background information and documents are available at the NMFS Northwest Region Web site at *http://www.nwr.noaa.gov/1sustfsh/gdfsh01.htm* and at the Council's Web site at *http://www.pcouncil.org.*

Background

A proposed rule for this action was published on May 22, 2003 (FR 86 27972). NMFS requested public comment on the proposed rule through July 21, 2003. During the comment period on the proposed rule, NMFS received 4 letters, including those received from the Council and from the public at the Council's June 2003 meeting. These comments are addressed later in the preamble to this final rule. See the preamble to the proposed rule for additional background information on the fishery and on this final rule.

Under this final rule, any vessel registered to a limited entry permit for the Pacific Coast groundfish fishery will be required to have an operating NMFS type-approved VMS transceiver unit on board while fishing in state or Federal waters off the states of Washington, Oregon and California. This regulatory amendment will require that the vessel owner or operator of a vessel registered to a limited entry groundfish permit carry and use a NMFS type-approved VMS transceiver at all times when engaged in any and all fisheries off the U.S. West Coast. A vessel owner required to continuously operate a VMS transceiver may choose to send an exemption report. This report will allow the owner to disconnect the power to the transceiver unit and discontinue transmissions during a period when the vessel will be continuously out of the water for more than 7 consecutive days, or will allow the owner to reduce or discontinue the VMS transmissions if the vessel is continuously operating seaward of the exclusive economic zone (EEZ) off Washington, Oregon, or California for more than 7 consecutive days.

Before the vessel is used to fish in any trawl Rockfish Conservation Area (RCA) or the Cowcod Conservation Areas (CCA) in a manner that is consistent with the requirements of the conservation areas, a declaration report will be required from (1) any vessel registered to a limited entry permit with a trawl endorsement; (2) any vessel using trawl gear, including exempted gear used to take pink shrimp, spot, and ridgeback prawns, California halibut and sea cucumbers; and (3) any tribal vessel using trawl gear. In addition declaration reports are required from vessels registered to limited entry permits with longline and pot endorsements, before these vessels can be used to fish in any non-trawl RCA or the CCA. The declaration report must be submitted before the vessel leaves port on the trip to fish in an RCA or a CCA. Each declaration report will be valid until cancelled or revised by the vessel operator. The declaration report must state the type of fishing in which the vessel will be engaged. If the type of fishing changes, a new declaration report must be submitted. For further information regarding declaration reports, see the preamble for the proposed rule for this action (68 FR 227972, May 23, 2003).

VMS is a tool that allows vessel activity to be monitored in relation to geographically defined management areas. VMS transceiver units installed aboard vessels automatically determine the vessel's position using Global Positioning System (GPS) satellites and transmit that position to a land based processing center via a communication satellite. At the processing center, the information is validated and analyzed before being disseminated for various purposes, which may include fisheries management, surveillance and enforcement.

VMS transceiver units are designed to be tamper resistant. In most cases, the vessel owner is not aware of exactly when the unit is transmitting and is unable to alter the signal or the time of transmission. On September 23, 1993 (58 FR 49285) and March 31, 1994 (59 FR 151180), NMFS published VMS standards for transceiver units and service providers used for Federal fisheries management.

Time and area closures have long been used in the Pacific Coast groundfish fishery to restrict fishing activity in order to keep harvests within sector allocations and at sustainable levels and to prohibit the catch of certain species. RCAs are depth-based management areas based on bottom depth ranges where overfished rockfish species commonly occur. The RCAs are large, irregularly-shaped geographical areas that are defined by a series of latitudinal and longitudinal coordinates which generally follow depth (fathom) contours. The RCAs differ from previously closed areas because they extend far offshore, making air and surface craft enforcement difficult.

The depth-based management strategy associated with the RCAs is designed to allow fishing for healthy stocks to continue, while protecting overfished species. However, it presents new enforcement challenges, and requires new tools such as VMS to supplement existing enforcement mechanisms. NMFS and cooperating enforcement agencies (such as the U.S. Coast Guard and state marine law enforcement agencies) will continue to use traditional enforcement methods such as aerial surveillance and marine patrols that have proved effective in the past. Adding requirements for VMS and declaration reports will allow the enforcement agencies to continuously monitor vessels fishing in, and transiting through, the RCAs.

Because of the critical need to monitor the integrity of conservation areas that protect overfished stocks, while allowing for the harvest of healthy stocks, NMFS believes it is necessary to proceed with this rulemaking with the requirement for fishery participants to bear the cost of purchasing, installing, and maintaining VMS transceiver units, VMS data transmissions, and reporting costs associated with declaration requirements. If state or Federal funding becomes available, fishery participants may be reimbursed for all or a portion of their VMS expenses.

NMFS may publish, and as necessary amend, a list of NMFS type-approved mobile transceiver units and communication service providers for the Pacific Coast groundfish fishery in the **Federal Register** or notify the public through other appropriate media or mailings to the permit owner's address of record. NMFS will also distribute installation and activation instructions for the affected vessel owners.

The installation of the VMS transceiver is expected to take less than 4 hours and will be the responsibility of the vessel owners. Prior to fishing, the vessel owner will be required to fax an activation report to NMFS to verify that the unit was installed correctly and has been activated.

Comments and Responses

Comment 1: Because the rule requires vessels with limited entry permits to have VMS transceiver units on at all times, there is no need to require declaration reports for vessels fishing in non-groundfish fisheries in the RCAs.

Response: Unless a vessel meets the specified exemption criteria and has submitted an exemption report, this rule requires all vessels registered to limited entry permits to continuously operate a VMS mobile transceiver regardless of the fishery. Owners/operators of vessels registered to limited entry permits must also submit a declaration report before leaving port on a trip in which (1) a vessel registered to a limited entry permit with a trawl endorsement is used to fish in any trawl RCA or the CCA, or (2) before a vessel registered to a limited entry permit with a pot or longline endorsement is used to fish in any non-trawl RCA or the CCA. Declaration reports are required whether the vessel is fishing for groundfish or non-groundfish species. Declaration reports are not required for vessels fishing seaward or shoreward of the conservation area.

Limited groundfish fishing (*i.e.*, mid-water whiting during the primary season, widow and yellowtail when limits are provided, etc.) as well as non-groundfish fishing are permitted within the RCA. Declaration reports are intended to provide enforcement officers with information to make an initial determination about a vessel's activity in relation to the conservation area restrictions. Because a VMS transceiver unit only transmits the vessel's position, a declaration report is needed to identify the intended target species and gear being deployed. Without a declaration report VMS would be less effective as an enforcement tool because costly visual observations would be required to determine if a limited entry vessel was fishing in a manner consistent with conservation area restrictions.

Comment 2: Three commenters stated that declaration reports alone would be adequate for monitoring limited entry vessels that are legally participating in non-groundfish fisheries within the conservation areas. Therefore, this rule should be amended to allow vessels to discontinue position transmissions when they are participating in non-groundfish fisheries.

Response: NMFS believes that requiring continuous operation of the VMS transceiver units is necessary to maintain the integrity of the monitoring program, and may produce a deterrent effect. Requiring the VMS mobile transceiver unit to be operated continuously will deter fishers from intentionally turning the units off to avoid detection or inadvertently forgetting to turn the units on when required. Requiring the transceiver units to be operated while the vessel is participating in non-groundfish fisheries will allow enforcement officers to easily identify vessels that are fishing in a manner consistent with the conservation area requirements during routine enforcement activities. This will allow traditional enforcement tools to be used more effectively.

Comment 3: One commenter stated that reliance on declaration reports alone for monitoring open access trawl and non-trawl vessels will not be adequate to ensure compliance with conservation area restrictions.

Response: Traditional enforcement methods will continue to be used to monitor fishing activities. Although not as effective as VMS, declaration reports will improve the information that is available for monitoring compliance with the depth-based restrictions and allow traditional enforcement tools to be used more efficiently.

During the initial phase of this program, the Council recommended that vessels registered to limited entry permits be required to carry and use VMS transceiver units while fishing off the West Coast. This is intended to be a pilot program that begins with the sector that is allocated the majority of the groundfish resources. NMFS believes that a VMS based monitoring program is an effective tool for monitoring compliance with time area restrictions and is therefore considering extending the requirement for vessels that participate in the open access and recreational sectors of the fishery.

Comment 4: VMS transmissions should only be required when a vessel is operating outside of the "boundary line" for state territorial waters.

Response: NMFS believes that it is necessary to require the VMS transceiver unit be operated from 0–200 nautical miles offshore (in state marine and Federal waters). Though the term EEZ was used in the proposed rule, and is defined at 50 CFR 660.10 as "all waters from the seaward boundary of each of the coastal states to a line in which each point is 200 nautical miles (370.40 km) from the baseline from which the territorial sea of the U.S. is measured", the term was used in error. NMFS believes that requiring continuous operation of the VMS transceiver units is necessary to maintain the integrity of the monitoring program as it might have a deterrent effect. The intent was for the rule to apply to all waters 0–200 nautical miles offshore. Data presented in the EA/RIR/FRFA supports this area of coverage.

In some cases the RCAs, which were created to reduce the impacts on overfished species, cross between state and Federal waters. A major benefit of VMS is its deterrent effect. It has been demonstrated that if fishing vessel operators know that they are being monitored and that a credible enforcement action will result from illegal activity, then the likelihood of that illegal activity occurring is significantly diminished. Requiring the VMS mobile transceiver unit to be operated continuously will deter fishers from intentionally turning the units off to avoid detection or inadvertently forgetting to turn the units on when required.

Comment 5: A fixed gear fisherman expressed concern about regulatory provisions regarding the transiting of RCAs. The provision requires limited entry vessels with trawl endorsements to have all trawl gear stowed and to be under continuous transit when in a trawl conservation area, unless otherwise announced in the **Federal Register.** The commenter indicated that many fishing fixed gear grounds are in areas deeper than 100 fathoms and are surrounded by shallow waters, that asking the vessel to move to deeper waters to drift while the crew is sleeping is too much, and that there will be a greater chance of injury due to fatigue. The commenter also expressed concern about increased fuel consumption and wear on the engines.

Response: Navigational rules promulgated by 33 U.S.C. Sections 1601–1608, require vessels to maintain a proper look-out by sight as well as by hearing and all other available means appropriate to the circumstances and conditions. This requirement is intended to allow for a full appraisal of the navigational situation to avoid the risk of collision. At this time, the transiting requirement to which the commenter is referring applies only to vessels registered to a limited entry permits with a trawl endorsement. However, at its October 7, 2003, meeting (68 FR 54895, September 19, 2003), the Council's ad hoc VMS Committee considered expanding this requirement to the fixed gear vessels, but failed to reach consensus on the issue. The need for transiting requirements for fixed gear vessels will be brought before the Council at a future date.

Comment 6: While bringing up the trawl net, many small trawl vessels are at the mercy of the wind and currents and unable to change their location. Small vessels could drift into the trawl RCAs while retrieving their gear and be in violation of the transiting provision that requires a vessel to have all trawl gear stowed and to be under continuous transit when in a trawl conservation area, unless otherwise announced in the **Federal Register.**

Response: Position reports from vessels drifting with the currents can look similar to vessels that are fishing. Given limited enforcement resources, NMFS Enforcement believes that the integrity of the restricted areas must be maintained. Therefore NMFS recommends that each vessel operator provide an adequate buffer to allow for drift due to weather and currents.

Comment 7: It is not practical to require vessels to follow the depth contours while transiting an RCA rather than allowing the most direct route to be traveled.

Response: This rule does not specify where a vessel is required to transit an RCA. The transiting provision only requires a vessel to be under continuous transit and all groundfish trawl gear stowed in accordance with 660.322(b)(8) or as authorized or required in the annual groundfish management measures published in the **Federal Register.**

Comment 8: VMS transceiver units need to have a non-fishing mode and the ability to be used in different ways when sleeping or moving between areas.

Response: NMFS is testing several VMS transceiver models that have a function that detects lack of vessel movement and stops sending position reports (greatly reducing power consumption and transmittal costs) when the vessel is not moving. When the vessel begins moving again, hourly position reports resume. NMFS believes that it is necessary to require that the VMS transceiver units be operable at all times, so the integrity of the monitoring program is maintained.

Comment 9: If a vessel were to shut down and drift to allow the crew to sleep, the vessel could drift into the trawl RCA and appear to be fishing.

Response: As also noted under comment 5, navigation rules promulgated by 33 U.S.C. Sections 1601–1608, require vessels to maintain a proper look-out by sight as well as by hearing and all other available means appropriate to the circumstances and conditions. Although this requirement is intended to allow for a full appraisal of the situation to avoid the risk of collision, having a crew member on watch may also be used to prevent drifting into restricted areas.

Comment 10: To prohibit only limited entry trawl vessels from any activity other than transiting a RCA, and to not have the same prohibition for fixed-gear vessels is discriminatory.

Response: NMFS does not agree that prohibiting only limited entry trawl vessels from any activity other than transiting an RCA is discriminatory. NMFS believes that it is necessary to have a provision that prohibits limited entry trawl vessels (except for those conducting allowed activities) from any activity other than transiting the RCA. Track lines from drifting vessels can look similar to track lines from a vessel that is fishing. Therefore, drifting vessels would cause unnecessary expenditure of enforcement resources to check to see if drifting vessels were actually engaged in illegal fishing in the conservation areas. However, at its October 7, 2003, meeting (68 FR 54895, September 19, 2003), the Council's ad hoc VMS Committee considered expanding this requirement to the fixed gear vessels, but failed to reach consensus on the issue. The need for transiting requirements for fixed gear vessels will be brought before the Council at a future date.

Comment 11: The rule should specifically address RCA transiting requirements for trawl vessels that are legally allowed to fish for groundfish within the trawl RCA (*i.e.*, mid-water whiting during the primary season or non-groundfish fishing). Currently it does not allow for legal fishing with trawl gear by vessels registered to limited entry permits.

Response: Language has been added to the prohibition at § 660.306 (bb) that clarifies that limited entry vessels with trawl endorsements will be allowed to conduct fishing activities that are permitted in the trawl RCA as specified in the groundfish harvest specifications and management measures published in the **Federal Register**.

Comment 12: Two commenters indicated that there are no provisions for transferring VMS transceiver units from one owner to another or one boat to another. The commenter suggests the addition of a simple notification system where a unit owner can notify NMFS that he or she no longer owns or controls the unit. The same notification system would be used in the event of a catastrophic vessel loss where a unit cannot be recovered.

Response: In response to the comments, NMFS has added a field to the activation report that can be used to recognize that a transceiver VMS unit has been previously used on another vessel. Regulatory language has been added that will prohibit transceiver units from being registered to more than one vessel and that requires proof of ownership of the VMS unit or documentation of service termination from the communication service provider before the transceiver unit can be registered to a new vessel.

Comment 13: Two commenters expressed concern that the VMS program will continue indefinitely, even though the need for VMS may disappear if the existing area closures are discontinued. The commenters recommended that a termination clause be written into the final rule.

Response: NMFS does not agree that there is a need to include a termination clause at this time. At any point in the future, the Council may choose to recommend changes and NMFS may choose to revise or eliminate the groundfish regulations pertaining to VMS.

Comment 14: One commenter indicated that VMS transceiver units should also be required for the open access vessels that target rockfish on the shelf or slope.

Response: During the initial phase of this program, the Council recommended that vessels registered to limited entry permits be required to carry and use VMS transceiver units while fishing off the West Coast. This is intended to be a pilot program that begins with the sector that is allocated the majority of the groundfish resources. NMFS believes that a VMS-based monitoring program is an effective tool for monitoring compliance with time area restrictions. At its October 7, 2003, meeting (68 FR 54895, September 19, 2003), the Council's ad hoc VMS Committee considered expanding the VMS requirements to other sectors of the fishery, including the open access groundfish fisheries.

Comment 15: The proposed rule requires that a VMS unit be installed according to procedures established by NMFS. Discussions with NMFS indicate that these procedures will include installation by a NMFS-certified installer. The commenter believes that the installation requirements should be limited to installation pursuant to manufacturer instructions. Certified installers are often not available in smaller ports, and this requirement can be both time consuming and costly.

Response: The rule does not require that a certified person perform the installation. Most of the systems being considered for type-approval are do-it-yourself installations. Vessels that already have VMS transceiver units installed for other fisheries or personal purposes may continue to use their current transceiver unit provided it is a model that has been type-approved for the Pacific Coast groundfish fishery and the software has been upgraded to meet the defined requirements.

Given that the VMS hardware and satellite communications services are provided by third party businesses, as approved by NMFS, there is a need for NMFS to collect information regarding the individual vessel's installation in order to ensure that automated position reports will be received without error. This would require that an activation report which contains a certification checklist be completed by the individual who installed the unit and that it be returned to NMFS prior to using the VMS transceiver to meet regulatory requirements. An activation report would be submitted to NMFS by the VMS installer who would certify the information about the installation by signing the checklist and returning it to NMFS. The checklist indicates the procedures to be followed by the installers and, upon certification and return to NMFS, provides the Office of Law Enforcement with information about the hardware installed and the communication service provider that will be used by the vessel operator.

Comment 16: The proposed rule does not include a provision for a vessel owner to purchase a backup transceiver unit that can be used if the primary transceiver fails during an extended fishing trip. One commenter suggests that a provision be added that will allow a back-up unit to be brought on-line during the course of a fishing trip through simple declaration procedures. This would prevent trips from being interrupted and would continue to meet the information need identified by NMFS.

Response: Nothing in this rule prohibits a vessel owner/operator from submitting an activation report for a back-up VMS transceiver unit. A separate activation report will need to be submitted for each VMS transceiver unit. For clarification, NMFS will ask that the owner/operator specify in the activation report if the unit is the primary or a back-up unit.

Comment 17: The action that NMFS intends to take if the VMS transceiver fails during a fishing trip is unclear. The rule should specifically state that if the VMS transceiver fails during a fishing trip, the vessel will be allowed to complete the current fishing trip provided the vessel operator notifies NMFS of the malfunction.

Response: As stated at § 660.359(d)(5), it is the vessel operator's responsibility to notify NMFS when he or she becomes aware that transmission of automatic position reports have been interrupted. Upon contact with NMFS, the vessel operator will be given specific instructions that may include, but are not limited to, manually communicating to a location designated by NMFS the vessel's position or returning to port until the VMS is operable. Because each incident must be considered on a case-by-case basis, NMFS believes that the regulations adequately reflect the range of actions that may be taken. After a fishing trip during which interruption of automatic position reports has occurred, the vessel owner or operator must replace or repair the mobile VMS transceiver unit prior to the vessel's next fishing trip.

Comment 18: The proposed rule states that a vessel registered to limited entry permits must have the VMS transceiver on at all times whether the vessel is fishing or out of the water. The vessel should only be required to have the VMS unit on when it is fishing for groundfish outside the boundary line for state territorial waters. Requiring transmissions when the vessel is out of the water or when it is not participating in the groundfish fishery is an unnecessary cost to fishermen.

Response: A vessel owner/operator may choose to send an exemption report to discontinue transmissions during a period when the vessel will be continuously out of the water for more than 7 consecutive days. To reduce the reporting burden on vessels outside the EEZ, an optional exemption report was added to the rule to allow vessels to reduce or discontinue VMS hourly position reports when they are out of the EEZ for more than 7 consecutive days. In all other circumstances, NMFS believes that it is necessary to require continuous transmissions of vessel positions to allow limited enforcement resources to be used efficiently and thereby maintain the integrity of the conservation areas.

Comment 19: Vessels that are registered to "small fleet" limited entry permits are placed on trailers and removed from the water each day. Requiring the vessel to keep the VMS transceiver unit on at all times would result in position transmissions from land and unnecessary transmission fees. The commenter recommends that NMFS establish a geo-fence that would trigger the VMS transceiver unit to stop and start position transmissions.

Response: NMFS recognizes there may be some unique circumstances where it is unnecessary for position reports to be sent while vessels are on land, and is therefore evaluating geo-fencing and other technologies to address the commenter's concern. Upon testing and evaluation, these technologies may provide options for modifying position reporting requirements in the future.

Comment 20: We note that the EA/RIR/IRFA prepared for the proposed rule grossly underestimates installation costs, because they do not include compensation for the travel time of a certified installer to remote ports.

Response: The use of certified installers is not required. The installation of the transceiver units was estimated at 4 hours per vessel, or $120, at $30 per hour for the do-it-yourself installation. The actual installation time for a VMS unit is estimated to be less than two hours, but a higher estimate of 4 hours/vessel is used, based on a worst case scenario where the power source (such as a 12-volt DC outlet) is not convenient to a location where the VMS unit can be installed. Most of the systems being considered for type-approval are do-it-yourself installations. Given that the VMS hardware and satellite communications services are provided by third party businesses, as approved by NMFS, there is a need for NMFS to collect information regarding the individual vessel's installation in order to ensure that automated position reports will be received. This information collection would not increase the time burden for installation of VMS, but would require that an activation report, which includes a certification checklist, be returned to NMFS prior to using the VMS transceiver to meet regulatory requirements. The time and cost burden of preparing and submitting installation information to NMFS is minor. Submission of a checklist would be required only for the initial installation or when the hardware or communications service provider changes. NMFS estimates a time burden of 5 minutes ($2.50 at $30 per hour) for completing the checklist and additional $3 for mailing/faxing to NMFS, for a total of $5.50 per occurrence.

Comment 21: Several commenters indicated that NMFS should pay for the costs of the VMS transceiver unit, while the vessel owner should only be responsible for installation and operation related costs of the VMS transceiver units.

Response: Although the Council recommended that NMFS fully fund a VMS monitoring program, it is not possible at this time because neither state nor Federal funding is available for purchasing, installing, or maintaining VMS transceiver units, nor is funding available for data transmission. Because of the critical need to monitor the integrity of conservation areas that protect overfished stocks, while allowing for the harvest of healthy stocks, NMFS believes it is necessary to proceed with this rulemaking. To move this rulemaking forward at this time, it is necessary to require fishery participants to bear the cost of purchasing, installing, and maintaining VMS transceiver units, VMS data transmissions, and reporting costs associated with declaration requirements. If state or Federal funding becomes available, fishery participants may be reimbursed for all or a portion of their VMS expenses.

Comment 22: The cost for the VMS transceiver units and installation presented in the preamble and the classification section under the Initial Regulatory Flexibility Analysis (IRFA) of the proposed rule are not consistent.

Response: The cost values for the VMS transceiver units and installation presented in the preamble and those values presented in the classification section under the IRFA of the proposed rule are consistent, but represent different groups of VMS transceiver units. The values presented in the preamble represent the current price range for all VMS units that are nationally type-approved for fishery monitoring in the various NMFS regions, this includes upgraded units with 2-way communications and other value added features. In contrast, the values presented in the IRFA are based on a price range for the units that are likely to be type-approved for the Pacific Coast groundfish fishery.

Comment 23: The estimated benefits of VMS presented in the classification section of the proposed rule under the EA/RIR/IRFA analysis misrepresent the benefits of VMS. Benefits associated with depth-based management should be removed from the analysis since there is no revenue gain to the fishermen from the VMS requirements.

Response: The 2003 depth-based management regime has closed large areas to fishing, but has allowed more liberal trip limits for healthy stocks than would have been available without depth-based closures. To continue to allow this combination of depth closures and higher limits, it is necessary to establish a monitoring program to ensure the integrity of these large depth-based conservation areas. With the 2003 Annual Specifications and Management Measures, the Council recommended several measures, including implementation of VMS, to track movement of vessels through and within depth zones. Without a management strategy based on depth-based conservation areas, the fishery would most likely be managed under more seriously constrained limits on healthy stocks that co-occur with overfished species. Therefore, NMFS believes that the values accurately reflect the benefit to the fisheries from VMS.

Comment 24: Because the cost of the VMS unit and its maintenance will likely be the burden of the vessel owner/operator, the type-approved units must be cost effective and durable enough for vessels registered to "small fleet": 16–21 ft (4.8–6.4 m), limited entry permits.

Response: NMFS is testing VMS transceiver units that are appropriate for "small fleet" limited entry vessels with the intent of type-approving models that are cost effective and durable enough for vessels registered to "small fleet" limited entry permits.

Comment 25: Because the cost of the VMS unit and its maintenance will likely be the burden of the vessel owner/operator, the approved units must be cost effective and durable enough for vessels registered to "small fleet" limited entry permits.

Response: NMFS is testing VMS transceiver units with the intent of type-approving models that are cost effective and durable enough for vessels registered to "small fleet" limited entry permits.

Comment 26: To take enforcement action against a vessel, NMFS should require that an actual observation be made of the violation, so it will hold up in court.

Response: By law, enforcement proceedings are subject to standards of proof and rules of evidence that will determine what evidence is sufficient in particular cases.

Comment 27: The commenter recommends that VMS transceiver units suitable for use on "small fleet" (16–21 ft) (4.8–6.4 m in length) limited entry vessels, *i.e.*, units that are small and durable, be type-approved for use under this rule.

Response: NMFS is in the process of testing and type-approving VMS transceiver units that are appropriate for "small fleet" limited entry vessels.

Comment 28: One commenter indicated that the final rule should not become effective before the congressionally-mandated capacity reduction program becomes effective because these same vessels would be affected by both actions. Another commenter stated that the final rule should not become effective before January 1, 2004. While yet another commenter stated that it is highly problematic because depth-based management measures are currently in place and need to be monitored. This commenter recommended immediate implementation of VMS.

Response: At its November 2002 meeting, the Council recommended that NMFS move forward with a proposed rule to implement a VMS program for the Pacific Coast groundfish fishery as soon as possible in 2003. NMFS recognizes the importance of VMS for monitoring depth-based management measures and intended to implement the program as soon as possible in 2003 while allowing adequate time for public review and for the affected public to purchase and install all of the necessary equipment and services.

At its June 2003 meeting, the Council reviewed the proposed rule and recommended that the effective date for the rulemaking be January 1, 2004. NMFS agrees with the Council's recommendation for the following reasons: (1) A substantial proportion of limited entry trawl vessels (20–40 percent) could be bought out of the fishery by January 2004, and requiring these vessels to purchase VMS units before then would be unnecessary; and (2) additional time is needed for NMFS to put the necessary VMS infrastructure in place. This is because defining and verifying coordinates for depth contour lines, creating a "geo-fence" for "small fleet" limited entry permits, and completing the type-approval process will require more time than had originally been estimated.

Comment 29: NMFS should require vessels to have VMS transceiver units with 2-way communications rather that the proposed requirement for 1-way communications. Having 2-way communications would allow NMFS to communicate directly with vessels to determine if they are engaged in illegal fishing rather than having to conduct an at-sea observation.

Response: NMFS agrees that the benefits of a VMS monitoring program that includes 2-way communications are greater than a program with 1-way communications. This is because 2-way communications can be used for transmitting reports from the vessel, receiving operational messages, and for inquiring about use of distress signal. However, the cost to industry and the diversity of fishery participants were also considered. NMFS determined that the Council recommended alternative which included a 1-way communications system (ship-to-shore) satisfied the defined need for action, while being less costly than a 2-way communication system. This rule defines minimum requirements and will not preclude a vessel owner from procuring a VMS unit type-approved by NMFS for the Pacific Coast groundfish fishery that provides additional services such as 2-way communications and has capabilities used exclusively by the vessel owner and operator.

Changes From the Proposed Rule

This final rule includes the following changes from the proposed rule:

1. In § 660.306(z)(6) language has been added that will prohibit transceiver units from being registered to more than one vessel at a time.
2. In § 660.306(bb) language has been added to allow limited entry vessels with trawl endorsements to conduct fishing activities that are permitted in the trawl RCA.
3. In § 660.359(d)(2)(ii) language has been added to require that a proof of ownership of the VMS transceiver unit or service termination from the communication service provider be provided in order for the unit to be registered to a new vessel.
4. In § 660.306(Z)(1) and 660.359(b) references to EEZ have been changed to clearly state that the rule applies to state and Federal marine waters 0–200 nautical miles.

Classification

The Administrator, Northwest Region, NMFS, determined that the FMP regulatory amendment is necessary for the conservation and management of the Pacific Coast groundfish fishery and that it is consistent with the Magnuson-Stevens Act and other applicable laws.

NMFS prepared an IRFA which was summarized in the proposed rule published on May 22, 2003 (68 FR 27972). NMFS prepared a FRFA that describes the economic impact of this action on small entities. The following is the summary of the FRFA. The need for and objectives of this final rule are contained in the SUPPLEMENTARY INFORMATION of the preamble and in the proposed rule.

This final rule does not duplicate, overlap, or conflict with other Federal rules. A range of five alternative actions were considered and analyzed. The alternative monitoring systems included: (1) The status quo, (2) a declaration system, (3) a basic VMS program with 1-way communications (the proposed action), (4) an upgraded VMS program with 2-way communications, and (5) the expanded use of fishery observers. Vessel plotters were recommended as a monitoring system by the industry. After consideration, it was determined that vessel plotters, which were designed as a navigational aid, would not be an adequate enforcement monitoring tool for depth-based management.

RCAs are large-scale, depth-related closed areas that are being used to restrict fishing across much of the continental shelf. The depth-based management strategy associated with the RCAs is designed to allow fishing for healthy stocks to continue, while protecting overfished species. However, it presents new enforcement challenges, and requires new tools such as VMS to supplement existing enforcement mechanisms.

Depth-based management measures would have remained in place under each of the alternatives, except that it is reasonable to believe that they would have been discontinued in 2004 under the status quo alternative. Declaration reports (Alternative 2) alone are not as effective as VMS in monitoring a vessel's location in relation to restricted areas. Observers (Alternative 5), the most expensive of the alternatives, provide detailed information, much of which goes beyond the identified need. VMS is an effective tool for monitoring vessel location. The two approaches to VMS considered during the rulemaking process were: A basic VMS system (Alternative 3—the preferred action) and an upgraded VMS system (Alternative 4). The primary difference between the two alternatives was that the upgraded system uses two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel, while the basic system only transmits positions to a shore station. It was determined that the basic system was the minimum system that would maintain the integrity of the closed areas. However, this action will not preclude vessels from installing an upgraded VMS system.

The alternative coverage levels for declarations and VMS monitoring ranged substantially, from all limited entry vessels actively fishing off the West Coast to all limited entry, open access, and recreational charter vessels regardless of where fishing occurs. During the initial phase of this program, the Council recommended starting with vessels registered to limited entry permits fishing in state or Federal waters off the Washington, Oregon, and California coasts to be required to have VMS transceiver units. This is intended to be a pilot program that begins with the sector that is allocated the majority of the groundfish resources. In addition, alternative approaches for funding the purchasing, installation, and maintenance of VMS transceiver units, as well as the responsibilities for transmission of reports and data were considered and included the following alternatives: Vessel pays all costs, vessel pays only for the transceiver, NMFS pays for initial transceiver, and NMFS pays all costs. Although the Council recommended that NMFS fully fund a VMS monitoring program, it is not possible at this time because neither state nor Federal funding is available for purchasing, installing, or maintaining VMS transceiver units, nor is funding available for data transmission. Because of the critical need to monitor the integrity of conservation areas that protect overfished stocks, while allowing for the harvest of healthy stocks, NMFS believes it is necessary to proceed with this rulemaking.

Approximately 424 vessels that are registered to limited entry permits that operate in the waters off the states of Washington, Oregon or California would be required to carry and operate a NMFS type-approved VMS transceiver unit. All but 10 of the affected entities qualify as small businesses. Vessels required to carry VMS transceiver units will provide installation/activation reports, hourly position reports, and exemption reports.

The burden on fishery participants was considered and only the minimum data needed to monitor compliance with regulations are being required. In addition to VMS requirements, declaration report requirements would apply to vessels registered to limited entry permits with trawl endorsements (262 vessels); other vessels using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber (299 vessels); and tribal vessels using trawl gear, before these vessel are used to fish in any trawl RCA or the CCA. In addition, declaration reports would be required from vessels registered to limited entry permits with longline and pot endorsements (167), before the vessel could be used to fish in any non-trawl RCA or the CCA.

The Council's VMS Committee initially considered declaration reports as "per trip" reports. Following consultation with fishery participants, it was determined that the needs of NMFS and the U.S. Coast Guard could be met with less frequently made declaration reports. Therefore, it was determined that a declaration report identifying the type of gear being used by a vessel would remain valid until cancelled or revised by the vessel operator. This results in a significant reduction in the number of reports.

Following consultation with fishery participants, it was determined that some vessels may prefer to reduce the costs of reporting when leaving the waters off the coasts of Washington, Oregon, and California. A substantial number of permitted vessels also fish in waters off Alaska and in areas seaward of the EEZ. In addition, vessels are commonly pulled out of the water for extended periods. To reduce the reporting burden on vessels seaward of the EEZ or out of the water, an optional exemption report was proposed to allow vessels to reduce or discontinue VMS hourly position reports when they are out of the EEZ for more than 7 consecutive days.

Public comment on the proposed rule identified that there are no provisions for transferring of VMS units from one owner to another or one boat to another. In response, NMFS added regulatory language that will prohibit transceiver units from being registered to more than one vessel at a time, while identifying how transceiver units can be transferred and registered to a new vessel.

The preferred alternative (alternative 3), which would require limited entry vessels to purchase and operate a VMS in waters off of Washington, Oregon, and California, is expected to result in increased profits to individual vessels because the depth-based strategy can continue to be used to manage the fishery. To determine profitability, the Council compared the costs of purchasing and operating a VMS unit to the increase in revenue that would be obtained from expanded fishing opportunities under the depth-based management program. Since revenue data for individual vessels were not readily available, the Council used average annual revenue per vessel as a proxy. In the absence of vessel operating cost data, the Council considered only the cost of purchasing and maintaining a VMS unit and assumed other costs to be constant. The VMS units that are expected to be type-approved for this fishery range in costs and service features. This allows the vessel owner the flexibility in choosing the model that best fits the needs of his or her vessel.

NMFS will pay for all costs associated with polling (when the processing center queries the transceiver, outside of regular transmission, for a position report). The costs of installation are minimal because the transceivers can be installed by the vessel operator. Vessels that already have VMS transceiver units installed for other fisheries or personal purposes could use their current unit, providing it is a model that has been type-approved for the Pacific Coast groundfish fishery and the software has been upgraded to meet the defined requirements. The estimated costs of purchasing and installing the VMS transceiver unit would be between $800 and $3800 per individual vessel, and between $548 and $1698 per year to operate and maintain the unit. Revenues from expanded fishing opportunities were estimated to increase $26,000 per year for limited entry trawl vessels and $14,000 per year for limited entry longline and pot vessels, far exceeding the estimated start-up and maintenance costs of the VMS. While ex-vessel revenues appear higher on average for vessels likely to be required to use VMS under the depth-based management regime, it should be noted that fishing costs may also be higher, offsetting some of the apparent gain. Unfortunately, vessel cost data necessary to estimate this effect are currently not available. It is also important to keep in mind that using average revenues masks the variability of ex-vessel revenues in each vessel class. While on average, additional revenues appear greater than VMS-related costs, for some individual vessels in each class this will not be the case. Alternative 4, which would implement a two-way VMS, would produce higher costs per vessel (year 1 at $3,878-$7,607; subsequent years at $1,063-$2,342) and would yield less profit, than the proposed VMS alternative. Alternative 5, which would implement observer coverage, would be very costly at $300 per day, or $36,000 per year assuming 10 fishing days per month, and would most likely produce economic losses for the majority of limited entry vessels. Alternative 2, which would allow expanded fishing by use of declaration only, would be more profitable to limited entry vessels than the proposed VMS measure, since they would earn the same revenue at a minimal cost.

Mandatory VMS will allow for better enforcement of fishing regulations and provide a more accurate database of fishing activity to better meet the conservation goals of the Pacific Groundfish FMP. The proposed measure to require all trawl vessels to declare their intentions to fish is expected to have only a minimal impact on individual trawlers since the cost of a declaration is minimal.

Most vessels affected by this action have gross annual receipts of under $3.5 million and are defined as small entities under section 601 of the Regulatory Flexibility Act; however, there are approximately 10 vessels defined as large entities operating in the limited trawl fishery. There could be some disproportionate economic impacts on small entities versus large entities for the group of limited entry vessels that are less than 40 ft (12.192 m) in length and have relatively low gross annual receipts. These include 90 limited entry vessels, comprised of 5 trawl vessels and 85 longline and pot vessels. Depending upon the cost of the VMS, some of these smaller vessels would be forced to pay a relatively larger share of their annual expenditures for purchase of the VMS compared to the larger vessels.

All vessels that fish in conservation areas would increase their gross receipts by being able to fish in more productive areas, having the effect of increasing profitability and mitigating the cost of the VMS. This mitigation would be less for smaller vessels, due to their smaller catches and, therefore, income from groundfish.

Section 212 of the Small Business Regulatory Enforcement and Fairness Act of 1996 states that, for each rule or group of related rules for which an agency is required to prepare a FRFA, the agency shall publish one or more guides to assist small entities in complying with this final rule, and shall designate such publications as "small entity compliance guides." The agency shall explain the actions a small entity is required to take to comply with a rule or group of rules. As part of this rulemaking process, a letter to permit holders that also serves as small entity compliance guide (the guide) will be prepared. Copies of this final rule are available from the Northwest Regional Office, and the guide, *i.e.*, permit holder letter, will be sent to all holders of limited entry permits for the Pacific Coast groundfish fishery. The guide and this final rule will also be available upon request.

This final rule contains a collection-of-information requirement subject to the Paperwork Reduction Act (PRA). The collection of this information has been approved by OMB, OMB Control Number 0648–0478. Public reporting burden for this collection of information is estimated to average as follows: 4 minutes per response for each declaration report at an estimated time burden on the public of 578 hours annually for all 723 respondents; At 4 hours per response for installation of the VMS transceiver unit and 5 minutes per response to send the installation/activation report with an estimated time burden to the public from all 424 respondents of 1,696 hours for installation of the VMS transceiver units and 34 hours annually for sending the installation/activation report; At 5 seconds per response for each hourly position report, the expected time burden on the public from all 424 respondents would be 5,159 hours annually; and at 4 minutes per response for each exemption report the expected time burden on the public from 145 respondents would be 19 hours annually. These estimates include the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection information. Written comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this rule may be submitted to NMFS at the address above and by e-mail to *David_Rostker@omb.eop.gov*, or faxed to (202) 395–7285.

Notwithstanding any other provision of the law, no person is required to respond to, and no person shall be subject to penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB control number.

This final rule has been determined to be not significant for purposes of Executive Order 12866.

This final rule was developed after meaningful consultation and collaboration with the tribal representative on the Council who has agreed with the provisions that apply to tribal vessels.

List of Subjects in 50 CFR Part 660

Administrative practice and procedure, American Samoa, Fisheries, Fishing, Guam, Hawaiian Natives, Indians, Northern Mariana Islands, Reporting and recordkeeping requirements.

Dated: October 29, 2003.

Rebeccca Lent,

Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

■ For the reasons set out in the preamble, 50 CFR part 660 is amended as follows:

PART 660—FISHERIES OFF THE WEST COAST STATES AND IN THE WESTERN PACIFIC

Subpart G—West Coast Groundfish Fisheries

■ 1. The authority citation for part 660 continues to read as follows:

Authority: 16 U.S.C. 1801 *et seq.*

■ 2. In § 660.302, add "Address of record", "Groundfish Conservation Area or GCA", "Mobile transceiver unit", "Office for Law Enforcement", and "Vessel monitoring system or VMS", in alphabetical order to read as follows:

§ 660.302 Definitions.

Address of record. Address of Record means the business address of a person, partnership, or corporation used by NMFS to provide notice of actions.

* * * * *

Groundfish Conservation Area or GCA means a geographic area defined by coordinates expressed in degrees latitude and longitude, created and enforced for the purpose of contributing to the rebuilding of overfished West Coast groundfish species. Specific GCAs are referred to or defined at 660.304(c).

* * * * *

Mobile transceiver unit means a vessel monitoring system or VMS device, as set forth at § 660.359, installed on board a vessel that is used for vessel monitoring and transmitting the vessel's position as required by this subpart.

Office for Law Enforcement (OLE) refers to the National Marine Fisheries Service, Office for Law Enforcement, Northwest Division.

* * * * *

Vessel monitoring system or VMS means a vessel monitoring system or mobile transceiver unit as set forth in § 660.359 and approved by NMFS for use on vessels that take (directly or incidentally) species managed under the Pacific Coast Groundfish FMP, as required by this subpart.

■ 3. Section 660.303 is revised to read as follows:

§ 660.303 Reporting and recordkeeping.

(a) This subpart recognizes that catch and effort data necessary for implementing the PCGFMP are collected by the States of Washington, Oregon, and California under existing state data collection requirements. Telephone surveys of the domestic industry may be conducted by NMFS to determine amounts of whiting that may be available for reallocation under 50 CFR 660.323(a)(4)(vi). No Federal reports are required of fishers or processors, so long as the data collection and reporting systems operated by state agencies continue to provide NMFS with statistical information adequate for management.

(b) Any person who is required to do so by the applicable state law must make and/or file, retain, or make available any and all reports of groundfish landings containing all data, and in the exact manner, required by the applicable state law.

(c) Any person landing groundfish must retain on board the vessel from which groundfish is landed, and provide to an authorized officer upon request, copies of any and all reports of groundfish landings containing all data, and in the exact manner, required by the applicable state law throughout the cumulative limit period during which a landing occurred and for 15 days thereafter.

(d) *Reporting requirements for vessels fishing in conservation areas*—(1) *Declaration reports for trawl vessels intending to fish in a conservation area.* The operator of any vessel registered to a limited entry permit with a trawl endorsement; any vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber; or any tribal vessel using trawl gear must provide NMFS with a declaration report, as specified at paragraph 660.303(d)(5), of this section to identify the intent to fish within the CCA, as defined at § 660.304, or any trawl RCA, as defined in the groundfish annual management measures that are published in the **Federal Register**.

(2) *Declaration reports for non-trawl vessels intending to fish in a conservation area.* The operator of any vessel registered to a limited entry permit with a longline or pot endorsement must provide NMFS OLE with a declaration report, as specified at paragraph (d)(5) of this section, to identify the intent to fish within the CCA, as defined at § 660.304, or any non-trawl RCA, as defined in the groundfish annual management measures that are published in the **Federal Register**.

(3) *When a declaration report for fishing in a conservation area is required,* as specified in paragraphs (d)(1) and (d)(2) of this section, it must be submitted before the vessel leaves port:

(i) On a trip in which the vessel will be used to fish in a conservation area for the first time during the calendar year;

(ii) On a trip in which the vessel will be used to fish in a conservation area with a gear type that is different from the gear declaration provided on a valid declaration report as defined at paragraph 660.303(d)(6) of this section; or

(iii) On a trip in which the vessel will be used to fish in a conservation area for the first time after a declaration report to cancel fishing in a conservation area was received by NMFS.

(4) *Declaration report to cancel fishing in a conservation area.* The operator of any vessel that provided NMFS with a declaration report for fishing in a conservation area, as required at paragraphs (d)(1) or (d)(2) of this section, must submit a declaration report to NMFS OLE to cancel the current declaration report before the vessel leaves port on a trip in which the vessel is used to fish with a gear that is not in the same gear category set out in paragraph § 660.303(d)(5)(i) declared by the vessel in the current declaration.

(5) *Declaration reports will include:* the vessel name and/or identification number, and gear declaration (as defined in § 660.303(d)(5)(i)). Upon receipt of a declaration report, NMFS will provide a confirmation code or receipt. Retention of the confirmation code or receipt to verify that the declaration requirement was met is the responsibility of the vessel owner or operator.

(i) One of the following gear types must be declared:

(A) Limited entry fixed gear,

(B) Limited entry midwater trawl,

(C) Limited entry bottom trawl,

(D) Trawl gear including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut south of Pt. Arena, CA, and sea cucumber,

(E) Tribal trawl,

(F) Other gear including: gear used to take spot and ridgeback prawns, crab or lobster, Pacific halibut, salmon, California halibut, California sheephead, highly migratory species, species managed under the Coastal Pelagic Species Fishery Management Plan, and any species in the gillnet complex as managed by the State of California,

(G) Non-trawl gear used to take groundfish.

(ii) Declaration reports must be submitted through the VMS or another method that is approved by NMFS OLE and announced in the **Federal Register**. Other methods may include email, facsimile, or telephone. NMFS OLE will provide, through appropriate media, instructions to the public on submitting declaration reports. Instructions and other information needed to make declarations may be mailed to the limited entry permit owner's address of record. NMFS will bear no responsibility if a notification is sent to the address of record and is not received because the permit owner's actual address has changed without notification to NMFS, as required at § 660.335(a)(2). Owners of vessels that are not registered to limited entry permits and owners of vessels registered to limited entry permits that did not receive instructions by mail are responsible for contacting NMFS OLE during business hours at least 3 days before the declaration is required to obtain information needed to make declaration reports. NMFS OLE must be contacted during business hours (Monday through Friday between 0800 and 1700 Pacific Time).

(6) *A declaration report will be valid until* a declaration report to revise the existing gear declaration or a declaration report to cancel fishing in a conservation area is received by NMFS OLE. During the period that a vessel has a valid declaration report on file with NMFS, it cannot fish with a gear other than a gear type that is within the gear category (50 CFR 660.303(d)(5)) declared by the vessel. After a declaration report to cancel fishing in the RCA is received, that vessel must not fish in a conservation area until another declaration report for fishing by that vessel in a conservation area is received by NMFS.

■ 4. Section 660.304 is revised to read as follows:

§ 660.304 Management areas, including conservation areas, and commonly used geographic coordinates.

(a) *Management areas.* (1) *Vancouver.* (i) The northeastern boundary is that part of a line connecting the light on Tatoosh Island, WA, with the light on Bonilla Point on Vancouver Island, British Columbia (at 48°35′75″ N. lat., 124°43′00″ W. long.) south of the International Boundary between the U.S. and Canada (at 48°29′37.19″ N. lat., 124°43′33.19″ W. long.), and north of the point where that line intersects with the boundary of the U.S. territorial sea.

(ii) The northern and northwestern boundary is a line connecting the following coordinates in the order listed, which is the provisional international boundary of the EEZ as shown on NOAA/NOS Charts #18480 and #18007:

Point	N. lat.	W. long.
1	48°29′37.19″	124°43′33.19″
2	48°30′11″	124°47′13″
3	48°30′22″	124°50′21″
4	48°30′14″	124°54′52″
5	48°29′57″	124°59′14″
6	48°29′44″	125°00′06″
7	48°28′09″	125°05′47″
8	48°27′10″	125°08′25″
9	48°26′47″	125°09′12″
10	48°20′16″	125°22′48″
11	48°18′22″	125°29′58″
12	48°11′05″	125°53′48″′
13	47°49′15″	126°40′57″
14	47°36′47″	127°11′58″
15	47°22′00″	127°41′23″
16	46°42′05″	128°51′56″
17	46°31′47″	129°07′39″

(iii) The southern limit is 47°30′ N. lat.

(2) *Columbia*. (i) The northern limit is 47°30′ N. lat.

(ii) The southern limit is 43°00′ N. lat.

(3) *Eureka*. (i) The northern limit is 43°00′ N. lat.

(ii) The southern limit is 40°30′ N. lat.

(4) *Monterey*. (i) The northern limit is 40°30′ N. lat.

(ii) The southern limit is 36°00′ N. lat.

(5) *Conception*. (i) The northern limit is 36°00′ N. lat.

(ii) The southern limit is the U.S.-Mexico International Boundary, which is a line connecting the following coordinates in the order listed:

Point	N. lat.	W. long.
1	32°35′22″	117°27′49″
2	32°37′37″	117°49′31″
3	31°07′58″	118°36′18″
4	30°32′31″	121°51′58″

(b) *Commonly used geographic coordinates*.

(1) Cape Falcon, OR—45°46′ N. lat.

(2) Cape Lookout, OR—45°20′15″ N. lat.

(3) Cape Blanco, OR—42°50′ N. lat.

(4) Cape Mendocino, CA—40°30′ N. lat.

(5) North/South management line—40°10′ N. lat.

(6) Point Arena, CA—38°57′30″ N. lat.

(7) Point Conception, CA—34°27′ N. lat.

(c) *Groundfish Conservation Areas (GCAs)*. In § 660.302, a GCA is defined as "a geographic area defined by coordinates expressed in latitude and longitude, created and enforced for the purpose of contributing to the rebuilding of overfished West Coast groundfish species." Specific GCAs may be defined here in this paragraph, or in the **Federal Register**, within the harvest specifications and management measures process. While some GCAs may be designed with the intent that their shape be determined by ocean bottom depth contours, their shapes are defined in regulation by latitude/longitude coordinates and are enforced by those coordinates. Fishing activity that is prohibited or permitted within a particular GCA is detailed in **Federal Register** documents associated with the harvest specifications and management measures process.

(1) *Rockfish Conservation Areas (RCAs)*. RCAs are defined in the **Federal Register** through the harvest specifications and management measures process. RCAs may apply to a single gear type or to a group of gear types, such as "trawl RCAs" or "non-trawl RCAs".

(2) *Cowcod Conservation Areas (CCAs)*. (i) The Western CCA is an area south of Point Conception that is bound by straight lines connecting all of the following points in the order listed:

33°50′ N. lat., 119°30′ W. long.;
33°50′ N. lat., 118°50′ W. long.;
32°20′ N. lat., 118°50′ W. long.;
32°20′ N. lat., 119°37′ W. long.;
33°00′ N. lat., 119°37′ W. long.;
33°00′ N. lat., 119°53′ W. long.;
33°33′ N. lat., 119°53′ W. long.;
33°33′ N. lat., 119°30′ W. long.; and connecting back to 33°50′ N. lat., 119°30′ W. long.

(2) The Eastern CCA is a smaller area west of San Diego that is bound by straight lines connecting all of the following points in the order listed:

32°42′ N. lat., 118°02 W. long.;
32°42′ N. lat., 117°50 W. long.;
32°36′42″ N. lat., 117°50 W. long.;
32°30′ N. lat., 117°53′30″ W. long.;
32°30′ N. lat., 118°02 W. long.; and connecting back to 32°42′ N. lat., 118°02′ W. long.

(d) *Yelloweye Rockfish Conservation Area (YRCA)*. The YRCA is a C-shaped area off the northern Washington coast that is bound by straight lines connecting all of the following points in the order listed:

48°18′ N. lat., 125°18′ W. long.;
48°18′ N. lat., 124°59′ W. long.;
48°11′ N. lat., 124°59′ W. long.;
48°11′ N. lat., 125°11′ W. long.;
48°04′ N. lat., 125°11′ W. long.;
48°04′ N. lat., 124°59′ W. long.;
48°00′ N. lat., 124°59′ W. long.;
48°00′ N. lat., 125°18′ W. long.; and connecting back to 48°18′ N. lat., 125°18′ W. long.

(e) *International boundaries*. (1) Any person fishing subject to this subpart is bound by the international boundaries described in this section, notwithstanding any dispute or negotiation between the United States and any neighboring country regarding their respective jurisdictions, until such time as new boundaries are established or recognized by the United States.

(2) The inner boundary of the fishery management area is a line coterminous with the seaward boundaries of the States of Washington, Oregon, and California (the "3-mile limit").

(3) The outer boundary of the fishery management area is a line drawn in such a manner that each point on it is 200 nm from the baseline from which the territorial sea is measured, or is a provisional or permanent international boundary between the United States and Canada or Mexico.

■ 5. In § 660.306, new paragraphs (z), (aa) and (bb) are added to read as follows:

§ 660.306 Prohibitions.

* * * * *

(z) *Vessel monitoring systems*. (1) Use any vessel registered to a limited entry permit to operate in State or Federal waters seaward of the baseline from which the territorial sea is measured off the States of Washington, Oregon or California, unless that vessel carries a NMFS OLE type-approved mobile transceiver unit and complies with the requirements described at § 660.359.

(2) Fail to install, activate, repair or replace a mobile transceiver unit prior to leaving port as specified at § 660.359.

(3) Fail to operate and maintain a mobile transceiver unit on board the vessel at all times as specified at § 660.359.

(4) Tamper with, damage, destroy, alter, or in any way distort, render useless, inoperative, ineffective, or inaccurate the VMS, mobile transceiver unit, or VMS signal required to be installed on or transmitted by a vessel as specified at § 660.359.

(5) Fail to contact NMFS OLE or follow NMFS OLE instructions when automatic position reporting has been interrupted as specified at § 660.359.

(6) Register a VMS transceiver unit registered to more than one vessel at the same time.

(aa) *Fishing in conservation areas*. Fish with any trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut south of Pt. Arena, CA, and sea cucumber; or with trawl gear from a tribal vessel or with any gear from a vessel registered to a groundfish limited entry permit in a conservation area unless the vessel owner or operator has a valid declaration confirmation code or receipt for fishing in conservation area as specified at § 660.303(d)(5).

(bb) Operate any vessel registered to a limited entry permit with a trawl endorsement in a Trawl Rockfish Conservation Area (as defined at

660.302), except for purposes of continuous transiting, with all groundfish trawl provided that all groundfish trawl gear is stowed in accordance with 660.322(b)(8), or except as authorized in the annual groundfish management measures published in the **Federal Register**.

■ 6. In § 660.322 new paragraph (b)(7) is added to read as follows:

§ 660.322 Gear restrictions.

* * * * *

(b) * * *

(7) Trawl vessels may transit through the trawl RCA, with or without groundfish on board, provided all groundfish trawl gear is stowed either:

(i) Below deck; or

(ii) If the gear cannot readily be moved, in a secured and covered manner, detached from all towing lines, so that it is rendered unusable for fishing; or

(iii) Remaining on deck uncovered if the trawl doors are hung from their stanchions and the net is disconnected from the doors.

* * * * *

■ 7. Section 660.359 is added to subpart G to read as follows:

§ 660.359 Vessel Monitoring System (VMS) Requirements.

(a) *What is a VMS?* A VMS consists of a NMFS OLE type-approved mobile transceiver unit that automatically determines the vessel's position and transmits it to a NMFS OLE type-approved communications service provider. The communications service provider receives the transmission and relays it to NMFS OLE.

(b) *Who is required to have VMS?* A vessel registered for use with a Pacific Coast groundfish limited entry permit that fishes in state or Federal water seaward of the baseline from which the territorial sea is measured off the States of Washington, Oregon or California is required to install a NMFS OLE type-approved mobile transceiver unit and to arrange for an NMFS OLE type-approved communications service provider to receive and relay transmissions to NMFS OLE, prior to fishing.

(c) *How are mobile transceiver units and communications service providers approved by NMFS OLE?* (1) NMFS OLE will publish type-approval specifications for VMS components in the **Federal Register** or notify the public through other appropriate media.

(2) Mobile transceiver unit manufacturers or communication service providers will submit products or services to NMFS OLE for evaluation based on the published specifications.

(3) NMFS OLE may publish a list of NMFS OLE type-approved mobile transceiver units and communication service providers for the Pacific Coast groundfish fishery in the **Federal Register** or notify the public through other appropriate media. As necessary, NMFS OLE may publish amendments to the list of type-approved mobile transceiver units and communication service providers in the **Federal Register** or through other appropriate media. A list of VMS transceivers that have been type-approved by NMFS OLE may be mailed to the permit owner's address of record. NMFS will bear no responsibility if a notification is sent to the address of record and is not received because the applicant's actual address has changed without notification to NMFS, as required at 660.335(a)(2).

(d) *What are the vessel owner's responsibilities?* If you are a vessel owner that must participate in the VMS program, you or the vessel operator must:

(1) Obtain a NMFS OLE type-approved mobile transceiver unit and have it installed on board your vessel in accordance with the instructions provided by NMFS OLE. You may get a copy of the VMS installation and operation instructions from the NMFS OLE Northwest, VMS Program Manager upon request at 7600 Sand Point Way NE., Seattle, WA 98115–6349, phone: (206) 526–6133.

(2) Activate the mobile transceiver unit, submit an activation report, and receive confirmation from NMFS OLE that the VMS transmissions are being received before participating in a fishery requiring the VMS. Instructions for submitting an activation report may be obtained from the NMFS OLE, Northwest VMS Program Manager upon request at 7600 Sand Point Way NE., Seattle, WA 98115–6349, phone: (206)526–6133. An activation report must again be submitted to NMFS OLE following reinstallation of a mobile transceiver unit or change in service provider before the vessel may participate in a fishery requiring the VMS.

(i) *Activation reports.* If you are a vessel owner who must use VMS and you are activating a VMS transceiver unit for the first time or reactivating a VMS transceiver unit following a reinstallation of a mobile transceiver unit or change in service provider, you must fax NMFS OLE an activation report that includes: Vessel name; vessel owner's name, address and telephone number, vessel operator's name, address and telephone number, USCG vessel documentation number/state registration number; if applicable, the groundfish permit number the vessel is registered to; VMS transceiver unit manufacturer; VMS communications service provider; VMS transceiver identification; identifying if the unit is the primary or backup; and a statement signed and dated by the vessel owner confirming compliance with the installation procedures provided by NMFS OLE.

(ii) Ownership of the VMS transceiver unit may be transferred from one vessel to another vessel by submitting a new activation report, which identifies that the transceiver unit was previously registered to another vessel, and by providing proof of ownership of the VMS transceiver unit or proof of service termination from the communication service provider.

(3) Operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year, unless such vessel is exempted under paragraph (d)(4) of this section.

(4) *VMS exemptions.* A vessel that is required to operate the mobile transceiver unit continuously 24 hours a day throughout the calendar year may be exempted from this requirement if a valid exemption report, as described at § 660.359(d)(4)(iii), is received by NMFS OLE and the vessel is in compliance with all conditions and requirements of the VMS exemption identified in this section.

(i) *Haul out exemption.* When it is anticipated that a vessel will be continuously out of the water for more than 7 consecutive days and a valid exemption report has been received by NMFS OLE, electrical power to the VMS mobile transceiver unit may be removed and transmissions may be discontinued. Under this exemption, VMS transmissions can be discontinued from the time the vessel is removed from the water until the time that the vessel is placed back in the water.

(ii) *Outside areas exemption.* When the vessel will be operating seaward of the EEZ off Washington, Oregon, or California continuously for more than 7 consecutive days and a valid exemption report has been received by NMFS OLE, the VMS mobile transceiver unit transmissions may be reduced or discontinued from the time the vessel leaves the EEZ off the coasts of Washington, Oregon or California until the time that the vessel re-enters the EEZ off the coasts of Washington, Oregon or California. Under this exemption, the vessel owner or operator can request that NMFS OLE reduce or discontinue the VMS transmissions after receipt of an exemption report, if the vessel is equipped with a VMS transceiver unit that NMFS OLE has approved for this exemption.

(iii) Exemption reports must be submitted through the VMS or another method that is approved by NMFS OLE and announced in the **Federal Register**. Other methods may include email, facsimile, or telephone. NMFS OLE will provide, through appropriate media, instructions to the public on submitting exemption reports. Instructions and other information needed to make exemption reports may be mailed to the limited entry permit owner's address of record. NMFS will bear no responsibility if a notification is sent to the address of record and is not received because the permit owner's actual address has changed without notification to NMFS, as required at 660.335(a)(2). Owners of vessels registered to limited entry permits that did not receive instructions by mail are responsible for contacting NMFS OLE during business hours at least 3 days before the exemption is required to obtain information needed to make exemption reports. NMFS OLE must be contacted during business hours (Monday through Friday between 0800 and 1700 Pacific Standard Time).

(iv) Exemption reports must be received by NMFS at least 2 hours and not more than 24 hours before the exempted activities defined at § 660.359(d)(4)(i) and (ii) occur. An exemption report is valid until NMFS receives a report canceling the exemption. An exemption cancellation must be received at least 2 hours before the vessel re-enters the EEZ following an outside areas exemption or at least 2 hours before the vessel is placed back in the water following a haul out exemption.

(5) When aware that transmission of automatic position reports has been interrupted, or when notified by NMFS OLE that automatic position reports are not being received, contact NMFS OLE at 7600 Sand Point Way NE, Seattle, WA 98115–6349, phone: (206)526–6133 and follow the instructions provided to you. Such instructions may include, but are not limited to, manually communicating to a location designated by NMFS OLE the vessel's position or returning to port until the VMS is operable.

(6) After a fishing trip during which interruption of automatic position reports has occurred, the vessel's owner or operator must replace or repair the mobile transceiver unit prior to the vessel's next fishing trip. Repair or reinstallation of a mobile transceiver unit or installation of a replacement, including change of communications service provider shall be in accordance with the instructions provided by NMFS OLE and require the same certification.

(7) Make the mobile transceiver units available for inspection by NMFS OLE personnel, U.S. Coast Guard personnel, state enforcement personnel or any authorized officer.

(8) Ensure that the mobile transceiver unit is not tampered with, disabled, destroyed or operated improperly.

(9) Pay all charges levied by the communication service provider as necessary to ensure continuous operation of the VMS transceiver units.

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Report of the Ad Hoc Vessel Monitoring Committee

The Ad Hoc Vessel Monitoring System Committee met on October 7, in Portland, Oregon to discuss transiting requirements within the RCA for limited entry fixed gear vessels and expansion of the vessel monitoring program as directed by the Council at the September Seattle meeting. Additionally, the committee heard an update on the existing monitoring program from Ms. Becky Renko and had a discussion on the USCG Automated Identification System (AIS).

With the retirement of Mr. Steve Springer, the past committee chair, a new chair election was held prior to discussion of any agenda items. Mr. Don Hansen, was elected chair and Mr. Dayna Matthews was elected vice chair.

Update on VMS Implementation

As reported by Ms. Becky Renko the proposed VMS rule was published on May 22, 2003 with the comment period closing on July 21. Comments received were comprised of the Groundfish Advisory Subpanel (GAP) report submitted at the June, 2003 Council meeting and four letters from private individuals. The final rule was submitted on September 1, 2003 and forwarded to Department of Commerce on October 6. Effective date for the rule is January 1, 2004.

Transiting Requirements for Limited Entry Fixed Gear Vessels

At the September meeting, the Enforcement Consultants (EC) asked the Council to include a transiting only (non drifting) requirement in the 2004 groundfish specifications for fixed gear limited entry vessels when operating within the non-trawl Rockfish Conservation Area (RCA). This resulted from a public comment that there was a transiting requirement for limited entry trawl vessels but not fixed gear. The EC believes that the need for the transiting requirement mirrors the trawl requirement already in place. As a track line, drifting can not be distinguished from fishing, thus the integrity of the VMS can not be maintained and the utility of VMS as an enforcement tool will be undermined. Representatives from the GAP have safety concerns and believe that prohibitions on drifting for both trawl and fixed gear vessels will put them in harms way. These two positions were again stated and affirmed at the Ad Hoc VMS Committee meeting on October 7.

Discussion on the issue looked at alternatives including; observers, use of the phone declaration system to declare intent to drift in the RCA, and use of e-mail notification. Requiring observes on the vessels was rejected due to costs and limited accommodations on many of the fixed gear vessels. Cell phone technology has limited capability off shore and therefore was not viewed as reliable. When the VMS program was first being developed, the Council asked NOAA Fisheries to identify basic low cost units for use in this program. While reducing the costs of the program for individual vessel owners, use of these low cost units minimizes two way communication options thus eliminating the alternative use of e-mail to address this issue.

Chair Don Hanson reported that in his discussions with those familiar with the VMS program in Hawaii, drifting could be distinguished from fishing. It was pointed out that the Hawaii program has 24/7 manned coverage, less than 150 vessels, and almost 10 years of experience in monitoring a "no incursion authorized" program. The program in Hawaii is quite different than the program here on the West Coast in the size of the area monitored, number of participating vessels, and incursion allowances. The West Cost program will not be manned 24/7, but will rely upon alerts programed into the software which will notify a duty agent through a pager of a possible unlawful incursion into the RCA.

The committee failed to reach consensus on transiting requirements in the non-trawl RCA. GAP representatives want to be able to drift or anchor within the RCA to escape bad weather and/or to avoid ship traffic when not fishing, and recommend 24/7 monitoring and two way communication as alternatives to the transiting only requirement.

The EC representatives can not recommend to the Council at this time any alternative other than to include a transiting only requirement in the 2004 specifications for the fixed gear limited entry fleet when operating within the non-trawl RCA, based on budget, enforcement concerns, and program constraints.

Automated Identification System (AIS)

An interim rule on AIS went into effect on July 1, 2003, with a final rule going into effect on November 21, 2003. AIS is a high priority Homeland Security issue tied to the nationwide Vessel Tracking System and is seen as an important component for ensuring the security of the nations navigable waters and harbor.

The Coast Guard representatives on the committee could not answer questions on AIS due to the status of the rule making process. Subsequent to the VMS Committee meeting, the Coast Guard published a final rule exempting commercial fishing vessels from the initial AIS requirement. The Coast Guard is still considering a separate rule which could require fishing vessels to carry AIS units.

Expansion of the VMS Monitoring Program

In evaluating possible expansion of the VMS Program under the stated goal "to effectively monitoring the RCAs," the committee explored the universe of possible VMS participants beyond the limited entry fleet presently included in the program. The committee defined the universe as any vessel under the jurisdiction of NOAA Fisheries (operating within the West Coast EEZ) capable of taking groundfish, both commercial and recreational. This would exclude vessels operating exclusively in state waters. Within the category of commercial, the universe of potential VMS candidates was defined as the open access fleet, and then further defined as directed open access (vessels which target groundfish). The open access fleet size is estimated at approximately 2,900 vessels. [**NOTE:** this number is still being evaluated]

Discussions ensued which developed an analysis for maintaining the integrity of the RCA through VMS.

1) Groundfish directed vessels- if prohibited vessels fish inside RCA the integrity of the RCA cannot be maintained. **VMS will work in this situation and is a useful enforcement tool.**

2) Bycatch fisheries that are allowed to retain inside the RCA - Shrimp vessels are an example. The only enforcement benefit is VMS helps identify look-a-like vessels and allows enforcement to easily identify shrimp vessels so they can check for the excluders. **Shrimpers are required to declare under the declaration system. VMS does not maintain integrity of RCA.**

3) Bycatch fishery without retention allowance - if vessels retain groundfish catch inside the RCA, the integrity of the RCA cannot not maintained – VMS does not solve the problem entirely, but is useful in determining where fishing occurred. This information can be used in conjunction with fish ticket audits and subsequent investigation. **VMS will work in this situation and is a useful enforcement tool.**

4) Bycatch hybrid fisheries Salmon Troll is a hybrid between 2&3 bound by a lower limit, i.e. the canary rule. VMS tells you which limits the vessel is bound by and gives you an historic track line to determine if the vessel fished in the RCA with prohibited species on board. This information can be used in conjunction with a fish ticket audit and subsequent investigation. **VMS will not fully maintain the integrity of the RCA, but may have useful enforcement applications.**

Proposed Option for Expansion of VMS

Commercial fishing vessels operating in the EEZ at any time during the year that are capable of catching groundfish using the listed gear below, must carry and use VMS transceivers regardless of what fishery they are in during the remainder of the year.

- Pot (Groundfish, not Crab)
- Long Line
- All Trawl (excluding Shrimp)
- All Line Gear (excluding Salmon Troll)
- California Set Gill Net

Exceptions: Crab, Albacore (no groundfish retained)

Adoption of this proposal would expand the current VMS Program from approximately 400 vessels to more than 2,000 vessels. The current system employed by NOAA Fisheries Office for Law Enforcement in Sand Point, Washington has a capacity of up to 10,000 vessels.

The committee reached consensus on this proposal through the first three gear types, groundfish pot, long line, and trawl (excluding Shrimp). The committee was split on excluding salmon troll from the line gear category. The Council may want to evaluate impacts on groundfish by salmon troll vessels by reviewing landings in 2002 and 2003 before making a decision on including salmon trollers in the VMS Program. The committee did not feel it had the proper expertise to fairly evaluate California Set Gill Net but included the gear type as a place holder for further analysis.

Phased in Approach

As a final discussion point under the commercial category, the committee discussed continuing a "phased in approach" to VMS expansion and were unanimous in their opinion that the first priority for VMS expansion was the Open access Fixed Gear Long Line Fleet which is comprised of approximately 1,400 vessels. [NOTE: this number is still being evaluated]

Recreational

At present there is no application of VMS for monitoring a recreation fishing activity anywhere in the world. The NOAA Fisheries Office for Law Enforcement does not view VMS as an appropriate tool for monitoring private recreational fishing vessels, but is interested in evaluating application of VMS in the recreational charter fishing industry. GAP representatives on the VMS Committee did not entirely agree with NOAA on this issue.

Under this back drop the committee discussed application of VMS in the recreational charter fishing fleet. In discussion, the committee determined that under current regulations requiring VMS on recreational charter vessels would derive limited benefit. The committee believes any evaluation of VMS application in the recreational charter fishing fleet should be done on an area by area basis, but does not recommend requiring VMS on recreational charter fishing vessels at this time.

DRAFT MEETING MINUTES

Ad Hoc Vessel Monitoring System Committee

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, OR 97220
(503) 820-2280
October 7, 2003

Members Present:

Mr. Joseph Albert, National Marine Fisheries Service, Law Enforcement
LT Jordan Baldeuza, Enforcement Consultants, United States Coast Guard
LT Gregg Casad, Enforcement Consultants, United States Coast Guard
Mr. Mark Cedergreen, Pacific Fishery Management Council, Washington Charter Boat Operator
CAPT Mike Cenci, Enforcement Consultants, Washington Department of Fish and Wildlife
Ms. Kathy Fosmark, Groundfish Advisory Subpanel, Southern Open Access Representative
Mr. Tom Ghio, Groundfish Advisory Subpanel, California Fixed Gear Representative
Mr. Don Hansen, Chair, Pacific Fishery Management Council, California Charter Boat Operator
Mr. Bill James, Alternate for Mr. Kenyon Hensel, Groundfish Advisory Subpanel, Northern Open Access
Mr. Marion Larkin, Groundfish Advisory Subpanel, Washington Trawler
Mr. Dayna Mathews, Vice Chair, Enforcement Consultants, National Marine Fisheries Service
Mr. Rod Moore, Groundfish Advisory Subpanel Chair
Ms. Becky Renko, National Marine Fisheries Service, Northwest Region

Others present:

Mr. Mike Burner, Council Staff Officer, Pacific Fishery Management Council
LT Dave Cleary, Enforcement Consultants, Oregon State Police
Ms. Eileen Cooney, National Oceanic and Atmospheric Administration, General Council
Mr. Brian Corrigan, Enforcement Consultants, United States Coast Guard
Mr. Brad Pettinger, Oregon Trawl Commission; Astoria, Oregon
Dr. Don McIsaac, Executive Director, Pacific Fishery Management Council
Ms. Vicki Nomura, National Marine Fisheries Service, Fisheries Enforcement

TUESDAY, OCTOBER 7, 2003 - 8:30 A.M.

A. *Call to Order and Administrative Matters*

1. Roll Call, Introductions, Announcements, etc. — Dayna Mathews/Joe Albert
2. Elect Chair

Due to the retirement of the former chair, Mr. Steve Springer, and the new membership of the Ad Hoc Vessel Monitoring Committee (VMSC), the group elected a new chair. Mr. Moore nominated Mr Hansen who was elected chair of the VMSC. Mr. Hansen requested that the group also elect a vice-chair. Mr. Dayna Matthews was nominated and elected as vice-chair.

3. Committee's Charge

Dr. McIsaac welcomed the group and summarized the Council's expectations from the committee. The Council has forwarded two major issues to the VMSC; requirements for vessels transiting/drifting in a closed area and expansion of the existing VMS program into additional fishery sectors.

4. Approve Agenda

Mr. Moore requested that agenda item E be expanded to included a GAP request that drifting and transit issues be addressed for all fishing sectors as there were concerns about the details of the transit rules for trawl fisheries.

B. ***Update on the Existing Monitoring Program***

1. Final Rule Implementation — Becky Renko

The comment period for the proposed rule closed in July. Comment received included June Council meeting input and the GAP statement. A final rule has been prepared and was submitted to NMFS Headquarters in early September. The rule is expected to proceed to the Department of Commerce for filing in October.

Comments on the proposed rule were varied and include:

- VMS is unnecessary if a declaration system is in place, while others stated that declaration was not enough.
- A sunset clause should be added to the program rather than implementing indefinitely.
- Vessel operators should have the option to turn off the units when not fishing or participating in a fishery that does not require VMS.
- Transiting issues; many relative to fixed gear, not fair to have transit requirements for trawl and not fixed gear.
- Fixed gear vessels often work steep canyons on the shelf making it difficult to stay on one side of the line.
- The rule needs a requirement for back up units.
- Installation cost concerns and the common misunderstanding that VMS equipment needs to be installed by a certified installer.
- Trailering of small vessels and the development of geofencing at the shoreline (*i.e., a management line specified by coordinates at the coastline, inland of which, VMS would automatically shut down until the unit again crosses to the seaward side*).
- Requests for low cost and durable units.
- NMFS should pay and the program should not begin until money is available.
- Comment on when VMS should be effective; as soon as possible, whenever buyback is complete, and January 1, 2004.

In response to all comments received, NMFS added language to:

- Prohibit a transceiver from being used on more than one vessel but allows transfer from one vessel to the next.
- Allow legal trawl fishing within the trawl RCA-pelagic trawl fisheries.
- Clarify the consistency of VMS regulations in state and federal waters.

Additionally,

- Small vessel VMS issues are being worked on by enforcement, including geofencing.

- Transit requirements for the limited entry trawl sector remained the same.

Mr. Larkin asked if money becomes available, will it be the vessel owner's responsibility to replace the unit. Ms. Renko stated that NMFS would likely reimburse the original costs, up to a cap, but the vessel owner would be responsible for replacement costs.

2. Vessel Monitoring System (VMS) — Dayna Mathews/Joe Albert

Mobile Transceiver Unit (MTU) type approval is currently underway. MTUs that have been type approved will be published in the final rule. MTUs type approved after the final rule is published, will be listed in subsequent Federal Register notices.

3. Declaration System — Dayna Mathews/Joe Albert

An interactive voice response telephone system has been developed. Participants will be prompted to enter information through codes. Confirmation of the declaration report and an identification number will be sent back. During business hours, a person can get a live person for questions. Computer systems at NMFS will eventually track declarations allowing operators to compare VMS track lines with declaration reports.

C. Transiting Requirements for Limited Entry Fixed Gear Vessels

1. Review of the Issue — Dayna Mathews

When comments on the proposed rule were being reviewed, it became apparent that transiting requirements for limited entry fixed gear vessels had been overlooked. NMFS had a few options; (1) change the rule and implement transiting requirements for fixed gear vessels in the final rule, or (2) bring the issue forward to the Council in September and address the issue during the process of developing the 2004 annual harvest specifications and management measures. Desiring additional public input on the issue, NMFS opted for the second option. At the September meeting, the Council referred the issue to the VMSC for further consideration. The VMSC is expected to report back to the Council at the November meeting allowing the Council the opportunity to submit recommended regulation changes during the comment period for the proposed rule on 2004 management measures.

2. Enforcement Concerns — State and Federal Enforcement Personnel

Enforcement personnel agreed that VMS track lines in an RCA need to either be explained by a declaration report or a clear transit signal. With the exception of gear stowage, the issues are very similar to the trawl fishery where transit requirements (no drifting) are in place. Enforcement does not feel that gear stowage is an issue for the limited entry fixed gear sector.

3. Industry Concerns — Tom Ghio

Industry representatives were most concerned with safety issues. Besides being further from port, drifting at night in areas deeper than the non-trawl RCA puts vessels in greater danger of bad weather and collision with cargo ships.

There were many questions about the ability to determine if a vessel is fishing or drifting from the VMS track line. Mr. Albert reported that the system will alert an agent when there is an infraction and the agent will have to make a judgement call on the vessel's activity (drifting, transiting, fishing). At this time, with a new system, it is unrealistic to expect an agent to determine fishing activity from drifting.

Enforcement personnel where asked how the transit requirements preserve the integrity of the RCA, if you see a questionable signal do you need to send out a visual sighting to prosecute? Mr. Matthews stated that an investigation would be initiated and would either go out to sea or meet the vessel at the dock. It was stated by the group that there will vessels drifting in the area that are not required to have VMS. Mr. Matthews replied that vessels without VMS are not the issue, and that if a vessels you are tracking has a questionable signal then enforcement would have to take action.

A VMS program in Hawaii was cited as an example of a fishery where drifting and fishing activity can be determined through VMS and appropriately investigated. This and other VMS systems have the simplifying aspect that vessels are prohibited from the closed unlike our system which has provisions for transit and legal fishing activities in the RCA.

Industry was also concerned with how NMFS will prosecute a case. For example, if a trawl vessel snags a net and is forced to enter a closed area, would the vessel operator have an opportunity to explain the situation. Mr. Matthews state that it is unlikely that a case would be made on the VMS track alone and that enforcement will consider each situation and contact the vessel.

Industry representatives felt that this system helps enforcement efforts but does little for fishers. It was stated that VMS is a mitigating factor which allows depth based management and continued fishing opportunity.

Observers are now estimated to be on between 20-30% of the vessels and their role in confirming accidental infractions or legal activities could at some point be a means of allowing drifting. Enforcement is a secondary role for observers but their input could be used as a witness.

4. Recommendation to the Council — Committee Discussion

Mr. Moore identified two issues for the group to consider; (1) should fixed gear vessel transit requirements be treated like trawl, and (2) should this issue be addressed through the VMS rule process or the 2004 annual specifications. On the latter, the group agreed that as long as there is public notice and comment then it is not critical whether the issue is handled under the specifications or VMS rules.

Enforcement personnel recommended that drifting not be allowed. Vessel operators will need to change their behavior to allow open fishing opportunities to exist in this era of overfished species. Enforcement does not have the tools to check every vessel that is drifting and cannot handle at-sea declarations. Two-way communication units are expensive and the current program is not likely to provide a communication system.

Industry representative reiterated their concerns of safety and life. Coast Guard representatives reminded the group that rules requiring vessels to have 24 hour lookouts already exist.

Units will be made available that allow two-way communication. The units are more expensive but are available. More work would need to be done with the automated computer system to allow VMS transmitted signals and declarations from sea.

Some learning and expertise will need to develop to determine which track lines are truly problematic and which are simply drifting too close. There will be investigations into at-seas declaration systems for the future but at this time there is no way to accommodate this request.

The committee was unable to reach consensus on implementation of transit requirements in the limited entry fixed gear fishery.

D. Automated Identification System (AIS)

1. AIS Overview and Update — LT Gregg Casad

LT Casad read the official USCG statement on AIS. (Gregg, can you send to me please?)

Public comment has been extended on a proposed rule until January 5, 2004. There is an interim rule in effect until November that specifies ports and vessel categories under the program. Public meetings are planned in New Bedford, Connecticut and Seattle. The USCG was limited in their ability to discuss the program during the open comment period. The committee has requested that the USCG legal council determine who can speak about the interim final rule that is in effect.

AIS is only effective within 30 miles but can transmit much more information about a vessel than VMS. The costs are considerable and wether vessels will be required to carry both VMS and AIS systems is unclear. The proposed rule does not currently allow VMS as a surrogate for AIS but the final rule has not yet been written.

E. Expansion of the Monitoring Program

1. Criteria for Considering Fishery Sectors for Expansion — Committee Discussion

The committee discussed the following as possible fishery criteria for expanding the VMS program:

- Impacts to overfished species in RCA.
- The ability to define the fleet.
- Targeting of groundfish (need specific criteria for this)
- Commercial vessels with gear types that look like the LE fleet that target groundfish- fixed gear/longline. (rationale: they look like LE vessels which complicates enforcement efforts).

Additionally, the committee also discussed criteria for defining directed OA vessels for VMS implementation:

1. Commercial (non-charter)
2. Operating in the EEZ - any time during the year
3. Landing groundfish
4. with the following gear (prioritized)
    - longline
    - groundfish pot
    - trawl (excluding shrimp?)
    - Line (exclude salmon troll?)

Shrimp vessels were discussed and included and excluded several times. Questions surrounded whether or not these vessels can be easily be visually discernable. The use of excluders diminishes groundfish impacts and the need for VMS.

The salmon troll fishery was discussed as a candidate fishery as a line gear fishery. If the most important criteria for inclusion in the VMS program is impacts then salmon vessels could be considered for VMS. However, VMS cannot tell where rockfish are caught by a salmon vessel and salmon troll is not excluded from the closed area so VMS is less effective as an enforcement tool. The Council may, in the future, consider new regulations for reducing groundfish interactions, (i.e, closed areas, spread limits). The committee was split on wether to recommend VMS on salmon troll vessels and agreed to evaluate groundfish impacts from 2002 and/or 2003 before making a final recommendation.

The committee acknowledged that other open access fisheries such as the California setnet fishery also needs further review before a final recommendation can be made. The committee also had unresolved questions about federal jurisdiction over a vessel that fishes exclusively in state waters without a federal permit. State licensed vessels may require state-federal cooperation to require VMS units aboard state licensed vessels.

It was suggested that any vessel that lands a federally managed groundfish species for commercial purposes be required to carry VMS equipment because universal application is required to ensure the integrity of the RCAs. Enforcement personnel are in favor of developing the VMS program in

The committee also discussed VMS in the charter and private sectors of the recreational fishery. It was unclear to the group why a program should single out charter vessels. In some areas, private vessels are an equal if not greater percentage of the catch and effort than the charter industry. Like the salmon troll fishery, VMS could verify that the species on board a recreational vessel were caught in the appropriate area but these vessels can still participate in the RCA. The committee recommends an area by area evaluation of groundfish impacts by charter and private vessels before making a final recommendation.

F. Report of the Committee to the Council in November

Committee Discussion

1. Written Report - Mr. Mathews will draft for committee review.
2. Council Presentation - To be given by Mr. Matthews.

Committee adjourned at 3:30 P.M.

ENFORCEMENT CONSULTANTS REPORT ON VESSEL MONITORING SYSTEM: TRANSITING REQUIREMENTS AND EXPANSION OF THE PROGRAM

The Enforcement Consultants (EC) strongly opposes any dilution of the selected enforcement tool for depth-based management. The Groundfish Advisory Subpanel (GAP) has stated that in the past the original vessel monitoring system (VMS) presenter with NMFS (now retired) advised that drifting in the Rockfish Conservation Area (RCA) could be differentiated from vessels that are fishing. The EC would like to set the record straight. The presenter advised that VMS system operators could tell the difference between fishing and not fishing, with "not fishing" being interpreted as "being underway." The context of that discussion was in reference to the trawl fishery and the declaration system in the 2003 specifications. Not including fixed gear in the discussion of transiting versus drifting was an oversight made by enforcement endeavoring to implement a complicated and new strategy. Nonetheless, this oversight needs to be rectified by applying a transiting requirement for fixed gear vessels in the 2004 specifications. Once system operators have become familiar with the capabilities of VMS, there is "potential" that drifting and fishing can be differentiated from each other. Obviously, implementation of VMS on the West Coast is new, and short comings have not yet been identified. It would be unwise to place constraints on our ability to utilize this program before we even implement it.

The Ad Hoc VMS Committee has discussed expansion of the program to other sectors of the fishing industry that directly impact groundfish species. One of the groups identified for consideration is the open-access-directed groundfish fishery. A drifting allowance will add an unmanageable level of complexity for system operators and law enforcement responses, as an estimated additional 1,500 vessels could potentially be drifting in and out of the RCA.

If the Council chooses to allow drifting within the RCA's, the EC does not recommend expansion of what would become a dysfunctional, yet expensive enforcement tool. Additionally, given a decision to allow drifting, the EC recommends the Council reconsider requiring VMS on any fixed gear vessel.

PFMC
11/06/03

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON VESSEL MONITORING SYSTEM: TRANSITING REQUIREMENTS AND EXPANSION OF THE PROGRAM

The Groundfish Advisory Subpanel (GAP) received a report from the Ad Hoc Vessel Monitoring System (VMS) Committee and provides the following comments.

The GAP continues to express its strong concern over prohibitions on entry by limited entry vessels into the Rockfish Conservation Area (RCA) for purposes other than transit. The GAP notes that the initial presentation made by NMFS two years ago on the VMS system included the statement the system could differentiate between a vessel that is fishing and a vessel that is not fishing. Now that the original presenter has retired from NMFS, we are being told that such is not the case unless there is a trained monitor observing VMS tracks 24 hours per day, seven days per week.

The GAP cannot emphasize strongly enough the safety concerns associated with an allowance for non-fishing, non-transiting entrance into the RCA. Testimony has been heard from numerous veteran fishermen about the need to get out of shipping channels, away from the weather effects of headlands, during typical northwestern storms. We are frustrated the Coast Guard, which has consistently weighed in on management measures affecting fishing vessel safety, has not taken this issue to heart. We are angry the NMFS Office of Law Enforcement continues to have tunnel vision on an issue that might make enforcement slightly more difficult or costly, but which could save lives.

The Ad Hoc VMS Committee report makes clear the lack of consensus between fishing representatives and law enforcement representatives on this issue. We ask the Council to make clear, in the strongest way possible, that an accommodation for safety must be made.

PFMC
11/06/03

Exhibit D.10.~~b~~d
Supplemental Public Comment
November 2003

Subject: **Fwd: Salmon Trollers VMS**
Date: Sat, 25 Oct 2003 21:27:33 -0700
From: Douglas Fricke <fricked@techline.com>
To: Chuck Tracy <Chuck.tracy@noaa.gov>
CC: Don Stevens <Spirit.spirit@verizon.net>

Chuck, Don Stevens suggested that I forward the following Email so it could go into the Council briefing book in the discussion on VMS - Thanks -- Doug Fricke

>Date: Thu, 23 Oct 2003 13:32:20 -0700
>To: Dayna Matthews
>From: Douglas Fricke <fricked@techline.com>
>Subject: Salmon Trollers VMS
>Cc: Don Stevens, Cathy Fosmark, WTA Board, Judie Graham, Mark Cedergreen,
>Phil Anderson
>
>It has come to my attention that PFMC VMS Advisory Group is considering >whether or not to exempt Coastal Salmon Trolling from the requirement of >carrying VMS while Trolling for salmon. One of the considerations is >the allowance of incidental retention of yellowtail rockfish by the >trollers while targeting on salmon. It seems that the incidental allowance >of yellowtail rockfish of which you are required to land two pounds of >salmon before any yellowtail can be retained and a 200 lb per month >(approximately $50 landing value) total allowance is going to encourage >salmon trollers to target on groundfish is totally unrealistic. We know >that yellowtail rockfish have a tendency to be higher in the water column >than most other rockfish and this is a way to reduce bycatch that is a >positive interest to everyone. We have vessels that troll for salmon along >the entire coasts of WA., OR., and CA., and can attest that there is no >targeting on groundfish while trolling for salmon and that the fishing >techniques utilized along all three states are virtually the same. We can >see no reason why VMS should be required for salmon trollers along the >Pacific Coast.
>The Washington Trollers do not have a representative on the GAP and do not >have the funds to send representatives to the GAP or VMS meetings on a >continual basis. We would appreciate notification to present our views on >issues affecting our fisheries before final decisions are made. - Doug >Fricke, WTA President

Captain Mike Cenci
Washington Department of Fish & Wildlife
PO Box 1279
Long Beach, WA 98631
cencimac@dfw.wa.gov

Dear Mike,

We feel more than compelled to write to you about the drifting in the RCA issue. We are adamant that some provision must be made to allow drifting in this area and our concerns centers around basic crew safety.

When a trawl vessel is reeling in the net, as soon as the net leaves the bottom, the boat develops a mind of its own. The net breaches the boat from the rear, the same location as the propeller. So it is very hard to maneuver the boat at this time and it is subject to the mercy of the wind and the currents. If the vessel were fishing near the RCA, the wind and currents could move the vessel inside the RCA while the crew is busy trying to secure the catch. This is an extremely vulnerable time for both the crew and the boat. All hands are so busy that they can not even take the time to respond to a phone or radio call. Snagging something on the bottom as the net is being raised could even pull the boat down. So this is the most crucial time during trawl fishing.

We need a solution to the problem of drifting in the RCA that the fishers can live with and the enforcers can manage. Not all boats fish close to the RCA lines all the time but most boats do occasionally find themselves close to the line as they attempt to catch what they are allowed to catch. A declaration system is part of the strategy of enforcing the RCA so why can't a boat contact the declaration system when they find themselves ready to haul in and are close to the RCA? That way it would be declared if they do drift into the RCA while hauling in. All trawl vessels have radios, cell phones, sat phones or some method of communication with shore. This requirement would have no economic impacts on the fleet and would not increase the size of the RCA by requiring a large drift zone margin around the RCA.

Another time a boat may drift is when the crew is making repairs. They may be on deck making repairs to the gear or they may be in the engine room dealing with mechanical problems During this time the boat is subject to the currents and wind and it is not uncommon to drift up to 10 miles while the crew deals with the repair. A simple call to the declaration system would avoid the need for the enforcers to come out to investigate.

Both drifting problems mentioned above could be addressed with a simple phone call if the declaration system could be used for this purpose. This solution has very little economic impact on the fleet. Perhaps some data from the observer program could shed some light on how boats are effected by net haul ups. Observer information could at least give some frequency data that may be useful in finding a solution to the drifting problems.

Sincerely,

Steve Bodnar, Executive Director

Coos Bay Trawlers' Association, Inc.
PO Box 5050
Coos Bay, Oregon 97420
phone:541-888-8012
fax:541-888-6165
c.trawl@verizon.net

Exhibit D.11.b
Attachment 2
November 2003

Preliminary Draft

West Coast Groundfish Bycatch Management Program

Programmatic Environmental Impact Statement

Prepared by NW Region, National Marine Fisheries Service
for the Pacific Fishery Management Council

November 2003

Table of Contents

Executive Summary
Groundfish Bycatch Programmatic EIS

1.0 The Proposed Action

The Pacific Fishery Management Council and National Marine Fisheries Service propose to establish a program to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law. The proposed action would establish the policies and program direction to achieve this purpose.

1.2 Purpose of the Proposed Action

As identified by the Council's ad hoc Environmental Impact Statement Oversight Committee (Committee), the purposes (objectives) of the proposed action include the following:

- **account for total fishing mortality by species**
- **establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits**
- **reduce unwanted incidental catch and bycatch of groundfish and other species**
- **reduce the mortality of animals taken as bycatch**
- **provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods**
- **monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly**
- **reduce unobserved fishing-caused mortalities of all fish**
- **gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches**.

1.3 Need for the Proposed Action

The proposed action is needed to (1) reduce waste, discard, and collateral damage to marine plants and animals by groundfish fishing activities on the Pacific coast, (2) collect and report appropriate and adequate information to support the groundfish fishery management program, and (3) balance these needs with environmental and social values (i.e., need to allow for fishing).

1.4 Selecting and Implementing a Preferred Alternative

The Council and NMFS will consider how each alternative addresses the purpose and need for action. While six alternatives have been proposed, there are a variety of management measures that could be included (or excluded) from any alternative. The Council and/or NMFS may find that by revising an alternative they may be able to achieve greater benefits or better mitigate anticipated negative effects. Finally, the Council and NMFS will determine if and how each alternative reduces bycatch to the extent practicable and, for bycatch that cannot be avoided, reduces bycatch mortality to the extent practicable.

The Council will review this preliminary draft EIS at its November 2003. NMFS will consider any Council comments on the preliminary draft and will prepare a final draft EIS (DEIS) in early 22004. NMFS expects to make the DEIS available for public comment in January 2004 and provide an extended comment period through April 2004. The Council will review the DEIS during the comment period and identify its preferred alternative at its April 2004 meeting. NMFS will prepare the Final EIS after the public comment period when it has received the Council's final recommendations.

1.5 How The EIS is Organized

This EIS follows the standard organization established by the CEQ regulations. Chapter 1 identifies the issue of bycatch reduction and reporting as the focus of the proposed action and describes why action is needed. Previous Council and NMFS actions relating to bycatch are described to help set the context for the proposed action. Chapter 1 also lays out the criteria the Council and NMFS will use for making their final decision.

Chapter 2 presents the six alternatives to reduce bycatch and bycatch mortality, and to establish a standardized reporting methodology. It describes how the alternatives were developed, and provides a summary of the anticipated environmental impacts of the each alternative. It briefly describes the management "tools" available to the Council and NMFS for reducing bycatch and for monitoring the effects and effectiveness of the various tools, and how the alternatives apply the tools. It identifies the direct, indirect and cumulative impacts so the decision-makers can make a reasoned and informed decision, and the public can understand the conclusions and how they were reached.

Chapter 3 describes the affected environment as it pertains to incidental catch, bycatch, bycatch mortality, and catch reporting/monitoring. The factors related to bycatch are identified and described: co-occurrence in time and space; species behavior; fish body size and shape; and types of fishing gears and methods used. Chapter 3 describes the current human environment as it relates to incidental catch, bycatch and bycatch mortality. The current condition of particularly important groundfish and other species of marine animals are described, and how they are directly affected (that is, bycaught) in groundfish fisheries. The social and economic conditions relating to bycatch, bycatch reduction methods, and bycatch monitoring are also described.

Chapter 4 presents the analysis of environmental impacts. The basic relationship between catch and effort, gear selectivity, and species abundance are described. Bycatch mitigation tools work through changing effort levels, gear selectivity/effectiveness, or by restricting access to areas of species abundance. Chapter 4 describes the capture methods of the various fishing gears, including selectivity features and placement factors (that is, where and in what conditions they can be used). Potential mitigation tools are described, that is, the available management measures and adjustments to control incidental catch and bycatch and to achieve other objectives. Regulations not related to fishing gears are identified and described: harvest specifications, allocation, retention limits, catch/ mortality limits, time/area management, and limiting effort (reducing fleet size). Collectively, these management measures are identified as the “bycatch mitigation toolbox.” Potential effects of each tool are described and the effects and effectiveness of each tool are ranked. Next, those ranks are applied to each alternative. This stepwise process provides the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes.

2.0 The Alternatives

Chapter 2 presents the alternatives that have been developed to resolve bycatch issues and to ensure the FMP complies with the bycatch reduction mandates of the Magnuson-Stevens Act. Each alternative describes a bycatch management program and includes all the parts of the program: the overall objectives, the methods to achieve the objectives, and the reporting and monitoring requirements that would be required. The six alternatives represent a variety of policies, approaches, and methods to reduce bycatch. The alternatives range from the current (2003) methods of reducing bycatch (Alternative 1, no action or the “status quo”) to more aggressive and comprehensive bycatch reduction policies and methods.

Section 2.1.1 presents the bycatch mitigation “toolbox,” that is, the variety of regulatory measures available to the Council and NOAA Fisheries to implement a bycatch monitoring, reporting and reduction program. Each tool is described in terms of its usefulness, effectiveness, effects, etc.

Section 2.1.2 describes how the alternatives are structured so they can be compared and understood more clearly. Sections 2.2.1-2.2.6 describe each alternative in detail. Section 2.3 summarizes the anticipated effects or impacts or each alternative in comparison to current conditions.

Alternative 1 reduces incidental catch and bycatch through a combination of indirect measures: Optimum Yield (OY) specifications, area closures, gear restrictions, variable trip limits and bag limits, seasons and other measures. High priority is given to minimize cost of catch monitoring. Vessel trip limits are calculated using a computer model and incidental catch ratios from past years.

Alternative 2 would reduce groundfish bycatch by increasing the size of trip limits. This would be achieved by reducing the trawl fleet by 50%; the goal of maintaining a year-round fishery would continue. The focus on fleet reduction is based on the Council’s *Strategic Plan for Groundfish*. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 3 would reduce groundfish bycatch by increasing the size of trip limits. This would be achieved by eliminating the goal of maintaining a year-round fishery and establishing a short season or series of seasons. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 4 would reduce bycatch by establishing catch limits for various fishery sectors in addition to vessel landing/retention limits. A portion of the overall allowable harvest would be held in reserve for those individuals with the lowest bycatch rates. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 5 would reduce bycatch by establishing groundfish catch quotas for individual commercial fishers and other qualified entities. Monitoring would be focused at the individual vessel level rather than at the sector level. Fishing restrictions might be relaxed to all vessels more flexibility to develop individual bycatch reduction methods.

Alternative 6 would reduce bycatch to near zero by (1) closing large areas, (2) establishing individual vessel catch allowances (caps), (3) requiring each commercial vessel to carry an onboard observer at all times the vessel fishes, and (4) requiring increased retention (limited discard) of groundfish.

3.0 The Affected Environment

Chapter 3 describes various components of the coastal marine ecosystem and how people and communities use and rely on the groundfish resources of this region. The groundfish FMP and management regime covers groundfish stocks off Cape Flattery, Washington to the California border with Mexico. Hundreds of plant and animal species occur along the West Coast and groundfish-related bycatch may affect many of them.

The chapter begins with a brief description of the physical environment, including marine geology, climate and currents. Basic biology of selected species, including important groundfish species, protected species, and other relevant fish and shellfish species, is provided. Species given special emphasis are identified: nine overfished groundfish species and protected marine species including Pacific salmon, marine birds, marine mammals and sea turtles. Other species are also described.

Fishing activities, gears and patterns are described. Important interactions among species, gears and fisheries are also described, as well as types of management tools and their application to bycatch issues. Chapter 3 also describes the human uses of West Coast groundfish stocks, and how these activities relate to other fishing activities in the region. The commercial and recreational fisheries, commercial fish buyers and processors, and coastal communities where groundfish-related activities occur are described.

4.0 Impacts of the Alternatives

Bycatch mitigation effects fall into four broad categories:

- Avoid catching fish that will not be kept and other animals
- Reduce the mortality of fish and other animals that are caught and released
- Reduce the waste of fish that are caught and are dead or will die as a result of being caught

- Avoid unobserved mortality of fish and other animals that directly results from fishing gear.

The highest priority of bycatch mitigation is to reduce the capture of any marine plant or animal that is unintended or unwanted. The goal is to harvest desired fish with the minimum impact on all other fish and animals. The second priority is to minimize damage to fish and animals that should or would not be caught in a perfectly selective fishery.

The amount of catch of any fish or other animal is related to the amount of effort, the selectivity of the gear, and the number of animals present. To reduce catch, any or all of these three factors can be modified.

The complicated relationships among these factors becomes evident when one considers more than one species at a time. No gear is equally selective for two species because of differences, however small, in species shape, size and behavior. Also, species abundance and distribution are never identical. This means that with any amount of fishing effort, the catch of two species will never be the same. The extent of geographic overlap affects the co-occurring catch, as does the degree of similarity in size and shape.

Capture methods of the various fishing gears are described, including selectivity features and placement factors. Non-gear related regulations are identified and described, such as harvest specifications, allocation, retention limits, catch/mortality limits, time/are management, and limiting effort (reducing fleet size). Collectively, these management measures are called the "bycatch mitigation toolbox." Potential effects of each tool are then described and ranked according to their effects and effectiveness. Then those ranks are applied to each alternative.

Section 4.1.2 describes the critical comparative methods used to analyze the effects of the various bycatch mitigation tools and the six alternatives. Section 4.1.3 identifies the available mitigation tools, and Section 4.1.4 describes the effects and effectiveness of the tools. The effects and effectiveness of each tool are ranked, and then ranks applied to each alternative. In this stepwise process, we provide the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes. Direct and indirect effects are described in Sections 4.2 through 4.11 Impacts to ecosystem and biodiversity are outlined in section 4.2. Impacts of the six alternatives are described in section 4.3. Section 4.5 summarizes impacts of each alternative proposed monitoring program. Section 4.6 summarizes impacts to the biological environment. Section 4.7 describes socioeconomic impacts. Effects on catch and bycatch distribution are discussed in section 4.8. Cumulative effects are summarized in section 4.9 and irreversible and irretrievable effects are discussed in Section 4.10. Impacts to management and environmental management issues are discussed in section 4.11.

5.0 Agency Preferred Alternative and the Environmentally Preferred Alternative

This chapter will be drafted when a preferred alternative has been identified, which may not be until April 2004. Chapter 5 will describe the decisions that went into the agency's choice of a preferred alternative. It will also identify the environmentally preferred alternative. If the preferred alternative is not the environmentally preferred alternative, this chapter will explain how and why they differ.

Table 2.2 Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

Goals and Objectives	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce bycatch by decreasing effort and permitting larger or more flexible trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce bycatch by reducing effort and permitting larger or more flexible trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector catch/ mortality caps	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch limits (individual quotas) for groundfish species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	Y	Y	Y	Y	Y	Y
Set **overfished groundfish catch caps** by **fishing sector**	N	N	N	Y	N	Y
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	Y	Y	Y	Y*	N	N
Use **catch limits** to control groundfish bycatch	N	N	N	Y	Y	Y
Set individual vessel/permit catch caps for overfished groundfish species	N	N	N	N	Y	Y
Set groundfish **discard caps** (require increased retention)	N	N	N	N	Y	Y
Establish **IQs** for other groundfish	N	N	N	N	Y	Y
Establish bycatch **performance standards**	N	N	N	N	Y	Y
Establish a reserve for fishers who achieve performance standards	N	N	N	Y	N/Y	Y
Gear Restrictions						
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	Y	Y	Y	Y	N	Y
Time/Area Restrictions	Y	Y	Y	Y	Y	Y
Establish **long term closures for all groundfish fishing**	N	N	N	N	N/Y	Y
Establish **long term closures for on-bottom fishing**	N	N	N	N	N/Y	Y
Capacity reduction (mandatory)	N	Y(50%)	N	N	N	N
Monitoring/Reporting Requirements						
Trawl logbooks	Y	Y	100%	Y	??	??
Fixed-gear logbooks	N	N	100%	Y	??	??
CPFV logbooks	N	N	N	Y		
Commercial **port sampling**	Y	Y	Y	>Y	N/Y	Y
Recreational port sampling	Y	Y	Y	>Y	Y	>>x
Observer coverage (commercial)	10%	10%	10%+logbook	60%?	100%	100%
CPFV observers	N	N	N	Y	Y	100%
VMS	Y	Y	Y	Y	Y	Y
Post-season observer data OK	Y	Y	Y	Y/N	N	N
Inseason observer data required	N	N	N	Y/N	Y	Y
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	Y	Y	Y	Y	N	N

* Trip limits may be required for some sectors to prevent "derby fishing".

Table 4.1.1 Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Harvest Levels					
ABC/OY	Low OYs often require management measures such as low cumulative landing limits under some alternatives that made lead to discard. On the other hand, higher OYs may result in higher levels of effort and catch. Depending on alternatives, higher discard may also result.	Many species limited by markets do not reach OY limits, due to the market limit and other constraints placed on fishery by overfished species OYs.	If OY's are reduced, regulatory bycatch mortality may increase for some species if trip limits are reduced. If overall effort is reduced due to restrictions, overall bycatch and bycatch mortality may be reduced.	Lower OY's should reduce fishing effort. Reducing effort should result in reduced habitat impacts.	Lower OYs required for rebuilding of some species may make it difficult to accurately track total catch under some alternatives.
Sector allocations 1/	Distributed OY may have a postive effect in reducing bycatch. Risk and consequences of encountering a "disaster tow" can be spread out among several boats within the sector.		Under a given OY, catch is allocated and distributed to fishery sectors in some alternatives. Distributed OY may have a postive effect in reducing bycatch mortality to the degree risk of bycatch can be spread and managed by the sector.		Sector allocations would work best with a robust monitoring program. With increased monitoring, There would be less incentive to discard allocated fish as it would count against the allocation.
Trip (landing) limits 2/	If landing limit increases, bycatch is reduced. Studies have shown that as trip limits decline or cumulative limits are approached, bycatch increases. As cumulative limits are reached there are stronger incentives to keep higher valued fish and discard species that are close to the limit in order to continue fishing for species having more cumulative limit remaining.	Economic factors such as price, demand, and minimum fish size needed for processing often determine market limits on the amount of fish landed. These factors can lead to discarding of fish after a market limit is reached.	If bycatch is reduced due to increased landing limit, bycatch morality is also reduced. If limits are increased due to larger OYs, bycatch and bycatch mortality may increase due to higher harvest levels.		If landing limits increase, regulatory induced discard is reduced. Reducing discard increases accuracy of estimating total catch at lower levels of fishery monitoring.
Catch limits	Vessel catch limits reduce bycatch when fishing ceases and/or there is a retention requirement. Effect is enhanced when limit is on individual boat, when applied to all groundfish, and monitoring is robust.	If all groundfish catch is retained (alternative 6), vessel catch limit will have no market induced bycatch.	Vessel catch limits should reduce bycatch mortality as there is less need to compete to catch fish (no derby fishery). Same pattern of effect as with regulatory bycatch.	Vessel catch limits may reduce hours trawled through incentives and efficencies to maintain strict catch caps under some options. Reducing trawl hours should reduce habitat impacts.	Catch limits may provide more flexibility by relaxing or eliminating landing limits and reducing discarded catch of those species that are not market limited. Thus, accountability is improved, if full retention is required and/or observer coverage is significantly

Table 4.1.1 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

			Effect		
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Gear Regulations 4/	Regulatory induced bycatch may be reduced by allowing modified gear or alternative gear types that are more selective for non-overfished species and less selective for overfished species.	Allowing modified or alternatives gears that are more selective for marketable species may reduce market induced bycatch. Gear changes to select against overfished species may interact with market induced bycatch both positively and negatively.	Making gears less efficient or more selective may result in some species or sizes being avoided, thus reducing bycatch mortality.	Gear modifications may reduce impacts to habitat. Smaller roller gear requires fishers to avoid high relief habitat. Other alternatives allow use of fixed gear to take unused portions of OY. In the latter case, habitat interactions are different, but likely reduced.	Flexible gear regulations may permit experimentation, and use of alternative and more selective gears to access unused portion of OY. Coupled with observers, species selective gears should reduce discarded fish and improve accountability.
Time/area restrictions 5/	Time/area closures eliminates regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, regulatory bycatch could increase outside the closure.	Time/area closures eliminates non-regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, non-regulatory bycatch could increase outside the closure.	Bycatch mortality would be reduced within the closed area. Bycatch mortality could increase outside of the closed area if fishing effort increases.	Habitat impacts would be reduced or eliminated within closed areas. Habitat impacts could increase outside of closed areas if effort increases outside the closure.	Accountability would be increased through VMS verification of fishing location
Capacity Reduction	Capacity reduction could occur through a buyback program or through sales of IQs. Reduced effort should allow more flexibility in vessel landing limits that would likely reduce regulatory induced bycatch.	If overall effort is reduced as a consequence of capacity reduction, bycatch of species with low or no value would be reduced. Fewer boats may induce buyers to relax market limits (supply and demand response) and effort could increase. Non-marketable or low valued fish would still contribute to bycatch.	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished however, offsetting positive effects.	Reduced effort should have a positive impact in reducing habitat impacts Fewer boats could result in increased hours fished however, offsetting positive effects.	

Table 4.1.1 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Data Reporting					
Logbooks					
Observers					Increased observer coverage under some alternatives would increase accountability by ensuring retention, if required, or accurately accounting for discarded fish
Vessel monitoring system 6/	VMS can directly reduce regulatory bycatch. Compliance with area closures to protect overfished species, for example, would be assured.		VMS can directly reduce regulatory bycatch mortality. Compliance with area closures to protect overfished species, for example, would be assured.		VMS increases accountability by verifying fishing location.
Enforcement					

1/ PFMC, 2003d.
2/ Pikitch, 1988, Methot, 2000.
3/ Larkin, 2003.
4/ Hanna, 2003 and Davis, 2003.
5/ PFMC, 2001.
6/ PFMC, 2003e.

Table 4.1.2 Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Harvest Levels				
ABC/OY	Abundance of overfished species should increase as stocks are rebuilt, those a above MSY could be reduced. *Any changes in population abundance and structure may affect forage available for other animals (birds, mammals, etc.).*			
Sector allocations				
Trip (landing) limits 1/	Present trip limit management attempts to maintain ratios of species in some sectors of the multi-species groundfish fishery. Ratio management may reduce discard but might result in long-term changes in abundance of individual species.		Present trip limit management attempts to maintain ratios of species in some sectors of the multi-species grounfish fishery. Ratio management may result in effort shifting, increasing and/or decreasing bycatch of individual species.	
Catch limits			Catch limits provide flexibility and accountability to manage bycatch. A reduction in derby style fishing should allow fishers to more effeciently pick fishing times and locations to minimize take of species with small catch or bycatch limits.	
Individual quotas 2/			Similar effect as described above under catch limits, but with more flexibility if IQs can be purchased.	

Table 4.1.2 (continued). Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Gear Regulations 3/	Allowing modified or alternatives gears that are less selective for overfished or other groundfish (undersized fish for example) should contribute to increased abundance of target species. If these changes also allow increased selection and catch per unit effort on non-overfished species, abundance of these species could decrease.	Gears modified to reduce bycatch of target species may have different impacts on habitat. The direction of impact is unknown.	Gear restrictions may have a positive impact at reducing regulatory bycatch of overfished species. If effort and target fishing increases on healthier stocks, bycatch of non-overfished species may increase.	Some gear modifications will make fishing gear less efficient, increasing cost per unit of value of catch.
Time/Area Closure 4/	Abundance (biomass) inside area closures should increase through growth. To the degree density dependence occurs, recruitment may be limited inside but increase outside of reserves.	Incentives for fishing outside of closed areas may result in effort shifts. Effort shifting may free up some kinds of habitat from impacts but increase those impacts elsewhere.	Area closures could result in effort shifting. While overfished species bycatch might be reduced, bycatch of market limited species might be increased, depending on alternatives.	
Capacity Reduction	Longer term, capacity reduction, if it results in reduced effort, contributes to a reduction in overall mortality and bycatch mortality which will in turn increase abundance.	Response to capacity reduction would be to reduce habitat interactions with fishing gears. Latent capacity exists even with a 50% reduction in fleet size. Thus, there is the potential for effort increase even though capacity is reduced. This would tend to offset any benefit and gear impacts on habitat could rebound.	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished however, offsetting positive effects. Less effort may allow more flexibility in choice of fishing location - reducing spatial or temporal concentrations of bycatch.	

Table 4.1.2 (continued). Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Data Reporting				
Logbooks				
Observers	Increased observer coverage may reduce fishing behaviors that lead to regulatory induced discard. This would have a positive indirect effect in reducing bycatch, reducing unaccounted for fishing mortality, and positively influencing abundance. Increased observer coverage should increase the quality of data used in stock assessments. Estimates of abundance should therefore be improved.	Increased observer coverage may provide better information on habitat - especially if observers collect data on bycatch of benthic invertebrate communities.	Increased observer coverage should provide more accurate data on distributional changes in bycatch.	Increased observer coverage will add to cost of management and fishing operations.
Vessel Monitoring Systems (VMS) 5/		VMS ensures compliance with fishing locations. Habitat protection within closed areas would be enhanced.		VMS add to cost of fishing and management operations. To the degree compliance and catch accounting are improved, future fishing opportunities and economic stability should be preserved.
Enforcement				

1/ Hastie, 2003.
2/ Larkin, 2003.
3/ Hanna, 2003 and Davis, 2003.
4/ PFMC, 2001.
5/ PFMC, 2003e.

Table 4.5.1 Monitoring tools and effects on improving accountability and cost impacts of each tool. Effects scaled as follows: Y (definitely, substantially), y (probably, moderately), n (probably not, minor), and N (no, none); L = lower cost, M = moderately higher cost, H = highest cost.

Monitoring/Reporting Requirements	Alternatives	Program	Identify fishing locations	Identify fishing depths	Provide tow by tow data	good data quality	Increase quantity and timeliness of data	Identify groundfish discards	Provide groundfish biological data	Provide non-groundfish data	Provide other non-finfish data	Provide mammal and seabird data	Ease of enforcement	Administrative Costs	Compliance Costs (to industry)
fish tickets	1-6	state	N	N	N	y	Y	N	N	y	N	N	Y	L	L
logbooks	1-2,4-6	state	y	y	y	y	n	N	N	N	N	N	Y	M	M
logbooks	3	federal	y	y	y	y	y	y	N	N	N	N	Y	M	M
observers															
commercial 10%	1-3	federal	Y	Y	Y	Y	n	Y	Y	Y	Y	Y		H	M/H
commercial 60%	4	federal	Y	Y	Y	Y	y	Y	Y	Y	Y	Y		H	M/H
commercial 100%	5,6	federal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		H	M/H
CPFV	4-5	(state)	Y	y	-	Y	Y	Y	Y	Y	Y	y		H	M/H
sport		n/a			-		-							HH	
port sampling															
commercial	1-6	state	y	y	N	Y		n	y	N	N	N		M	L
CPFV	1-6	state	y	y	-	Y		n	y	y	N	N		M	L
sport	1-6	state	y		-				y?	y?				M/H	L
VMS	1-6	federal	Y	y	N	Y	Y	N	N	N	N	N	Y	L	M
mandatory retention	5,6	federal				Y	Y	y	y	n	n	N	N	H/M	M/H
Enforcement cost			H	H	H			H		H	H				

Table 4.5.2 Monitoring alternatives and rank of effects on improving accountability, and cost impacts of each alternative.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
RELATIVE RANK OF ALTERNATIVES BY EFFECTIVENESS AT IMPROVING ACCOUNTABILITY, EASE OF ENFORCEMENT, REDUCING COMPLIANCE COSTS	10% Commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, 100% log coverage, log verification, VMS.	60% commercial and recreational (CPFV) observer coverage, increased commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and increased recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.
Indentify fishing locations (VMS)	1	1	1	1	1	1
Identify fishing depths (VMS)	1	1	1	1	1	1
Provide tow by tow data	2	2	1	1	1	1
Provide good quality data	4	4	3	2	1	1
Increase quantity of data	5	4	3	2	1	1
Allow inseason use of data	3	3	3	2	1	1
Identify groundfish discards	5	4	3	2	1	1
Provide groundfish biological data	6	5	4	3	2	1
Provide non-groundfish biological data	3	3	3	2	1	1
Provide non-finfish biological data	3	3	3	2	1	1
Provide mammal and seabird data	3	3	3	2	1	1
Ease of enforcement	5	4	3	2	1	1
Keep administrative costs low	2	3	4	5	6	6
Keep industry compliance costs low	2	3	4	5	6	6
Rank of location	2	2	1	1	1	1
Rank of quality, quantity, timeliness	5	4	3	2	1	1
Rank of groundfish biological data	6	5	4	3	2	1
Rank of non-groundfish biological data	3	3	3	2	1	1
Rank of ease of enforcement	5	4	3	2	1	1
Rank of cost	1	2	3	4	5	5
Number of first place scores	2	2	4	4	15	17
Number of last place scores	15	8	5	0	3	3
Overall Rank	6	5	4	3	2	1

Table 4.6.1 Relative rank of bycatch reduction methods (tools) for each alternative used to reduce bycatch and bycatch mortality, and address accountability issues.

RELATIVE RANK OF ALTERNATIVES BY BYCATCH REDUCTION TOOL TYPE	Alternative 1 Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	Alternative 2 Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	Alternative 3 Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	Alternative 4 Reduce all groundfish bycatch by establishing sector caps	Alternative 5 Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	Alternative 6 Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	1	1	1	1	1	1
Set **overfished groundfish catch caps** by **fishing sector**	2	2	2	1	2	2
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	4	2	3	2	1	1
Use **catch limits** to control groundfish bycatch	3	3	3	2	1	1
Set individual vessel/permit catch caps for overfished groundfish species	3	3	3	3	2	1
Set groundfish **discard caps** (require increased retention)	2	2	2	2	1	1
Establish **IQs** for other groundfish	2	2	2	2	1	1
Establish bycatch **performance standards**	3	3	3	2	1	1
Establish a reserve for fishers who achieve performance standards	3	3	3	2	1	1
Gear Restricitons						
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	2	2	2	2	3	1
Time/Area Restrictions	3	3	3	3	2	1
Establish **long term closures for all groundfish fishing**	3	3	3	3	2	1
Establish **long term closures for on-bottom fishing**	2	2	2	2	1	1
Capacity reduction (mandatory)	3	1	3	3	2	2
Monitoring/Reporting Requirements						
Trawl logbooks	2	2	1	2	2	2
Fixed-gear logbooks	2	2	1	2	2	2
CPFV logbooks	2	2	2	1	1	1
Commercial **port sampling**	3	3	3	2	1	1
Recreational port sampling	3	3	3	1	2	1
Observer coverage (commercial)	5	4	3	2	1	1
CPFV observers	3	3	3	2	2	1
VMS	1	1	1	1	1	1
Post-season observer data OK	3	3	3	2	1	1
Inseason observer data required	3	3	3	2	1	1
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	2	2	2	2	1	1
Discount fish ticket records of overfished species landings due to the low likelihood they accurately reflect actual catch and mortality.	2	2	2	1	1	1
Number of first place scores	2	3	4	5	16	22
Number of last place scores	23	20	18	12	3	3
Overall Rank	5	4	4	3	2	1

* Trip limits may be required for some sectors to prevent "derby fishing".

Table 4.6.2 Alternatives ranked by their effectiveness at reducing bycatch, enforcing and monitoring bycatch measures, and reducing compliance costs to industry.

RELATIVE RANK OF ALTERNATIVES BY POTENTIAL BYCATCH REDUCTION, EASE OF ENFORCEMENT AND COST	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector caps	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
Reduce catch in excess of vessel limits?	5	4	5	3	2	1
Reduce proportion of overfished species?	5	3	4	2	1	1
Reduce encounters with overfished	5	3	4	2	1	1
Reduce fishing in high relief seafloor	5	3	4	2	2	1
Reduce catch proportion of on-bottom	5	3	4	3	2	1
Reduce catch proportion of off-bottom	6	4	5	3	2	1
Reduce catch proportion of small fish?	3	3	3	3	2	1
Reduce catch of unwanted finfish species?	3	3	3	3	2	1
Reduce potential for "ghost fishing"?	1	1	1	1	1	1
Reduce catch of marine mammals?	2	1	2	2	2	2
Reduce catch of seabirds?	2	1	2	2	2	2
How easily enforced/ monitored?	5	4	3	2	1	1
Compliance Costs (to vessel)	1	2	3	4	5	6
Rank of Groundfish Bycatch Reduction	6	4	5	3	2	1
Rank of Other Bycatch Reduction	2	1	2	2	2	2
Rank of Enforcement	5	4	3	2	1	1
Rank of Cost	1	2	3	4	5	6
Number of first place scores	2	3	1	1	4	10
Number of last place scores	11	2	4	4	2	3
Overall Rank	6	4	5	3	2	1

1.0 Purpose of and Need for Action

1.1 The Proposed Action

The PACIFIC FISHERY MANAGEMENT COUNCIL and NATIONAL MARINE FISHERIES SERVICE propose to establish a program to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law. The proposed action would establish the policies and program direction to achieve this purpose.

The Proposed Action is to establish policies and program direction that minimize bycatch to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law.

1.2 Purpose of the Proposed Action

As identified by the Council's ad hoc Environmental Impact Statement Oversight Committee (Committee), the purposes (objectives) of the proposed action include the following:

- **account for total fishing mortality by species**
- **establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits**
- **reduce unwanted incidental catch and bycatch of groundfish and other species**
- **reduce the mortality of animals taken as bycatch**
- **provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods**
- **monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly**
- **reduce unobserved fishing-caused mortalities of all fish**
- **gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches**.

1.3 Need for the Proposed Action

The proposed action is needed to (1) reduce waste, discard, and collateral damage to marine plants and animals by groundfish fishing activities on the Pacific coast, (2) collect and report appropriate and adequate information to support the groundfish fishery management program, and (3) balance these needs with environmental and social values (i.e., need to allow for fishing).

1.4 How this Chapter Is Organized

Words printed in this TYPE ARE defined in the glossary at the end of this document.

Chapter 1 identifies the issue of bycatch reduction and reporting as the focus of the proposed action and describes why action is needed. Section 1.5 further clarifies the legal mandates and defines the term "bycatch" as it is used throughout this EIS. Council and NMFS actions relating to bycatch are described to help set the context for the proposed action. Section 1.6 describes the process used to identify the important environmental issues to be addressed by various alternatives. Previous Council and NMFS actions to reduce bycatch are described in Section 1.7. Section 1.8 identifies the criteria that will be used in selecting a preferred alternative. Section 1.9 describes the organization of this EIS and the steps to determine and evaluate the anticipated environmental impacts.

1.5 Background

The Groundfish FMP must establish a standardized reporting system to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that minimize bycatch and minimize the mortality of bycatch which cannot be avoided."

The 1996 SUSTAINABLE FISHERIES ACT requires that every federal FISHERY MANAGEMENT PLAN (FMP) must be consistent with NATIONAL STANDARD 9 of the MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (MAGNUSON-STEVENS ACT). National Standard 9 requires that "Conservation and management measures shall, to the extent practicable, (A) minimize BYCATCH and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Section 303(a)(11) of the Magnuson-Stevens Act requires each FMP "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the FISHERY, and include conservation and management measures that, to the extent practicable and in the following priority –

(A) minimize bycatch; and

(B) minimize the mortality of bycatch which cannot be avoided."

The Proposed Action is to establish bycatch management policies and program direction consistent with these mandates.

In this EIS, "BYCATCH" means discarded catch of any living marine resource plus unobserved mortality that results from a direct encounter with fishing gear.

The bycatch management policies, reporting methodologies, and reduction measures make up a bycatch management program. "Bycatch," as the term is defined in the Magnuson-Stevens Act, refers specifically to fish. "FISH" is defined broadly to include nearly all species of marine organisms except seabirds and marine mammals; however, these non-target marine animals may also be affected by federally-managed fisheries, and impacts on them must also be considered in order to be consistent with other federal laws. Therefore, for the purposes of this ENVIRONMENTAL IMPACT STATEMENT (EIS), the term bycatch will mean discarded catch of any living marine resource, plus any unobserved mortality that results from a direct encounter with fishing gear.

"FISH" means finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds.

The Pacific Coast GROUNDFISH fishery management plan, prepared by the PACIFIC FISHERY MANAGEMENT COUNCIL (COUNCIL), constitutes the fundamental policies and lays out the fishery management program. The Council prepared the original FMP in the late 1970s and early 1980s during a period when foreign nations took the majority of the annual groundfish harvest. (Prior to that, NMFS had prepared a "Preliminary Management Plan" and EIS that applied only to foreign fishing.) U.S. fishery policy focused primarily on development of American fishing and processing capacity so the entire harvest could be used by U.S. citizens. Bycatch was considered to be mainly a social and economic issue; the main concerns were bycatch of SALMON, Pacific halibut, and high valued groundfish caught by foreign TRAWL fishing operations targeting Pacific whiting, and catch of salmon and halibut caught by American trawl fishers. Foreign catch of Pacific ocean perch was considered a conservation issue because this species had been severely depleted by earlier foreign fishing. Bycatch of salmon and Pacific halibut by U.S. trawl fishers was also considered a problem because it could reduce the target fishery quotas for these species. (The International Pacific Halibut Convention prohibits the use of trawls to harvest halibut; harvest of salmon with trawls is also prohibited in U.S. and Canadian waters. Dungeness crab is another PROHIBITED SPECIES in most COMMERCIAL groundfish fishing operations.) When certain salmon populations were listed as THREATENED or ENDANGERED under the ENDANGERED SPECIES ACT (ESA), NMFS evaluated the impact of the groundfish fisheries on these populations and prepared a series of BIOLOGICAL OPINIONS. Amendment 7 to the groundfish FMP acknowledged that groundfish fishing may directly impact non-groundfish species and authorized implementation of measures to control groundfish fishing to share conservation burdens to protect those stocks.

"The practice of discarding is a common feature of many fisheries around the world. Records of discarding unwanted catch date back to biblical times. As a wide variety of fish species occupy the same habitat, fishers are generally unable to catch individual species without some unintended catch of other species. This incidental catch is known as bycatch." *FAO Fisheries Technical Paper No. 370, 1997*

The groundfish resource includes 83 species of FINFISH that inhabit a wide variety of marine habitats. Many of these species occupy the same HABITATS and are caught together, either intentionally or unintentionally. While some species may be more desirable from a COMMERCIAL or RECREATIONAL

> "Bycatch concerns stem from the apparent waste that discards represent when so many of the world's marine resources either are utilized to their full potential or are overexploited. These issues apply to fishery resources as well as to marine mammals, sea turtles, seabirds, and other components of marine ecosystems." - *Managing the Nation's Bycatch*

standpoint, fishing methods are rarely selective enough to catch only the most desirable species. Other GROUNDFISH species are typically caught incidentally, and many considered valuable for human consumption, bait or other uses. This INCIDENTAL CATCH has always been considered a part of fishing, and fishers typically keep what they can use; bycatch (DISCARD) of groundfish is the portion of the catch that cannot be used, whether due to regulations, markets, or edibility (or palatability). Incidental catch and bycatch in the groundfish fishery were initially considered an unavoidable "cost of doing business." The main concerns were the cost of sorting the catch, damage to more valuable fish, lack of storage space, or lack of markets. In fact, the original FMP defined the OPTIMUM YIELD (OY) to exclude all groundfish discarded by U.S. fishermen and fishing vessels. A single OY was established for the entire groundfish resource, defined as "all the groundfish that can be taken under the regulations, specifications, and management measures authorized by the FMP and promulgated by the SECRETARY (of Commerce)." This OY was not a predetermined or specified numerical amount, but rather whatever harvest (landed catch) resulted under the regulatory program and economic conditions. As U.S. harvesting capacity grew and exceeded sustainable harvest levels, retention limits were established for commercial fishing vessels to prevent excessive harvest of certain GROUNDFISH species. These vessel limits, called TRIP LIMITS, initially limited the amount of fish a vessel could catch and retain during a single fishing trip. Later, trip limits were applied to a period of time such as a week or two-week period; more recently the time periods were extended to monthly or two-month periods. Much of the management process each year is focused on monitoring the rate of commercial landings and adjusting trip limits to maintain a relatively consistent product flow throughout the year. This system requires commercial vessel operators to cull (discard) any catches that exceed specified limits. The system worked relatively well as long as trip limits were so large (tens or hundreds of thousands of pounds) that few vessels reached them. However, as various species were "fished down," trip limits were reduced correspondingly to the point where many vessels reach them frequently. Trawl gear designed to catch large amounts of fish often captures too much, especially late in a period when the vessel is trying to catch just enough to fill its limit. This became more acute as trip limits were established for more species, and as trip limits became smaller (for example, a few thousand pounds). Since 1999, with development of REBUILDING PLANS for OVERFISHED groundfish species, some trip limits have been reduced to a few hundred pounds. Fishers must now avoid these species as much as possible, although they are allowed to keep overfished species up to the limits.

In 1996, Congress responded to the increasing national concerns about bycatch and included amendments to the Magnuson-Stevens Act that require all regional fishery management councils to amend their FMPs to monitor the amount of bycatch and to reduce it to the extent practicable. The Council prepared Amendment 11, which included provisions intended to bring the groundfish FMP into compliance with the Act. However, NMFS found the provisions to be inadequate and disapproved the bycatch sections, sending them back to the Council for reconsideration and improvement. The Council then prepared Amendment 13, expanding the discussion of bycatch and measures that had been or could be implemented to reduce bycatch. NMFS approved this amendment, but the amendment was subsequently challenged in federal district court by a group of environmental organizations that charged the environmental impact analysis was insufficient and the bycatch measures were inadequate. The Court agreed with the plaintiffs and remanded Amendment 13 to the Council and NMFS. The Court also identified certain alternative bycatch reduction methods that must be evaluated before NMFS approves a new bycatch amendment. Thus, the FMP is not yet in compliance with the bycatch requirements of the Magnuson-Stevens Act. However, bycatch reduction, monitoring and reporting measures are currently in effect and will remain in effect until modified.

> "NEPA" stands for the National Environmental Policy Act. This federal law requires every federal agency to prepare an analysis of environmental effects before it takes a major action that may affect the environment. The agency must "specify the alternative or alternatives ... considered to be environmentally preferable" and "whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not."

Federal agencies are required to comply with the NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) when a major federal action may be taken by an agency. Federal decision-makers are to use NEPA to assist them with making the appropriate decision for a PROPOSED ACTION, including fishery management plans and regulations. NEPA requires agencies, in this case the Council and NMFS, to consider reasonable alternatives to achieve the identified purpose and need, to evaluate the environmental consequences of the alternatives, and to provide for public participation in the decision-making process.

The proposed action is to amend the FMP and its implementing regulations to comply with section 303(a)(11) of the Magnuson-Stevens Act. Changes to the bycatch program may require revisions to the catch and bycatch reporting and monitoring systems and/or to conservation and management measures. In considering this action, the Council and NMFS will evaluate the effects of bycatch on other non-target species to ensure that fishery management does not result in conflicts with other legal mandates. This action is being undertaken to ensure the conservation and management as required under the Magnuson-Stevens Act , MARINE MAMMAL PROTECTION ACT (MMPA), MIGRATORY BIRD ACT, ENDANGERED SPECIES ACT (ESA) and other applicable federal laws.

This Environmental Impact Statement (EIS) addresses the issue of bycatch and other incidental catch in the Pacific Coast groundfish fishery. Specifically, this EIS analyzes the expected environmental IMPACTS of various alternative methods to reduce bycatch taken by commercial and recreational fishers fishing for groundfish and associated species and methods of collecting bycatch information.

> The bycatch provisions of the Groundfish FMP were "overturned" and sent back to NMFS and the Council. The FMP must be amended to comply with the bycatch management requirements specified in the Magnuson-Stevens Act.

Effective fishery management programs include several smaller programs such as stock assessment, policy and regulation development, decision-making, monitoring, information collection, and enforcement. These sub-programs must be designed, matched and integrated to achieve the overall program goals and objectives. The Magnuson-Stevens Act provides the Nation's overall goals and policies and describes the contents of fishery management plans, authorizing regional fishery management councils to prepare FMPs for stocks in need of federal management. The PACIFIC COAST GROUNDFISH FMP is one of four FMPs prepared by the Pacific Council. The fishery management program established by the groundfish FMP is one of the most complex and complicated in the Nation, covering 83 species over the entire West Coast of the U.S. Thousands of commercial fishing vessels harvest groundfish each year, and many more thousands of recreational fishers fish for many of the same species. The catching capacity ("fishing power") of each of these sectors far exceeds the capacity of many species to sustain themselves, and regulations to limit catch have become more stringent and complex. Nine groundfish stocks have been classified as overfished, and efforts to rebuild them require that harvest be minimized to the extent practicable. Along with this, it is critical that rebuilding efforts be closely monitored to ensure the regulations are effective and catches are reduced as intended. In addition, effects of fishing on other fish, birds and marine mammals should be monitored and mitigated as appropriate.

Groundfish species are important components of the marine ECOSYSTEM off the Pacific coast of North America, and fishing for groundfish affects other components of the marine environment.

Groundfish species are important components of the marine ECOSYSTEM off the Pacific coast of North America, and fishing for groundfish affects other components of the marine environment. Non-groundfish species may be captured and/or killed directly by groundfish fishing gears or fishing methods. Even some groundfish species may be subjected to additional mortality, such as being captured and released. Groundfish fishing may reduce food sources (FORAGE) for other marine animals. In some cases, groundfish species may be the forage. In other cases, the forage may be other species that are affected by groundfish fishing.

HARVEST includes all fish that are captured, whether intentional or not, and all fish that are killed, whether retained by the fisher. Fish that are captured and released or discarded are called bycatch. Bycatch also includes fish that are injured or killed but not captured (for example, "dropouts" and fish that become unhooked) and fish killed by lost and discarded gear (ghost fishing). In addition, groundfish fishing could directly or indirectly affect other marine animals such as marine mammals, seabirds and turtles. The EIS evaluates certain potential effects and could indicate the need for management measures to MITIGATE such impacts.

The current bycatch program includes a mix of indirect measures to control bycatch and a combination of methods to report and assess catch and bycatch amounts. Some management policies and measures tend to increase regulatory bycatch. Overall, the current bycatch program provides little individual bycatch accountability or opportunity or incentives for individuals to reduce bycatch.

1.6 Scoping: Key Issues and Development of Alternatives

***Pacific Coast Groundfish SEIS Scoping Hearings*, 2001**

CITY	DATE
Newport, OR	May 22
Astoria, OR	May 23
Eureka, CA	May 29
Los Alamitos, CA	May 30
Seattle, WA	June 5
Burlingame, CA *(at Council meeting)*	June 12

NEPA mandates that "[t]here shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." This process, termed scoping, allows the public to comment on what the EIS should cover in order to help determine possible alternatives, issues and impacts to be analyzed. The overall purpose of the scoping process is to identify the affected public, identify public and agency concerns, define issues that will be examined, and assign EIS preparation tasks.

The scope of this EIS has been refined since NMFS initially identified a need for action, and NMFS conducted two scoping processes relating to this EIS. The first scoping process, from April 10, 2001 through June 12, 2001, focused on the need for a Programmatic EIS (PEIS) on the entire Pacific Coast groundfish fishery management program. NMFS published an initial scoping report in August 2001 which provided a summary of all comments received and key issues identified during the scoping process. Bycatch was a major issue identified during scoping, along with protection of essential fish habitat (EFH) and several other issues. NMFS immediately began working with the Council to develop alternatives to address the purpose and need for the PEIS. In February 2002, NMFS determined there was a need to address EFH issues independently and began preparation of a separate EIS focusing specifically on designation of essential fish habitat (EFH) and associated management measures, including measures to reduce effects of fishing on EFH. This separation was intended to improve public understanding and participation in the NEPA process, to make each EIS more useful in future management decisions, and to more clearly distinguish between programmatic groundfish fishery management and specific EFH issues. On May 16, 2003, NMFS published a notice of its intent to further revise the scope of the PEIS; the intent was to focus more specifically on issues relating to bycatch reduction and monitoring.

The Council established an ad hoc Groundfish EIS Oversight Committee (Committee) to advise the drafting team and help develop a range of programmatic alternatives for managing the Pacific Coast groundfish fishery. The Committee, at its third meeting (April 22-23, 2003), reviewed the status of the PEIS, the alternatives under consideration, events subsequent to the initial scoping period. Based on its perception that conditions and needs had changed and on NMFS comments, the Committee recommended the scope of the EIS be focused more narrowly on the more pressing issue of bycatch reduction and reporting. The Committee prepared a revised set of alternatives to encompass the range of approaches to reduce bycatch and to address incidental catch monitoring and reporting issues. NMFS reopened scoping and conducted an additional scoping meeting on June 16, 2003 in conjunction with the Council meeting in Foster City, California. These alternative were presented to the Council at its meeting, along with a summary of comments received during the second scoping period. The Council provided comments in concurrence with the revised scope and suggested improvements to the alternatives its committee had prepared. NMFS has adopted those alternatives in this EIS.

1.6.1 Key Issues Identified During Initial Scoping Period

Time/Area Management

- Consider discontinuing year-round fishery policy
- Move management from traditional single-species management to ecosystem-based approach

Fleet Capacity

- Reduce capacity, keep number of harvesters consistent with number of fish available
- Consider where and how to position large capacity vessels
- Overcapitalized, that's capitalism (i.e. don't subsidize, let capacity reach equilibrium)
- Overcapacity is too narrow an issue for an option in EIS analysis
- If limit capacity, don't need MPAs

Resource Allocation

- Promote IFQs/ITQs
- Consider whether flexibility of ITQs will harm coastal communities
- Keep effort/people spread along coast
- Consider port quotas, like CDQs and Cooperatives, for West Coast communities
- Allow permit transfers between gear types in the limited entry program
- Allocate resource equitably between recreational and commercial sectors
- Coordinate inshore species allocation for recreational and commercial sectors with States
- Consider gear impacts and efficiency during allocation (favor low impact, less efficient gear)
- Allocate catch to particular vessels rather than gear types based on "clean" fishing practices (low bycatch, minimal habitat disturbance by gear)

Bycatch/Discards

- Bycatch and discards created by regulations; Analyze year-round fishery for bycatch/discards; Verify effectiveness of time/area management as a bycatch reduction measure

- Higher limits would reduce discards
- Standardize a reporting method for bycatch; Ask fishers to provide bycatch information in logbooks
- Lack of data on discards (number, type, mortality)
- Lack of research on bycatch-friendly gear; hook-and-line fishery has no bycatch
- Create incentives to reduce bycatch
- Use bycatch/discard overages instead of throwing them away
- Recreational fishery should increase efforts to help discarded fish survive, especially undersized fish
- Reevaluate bycatch estimates for fisheries
- Use bycatch caps to close target fishery
- If it's legal for you to sell, it's not bycatch
- Ocean ecosystem linked tighter than land ecosystem, therefore if protein taken out, affects felt elsewhere

Gear

- Lack of data on relative selectivity of gear
- Favor more selective gear types
- Evaluate gear performance standards vs. design standards

Gear restrictions: Create incentives/penalties rather than mandating gear changes/restrictions; do not ban gear; must be a better way to protect red rockfish than requiring small footropes; prohibit "rockhopper" gear; evaluate if small footrope requirement is working.

1.6.2 Key Issues and Comments During Second Scoping Period

Substantial support remains for a programmatic EIS for the broader groundfish management program.

The second scoping period focused primarily on whether to refine the scope to focus more narrowly on bycatch or to continue with the broad scope of the entire groundfish fishery management program. Support for the broad scope was expressed, along with need for specific bycatch reduction measures at the end of this NEPA process. Methods to improve bycatch avoidance were stressed, and development of incentive-based measures. While increased observer coverage was widely endorsed, concerns about cost and cost-effectiveness were also expressed. No new issues were identified beyond those identified in the initial scoping process.

1.7 History of Bycatch Management in the Groundfish Fishery, Including Previous NEPA Documents

The original groundfish FMP did not include discarded groundfish in the definition of OY.

When the FMP went into effect in 1982, most groundfish were included in a non-numerical OY that excluded bycatch. Rather, the non-numerical OY was defined as "all the fish that can be taken under the regulations, specifications, and management measures authorized by the FMP and promulgated by the U.S. Secretary of Commerce. This non-numerical OY is not a predetermined numerical value, but rather the harvest that results from regulations..." In short, OY included all groundfish legally caught and landed. This definition was based on the understanding the groundfish fishery is a multi-species fishery, with multiple fishing strategies and target strategies. Fishers were expected to generally retain and land whatever provided them optimal revenue. Also, there was very limited information on stock sizes and sustainable fishing rates.

Initially, trip limits were "per trip" limits.

Winter weather was the only obstacle to a year-round groundfish fishery, and the FMP set the fishing year at January 1 through December 31. One of the original objectives of the FMP was to, "Provide a favorable climate for existing domestic commercial and recreational groundfish fisheries within the limitations of other objectives and guidelines. When change is necessary, institute the regulation which accomplishes the change while minimizing disruption of current domestic fishing practices, marketing procedures and environment." This objective of "minimizing disruption of current domestic fishing practices" has remained a management objective through various iterations of the FMP, and has been combined with current objectives to ". . . promote year round availability of quality seafood to the consumer," and ". . . promote year round marketing opportunities and establish management policies that extend those sectors (for which year round marketing is beneficial) fishing and marketing opportunities as long as practicable during the fishing year" (PFMC, 1982). Taken together, these objectives have resulted in the Council's enduring policy of year-round trip limit management for most groundfish fisheries.

Bycatch and discards can result from a regime of multiple trip limits because a fisher might target gear on a complex of species, and then find that in order to catch the full limit on one species, he has to exceed the limit on other species, and then discard that excess.

Active groundfish management essentially began in 1983, when the Council introduced the first numerical OYs for several managed species, and trip limits for widow rockfish, the *SEBASTES* COMPLEX, and sablefish. The first landings limits the Council used were "per trip" limits, which were intended to slow landings somewhat so that the fleet would not achieve species annual harvest guidelines early in the year. Almost all domestic groundfish bycatch in the early years of groundfish management was market-induced discards, where fishers were throwing away unmarketable species or unmarketable sizes of targeted species. Domestic fisheries management did not account for these discards; targets for landed catch were set equal to the ACCEPTABLE BIOLOGICAL CATCH (ABC). For the foreign and joint venture fisheries, the Council set incidental catch allowances for non-target species.

Over time, foreign and joint venture fisheries dwindled, and the Council introduced trip limits for a greater number of species taken in the domestic fisheries. EFFORT increased in the domestic fishery, and trip limits became more restrictive to control harvest rates. The Council realized that managing a variety of species under trip limits could lead to increased rates of discards for some species. Bycatch and discards can result from a regime of multiple trip limits because a fisher might target gear on a complex of species, and then find that in order to catch the full limit on one species, he has to exceed the limit on other species, and then discard that excess. To address this issue, the Council shifted away from per trip limits for most species and towards monthly cumulative limits. Cumulative limits were preferable to per trip limits because a fisher could accumulate species at different rates over different trips, without having to discard fish each trip because of exceeding per trip limits. Once the Council had seen that monthly landings limits would continue to allow a year-round fishery, it introduced two-month cumulative limits to again reduce the likelihood that fishermen would have to discard overages of particular species within a multi-species complex fishery.

> Under cumulative limits, fishers can accumulate species at different rates over different trips, without having to discard fish each trip because of exceeding per trip limits.

In addition to modifying the use of trip limits to reduce discards, the Council used other regulatory measures to reduce incidental catch of JUVENILE fish that would be discarded as unmarketable, and to reduce bycatch of protected salmon species. In the early 1990s, the Council experimented with different combinations of gear regulations, first requiring larger trawl mesh sizes in net CODENDS, and then moving to requirements for larger mesh sizes throughout trawl nets. By 1995, bottom trawl nets were required to have a minimum of 4.5 inch mesh, double-walled (lined) codends were prohibited, and the use of chafing gear was restricted (60 FR 13377, March 13, 1995, codified at 50 CFR 660.322). All of these measures were intended to give smaller-size fish the opportunity to escape from the trawl net,

> The minimum mesh size in bottom trawls is set at 4.5 inches to reduce incidental catch of juvenile fish that would be discarded as unmarketable.

reducing the likelihood that those fish would be caught and discarded.

In the early 1990s, the Council sought to reduce at-sea catch of protected salmon stocks to soften management restrictions for the directed salmon fisheries. The Council brought salmon and whiting fishers together to develop salmon bycatch standards, area closures other recommendations for the whiting fishery.

Reducing bycatch of threatened and endangered salmon species was particularly important to the Council as it looked for ways to reduce at-sea catch and interception of protected salmon stocks to soften management restrictions for the directed salmon fisheries. The Council brought salmon and whiting fishers together to address salmon bycatch in the whiting fishery. In 1993, the Council established Klamath River and Columbia River salmon conservation zones and Eureka area trip limit restrictions to prohibit or reduce whiting fishing in areas of high salmon interception rates (58 FR 21261, codified at 50 CFR 660.323). The whiting fleets now also work to keep their chinook salmon interception below a voluntary threshold of 0.05 chinook salmon per metric ton of whiting.

Growth of the West Coast groundfish fisheries and inadequate scientific information combined to frustrate efforts to stabilize the management program and maintain stocks near MSY levels. While the Council was experimenting with these methods to reduce bycatch, domestic fishing capacity in the groundfish fleet was growing and outstripping resource productivity. We now also know that stock assessment information in the 1980s and early 1990s was not adequate to draw a clear picture of West Coast rockfish productivity. Harvest rates were based on scientific information available at the time are now considered too aggressive for SUSTAINABLE harvest on the very low productivity West Coast rockfish stocks (Myers, et al, 1999; Ralston et al, PFMC, 2000). The combination of increasing fishing capacity and decreasing OYs led to ever more restrictive cumulative landings limits. The Council's GROUNDFISH MANAGEMENT TEAM (GMT) became concerned about the effects of a restrictive cumulative landings limit regime on rates of bycatch and discard, and announced in April 1990 its plans to begin to factor discards into setting ABCs for the 1991 fishing year (PFMC GMT, 1990). In August 1990, the Council finalized Amendment 4 to the FMP, which introduced the practice of distinguishing between ABCs and HARVEST GUIDELINES to, among other things, account for fishing mortality beyond landed catch numbers (PFMC, August 1990.)

In 1991 and 1992, the Council's bycatch accounting policies took shape. For 1991, the Council recommended ABCs that accounted for discards for sablefish, Dover sole, and widow rockfish. The widow rockfish coastwide ABC of 7,000 mt was set equal to the landed catch OY, but in setting the ABC, 1,000-1,200 mt discard was assumed above the 7,000 mt landed catch. The sablefish coastwide ABC was reduced by 12.7% to account for discards, and the OY was set equal to landed catch. Although Dover sole was managed under a coastwide ABC in 1991, only the contributing ABCs for the Eureka and Columbia areas were reduced for discards, with the Eureka ABC reduced by 5.7% and the Columbia ABC reduced by 13% (56 FR 465, January 8, 1991.)

In 1992, the Council added yellowtail rockfish to the list of species with ABCs set to account for discard. Widow rockfish again had a coastwide ABC/landed catch of 7,000 mt, with a 1,000-1,200 mt discard assumed above the ABC (14-17%). Similarly, the 1991 sablefish landed catch was the same amount that it had been in 1991 (8,900 mt), with no change to the 12.7% reduction for discards. Dover sole in the Eureka area was reassessed in 1991, resulting in a change in the Eureka area ABC, and a change in the discard reduction for Eureka area Dover sole from 5.7% in 1991 to 9.6% in 1992. Dover sole ABCs for other statistical areas were unchanged. Yellowtail rockfish discards were assumed to be 16% of the ABC, and the GMT inflated the inseason landings data by 16% to reflect expected bycatch. The assumption that 16% of the yellowtail rockfish catch was discarded was based on a 1988 study (Pikitch, et al, "An evaluation of the effectiveness of trip limits as a management tool"); that study observed a 16% discard of widow rockfish, which this was used as the best estimate for yellowtail rockfish also (57 FR1654, January 15, 1992).

Annual management measures have also incorporated a variety of other strategies to reduce bycatch in the groundfish fishery. For trawl vessels, cumulative landings limits for the "DTS COMPLEX" have been based on catch ratios between the four species in the complex–Dover sole, thornyheads (shortspine and longspine), and sablefish. Often, harvest of the more abundant species in the DTS complex is curtailed to prevent overharvest of the less abundant species (shortspine thornyhead.) Similar species complex management was used for *Sebastes* complex species prior to 2000, with some particular *Sebastes* species managed by harvest and trip limits within the overall *Sebastes* complex harvest and trip limits.

Management measures for 2000 included novel methods to of reduce the catch of overfished groundfish species (65 FR 221, January 4, 2000). The Council determined simply lowering the overall harvest limits of overfished and depleted species is not adequate to protect and rebuild those species. For example, the Council recommended prohibiting landings of lingcod from January through April and November through December to protect the species during its spawning and nesting period. This was expected to be effective because lingcod caught by hook-and-line methods can often be released alive. This complete prohibition of landings is believed to be an adequate disincentive because commercial hook-and-line fishers can usually avoid catching lingcod; with all economic benefits eliminated, there remains no incentive to target this species. Most overfished rockfish, on the other hand, generally cannot be released alive, regardless of the method of catch. The challenge with reducing rockfish catch has been not only to reduce fisher incentives to target them, but also to reduce the likelihood of either accidentally or intentionally catching them. To prevent waste of these overfished species that are truly incidental catch, retention and landing of small amounts are allowed. Direct fishing effort on healthy species is limited to times and areas when those species are most concentrated, or when bycatch of other species is expected to be relatively low. In particular, cumulative landings limits have been set to move fishing effort away from the deeper continental shelf, which is the primary habitat of several of the overfished species. Rockfish cumulative landings limits are typically set higher in the summer months, when directed targeting on healthy stocks is less likely to result in incidental harvest of depleted and overfished stocks.

Another method to reduce bycatch is to close the fishery for part of the year and set higher trip limits during the open period. For example, south of Cape Mendocino, open access, limited entry non-trawl, and recreational fisheries were closed for two months in 2000. Larger commercial landings limits and recreational bag limits were set for the remaining ten months in the fishing season.

Also in 2000, the Council and NMFS introduced differential landings limits for limited entry trawlers operating with different trawl gear configurations (bottom trawling with FOOTROPES greater than 8 inches in diameter, bottom trawling with footropes smaller than 8 inches in diameter, and MIDWATER or PELAGIC TRAWLING.) Trawling with footropes that have roller gear or other devices designed to bounce over rough rock piles tends to allow those vessels greater access to prime rockfish and lingcod habitat. Therefore, landings of

SHELF rockfish were prohibited if large footrope trawls (roller gear) were used. Small amounts of shelf rockfish bycatch were allowed to be landed if small footrope trawls were used, and targeting healthy shelf rockfish stocks was encouraged only if midwater trawls were used.

Finally, at the GMT's recommendation, the Council revised its historical practice of managing the *Sebastes* complex as simply northern and southern units. Beginning in the mid-1980s, rockfish species without assessments and those with less rigorous assessments were managed under a generic *Sebastes* complex landings limit. The GMT had expressed concern this approach provided opportunity to harvest lower-abundance, higher-valued species at unsustainable rates. In response to these concerns, the Council separated the ABCs/OYs for chilipepper and splitnose rockfishes from the southern *Sebastes* complex for the 1999 fishery. Conversely, concerns also developed that rebuilding plans for overfished species could result in unnecessarily severe restrictions for the entire complex than would be the case if sub-groups of these species could be developed. For 2000, the GMT developed species lists for three sub-groups of rockfish– nearshore**,** shelf, and slope– for the northern (U.S. Vancouver, Columbia and Eureka subareas combined) and Southern (Monterey and Conception subareas combined) areas. Organizing *Sebastes* species into groups based on the most common catch associations is intended to equalize the harvest rates for most rockfish stocks. It reduces the likelihood of overharvesting overfished stocks, depleted species, and species for which there is relatively little stock assessment information.

Beginning late in 2002 (under emergency regulations), management measures based on depth were initiated. In 2003, large areas of the outer continental shelf, referred to as Rockfish Conservation Areas (RCAs) were closed to many fishing activities. These were described in detail in the EIS prepared for the 2003 annual management specifications.

1.8 Selecting and Implementing a Preferred Alternative

The Council and NMFS will consider how each alternative addresses the purpose and need for action (see sections 1.1, 1.2 and 1.3). They will weigh the expected or potential benefits and costs of each alternative and decide which, if any, alternative, provides the optimal balance. While six alternatives have been proposed, there are a variety of management measures that could be included (or excluded) from any alternative. The Council and/or NMFS may find that by revising an alternative they may be able to achieve greater benefits or better mitigate anticipated negative effects. Finally, the Council and NMFS will determine if and how each alternative reduces bycatch to the extent practicable and, for bycatch that cannot be avoided, reduces bycatch mortality to the extent practicable.

The Council will review this preliminary draft EIS at its November 2003. NMFS will consider any Council comments on the preliminary draft and will prepare a final draft EIS (DEIS) in early 22004. NMFS expects to make the DEIS available for public comment in January 2004 and provide an extended comment period through April 2004. The Council will review the DEIS during the comment period and identify its preferred alternative at its April 2004 meeting. NMFS will make its decision based on the analysis of impacts, the Council's recommendations, public comments received on the DEIS, and any other relevant information available. A Final EIS will be prepared that responds to public comments received on the DEIS, identifies the final preferred alternative, and provides the rationale for NMFS' final decision. The alternative that is determined to be the "environmentally preferred" may or may not be same as the final preferred alternative. Any difference will be clearly explained.

1.9 How This Document is Organized

This EIS follows the standard organization established by the CEQ regulations. Chapter 1 identifies the issue of bycatch reduction and reporting as the focus of the proposed action and describes why action is needed. Previous Council and NMFS actions relating to bycatch are described to help set the context for the proposed action. Chapter 1 also lays out the criteria the Council and NMFS will use for making their final decision.

Chapter 2 presents the six alternatives to reduce bycatch and bycatch mortality, and to establish a standardized reporting methodology. It describes how the alternatives were developed, and provides a summary of the anticipated environmental impacts of the each alternative. It briefly describes the management "tools" available to the Council and NMFS for reducing bycatch and for monitoring the effects and effectiveness of the various tools, and how the alternatives apply the tools. It identifies the direct, indirect and cumulative impacts so the decision-makers can make a reasoned and informed decision, and the public can understand the conclusions and how they were reached.

Chapter 3 describes the affected environment as it pertains to incidental catch, bycatch, bycatch mortality, and catch reporting/monitoring. The factors related to bycatch are identified and described: co-occurrence in time and space; species behavior; fish body size and shape; and types of fishing gears and methods used. Chapter 3 describes the current human environment as it relates to incidental catch, bycatch and bycatch mortality. The current condition of particularly important groundfish and other species of marine animals are described, and how they are directly affected (that is, bycaught) in groundfish fisheries. The social and economic conditions relating to bycatch, bycatch reduction methods, and bycatch monitoring are also described.

Chapter 4 presents the analysis of environmental impacts. This chapter describes the capture methods of the various fishing gears, including selectivity features and placement factors (that is, where and in what conditions they can be used). Potential mitigation tools are described, that is, the available management measures and adjustments to control incidental catch and bycatch and to achieve other objectives. Regulations not related to fishing gears are identified and described: harvest specifications, allocation, retention limits, catch/ mortality limits, time/area management, and limiting access (reducing fleet size). Collectively, these management measures are identified as the “mitigation toolbox.” Potential effects of each tool are described and the effects and effectiveness of each tool are ranked. Next, those ranks are applied to each alternative. This stepwise process provides the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes.

2.0 Alternatives, Including the Status Quo

2.1 Introduction

2.1.1 How this Chapter is Organized

Chapter 2 presents the alternatives that have been developed to resolve bycatch issues and to ensure the FMP complies with the bycatch reduction mandates of the MAGNUSON-STEVENS ACT. Each ALTERNATIVE describes a BYCATCH management program and includes all the parts of the program: the overall objectives, the methods to achieve the objectives, and the reporting and monitoring requirements that would be required. The six alternatives represent a variety of policies, approaches, and methods to reduce bycatch. The alternatives range from the current (2003) methods of reducing bycatch (Alternative 1, the status quo) to more aggressive and comprehensive bycatch reduction policies and methods.

Words printed in THIS TYPE are defined in the glossary at the end of this document. Other words are also defined.

Section 2.1.1 presents the bycatch mitigation "TOOLBOX," that is, the variety of regulatory measures available to the COUNCIL and Agency to implement a bycatch monitoring, reporting and reduction program. Each tool is described in terms of its usefulness, effectiveness, effects, etc. Not all of the available tools have been used to manage the Pacific GROUNDFISH fisheries.

Section 2.1.2 describes how the alternatives are structured so they can be compared and understood more clearly.
Sections 2.2.1-2.2.6 describe each alternative in detail. Section 2.3 summarizes the anticipated effects or impacts or each alternative in comparison to current conditions.

2.1.2 Available Management Measures (The "Bycatch Mitigation Toolbox")

The "bycatch mitigation toolbox" describes all the management measures (fishing regulations) that can be used to reduce bycatch to the extent practicable, and unavoidable bycatch mortality to the extent practicable.

A variety of management measures are used for controlling the West Coast groundfish fishing activities to ensure sustainable groundfish resources, habitats and fisheries.. These include harvest limits, restrictions on fishing gears and fishing locations, reporting requirements and species RETENTION LIMITS. They are the tools for managing groundfish HARVESTS. In this EIS, these management tools are collectively described as the "toolbox" which is available to the Council and NOAA Fisheries. Not all of the available tools are used for managing the groundfish fishery. The decisions about which tools to use or not use have been made over a number of years to address the

FISHERY MANAGEMENT TOOLS

Harvest Levels
- ABC/OY
- sector allocations
- trip (landing) limits
- catch limits
- individual quotas

Gear Restrictions

Trawl
- mesh size
- footrope diameter/length
- net height
- codend mesh and dimensions
- design: on-bottom or pelagic
- bycatch reduction devices (BRDs)

Line
- number of hooks
- hook size
- line length
- retrieval requirements

Pot/trap
- number of pots
- pot size
- escape panel in net/pot
- retrieval requirements

Other
- setnets (gill and trammel nets)

Time/Area Restrictions
- seasons
- area closures
- depth closures
- marine reserves

Capacity (number of participants)
- permits/licenses/endorsements
- limited entry

Capacity (Vessel Restrictions)
- vessel size
- engine power
- vessel type

Monitoring/Reporting Requirements
- permits/licenses
- registrations
- Fish tickets (commercial landings/ sales receipts)
- Vessel logbooks
- Surveys
- Punch cards/tags (recreational)
- Port sampling/on-shore observers
- On-board observers
- Vessel monitoring systems (VMS)
- Onboard video recording devices
- Enforcement

variety of problems and issues that have come up. The main categories of tools in the toolbox are harvest level specifications, gear restrictions, time/area restrictions, capacity restrictions, and reporting/monitoring requirements.

Most management measures affect bycatch directly or indirectly; some tend to reduce bycatch, and some tend to increase bycatch. Chapter 3 of this EIS provides an evaluation of the relative EFFECTS and effectiveness of the various tools for reducing bycatch and fulfilling the bycatch reporting requirements specified in the Magnuson-Stevens Act.

2.1.3 Structure of the Alternatives

Each alternative includes general goals and/or objectives and the management tools to achieve them. Five alternatives to the STATUS QUO have been developed to provide a range of approaches to reducing bycatch and incidental catch. Some alternatives are more comprehensive than others, representing a different balance between regulatory burden, costs and other considerations. Some provide more information than others, thus reducing some of the uncertainty about status of groundfish stocks, ECOSYSTEM condition, and management program effectiveness. Some alternatives are more costly than others, both to fishers and to the management agencies (both state and federal). The alternatives have been structured to clearly show the IMPACTS (effects) of different management approaches and combinations of management tools.

2.2 The Alternatives

Table 2.2 at the end of this section summarizes the bycatch mitigation tools included in each alternative.

2.2.1 Alternative 1: No Action (The Status Quo)

Alternative 1 reduces incidental catch and bycatch through a combination of indirect measures: Optimum Yield (OY) specifications, area closures, gear restrictions, variable trip limits and bag limits, seasons and other measures. High priority is given to minimize cost of catch monitoring. Vessel trip limits are calculated using a computer model and incidental catch ratios from past years.

The status quo minimizes bycatch through a combination of OPTIMUM YIELD (OY) specifications, gear restrictions, area closures, variable TRIP LIMITS and BAG LIMITS, seasons and other measures, while minimizing cost of bycatch monitoring. The primary focus of this bycatch program is groundfish species. Negative INCENTIVES include requirements to sort groundfish catches into established categories (species or species group), discard PROHIBITED SPECIES (salmon, halibut, Dungeness crab), and discard all groundfish that exceed the trip (retention) limits. In addition, estimated bycatch mortalities are deducted from the annual allowable catch levels. Positive incentives include larger trip limits in areas where encounters with OVERFISHED species are expected to be low. In addition, a sablefish species ENDORSEMENT has been established for limited entry FIXED-GEAR vessels, along with PERMIT STACKING, individual permit sablefish catch allowances, and a longer season, which greatly reduces the "RACE FOR FISH" that occurred in past years. In the Pacific whiting fishery, OY is allocated among four sectors and vessels voluntarily practice bycatch reduction methods that focus on salmon as well as incidental catch of certain groundfish species.

The current bycatch management program uses indirect measures such as setting an overall OY (catch limit) for various groundfish species and, in some cases, sub-limits or ALLOCATIONS for each fishery SECTOR. A variety of measures such as area closures, seasons, gear modifications, etc., are established to ensure groundfish catches do not exceed the specified limits.

Since 1998, groundfish management measures have been shaped by the need to rebuild overfished groundfish stocks. There are more than 80 species in the West Coast groundfish complex, and many of these species co-occur to different degrees in different areas. Each species has its own habitat "affinity" associated with depth, substrate, temperature, portion of the water column, etc. Some have fairly restricted distributions, while others are widespread. Over the past several years, groundfish management measures have been more carefully crafted to recognize the tendencies of overfished species to co-occur with healthy stocks in certain times and areas.

In 2000, the Council refined the management program on the understanding that certain types of TRAWL gear cannot be effectively fished in areas where the seafloor is rocky or uneven. Specifically, only BOTTOM TRAWLS with large diameter FOOTROPES can pass along this type of seafloor without snagging or hanging up on the multitude of obstructions. Use of large footrope trawls was not prohibited, but trip limits were set at such small levels that the economic incentives favored small footrope gear. Allowances were made for use of large footrope gear for deepwater stocks found primarily outside the range of most overfished species. In 2002 the Council introduced a new "bycatch" analysis model that allowed managers to set trip limits so that more abundant stocks were strongly TARGETED in times when they were less likely to co-occur with overfished stocks. The 2002 management measures primarily varied by time (two-month period) and by north-south management area (north of Cape Mendocino, between Cape Mendocino and Point Conception, south of Point Conception, etc.). Beginning in 2003, the Council began using depth-based area restrictions. These area restrictions are intended to prevent vessels from fishing in depths where overfished species commonly occur, while still allowing some fishing for more abundant stocks in the open areas. The inner and outer boundaries of these closed areas may be adjusted seasonally; the boundaries may be expanded during periods when overfished stocks are distributed more widely. Conversely, the boundaries may be narrowed when the overfished species are more concentrated or to allow access to other stocks that are more available at certain times. Different closed areas are provided for different gear types, as not all gear types encounter each overfished species at the same rate or in similar areas.

Participation in the COMMERCIAL groundfish fisheries is limited by a federal permit system established in 1994. This program limited the number of trawl, LONGLINE and POT (fish trap) permits and established a number of conditions and requirements. Each permit specifies the type of gear the vessel may use to participate in the limited entry fishery, and the vessel length associated with the permit. A vessel may only participate in the fishery with the gear designated on its

permit(s) and may only be registered to a permit appropriate to the vessel's length. Since 1994, the Council has modified license restrictions for the LIMITED ENTRY fixed gear (longline and fish pot gear) to allow vessels to accumulate ("stack") and use as many as three sablefish-endorsed permits during the primary sablefish fishery.
The number of trawl permits was reduced in the mid-1990s when seven large FACTORY-TRAWL vessels purchased and consolidated a number of permits in order to participate in the Pacific whiting fishery. A federally-supported trawl BUY-BACK program is being developed in 2003 to further reduce the number of permits. NMFS has reported that 108 individuals submitted bids to participate in the buy-back program. Of these, 92 have been accepted as successful bidders. These 92 vessels account for 35% of all of the groundfish trawl permits. During the 1998 - 2001 base years, these vessels accounted for 36.5% of the trawl-caught groundfish, including whiting. They accounted for 46% of all the non-whiting groundfish during that period. In addition to removing groundfish trawl permits, this program also requires the retirement of Dungeness crab and pink shrimp permits as well. Vessels remaining in the fishery would pay the costs of the reduction program.

Certain gear types and fisheries were exempted from the limited entry program and remain "OPEN ACCESS." Trip limits for these vessels are set to allow retention of incidentally-caught groundfish and limited intentional groundfish harvest.

Recreational fisheries off Washington, Oregon, and California are managed by a combination of bag limits, gear requirements, size limits, seasons and area closures. In 2003, most RECREATIONAL FISHING was restricted to relatively shallow waters (generally less than 20-27 fathoms).

Bycatch management in 2000 and 2001 was a major departure from previous years, as different trip limits were based on the type of trawl gear used. In order to reduce fishing in rocky areas of the CONTINENTAL SHELF, trip limits for vessels using trawls configured with large footropes (those with footrope diameter greater than 8 inches) were set at minimal levels. This created strong disincentives for vessels using BOTTOM TRAWL gear to avoid prime ROCKFISH habitat areas, while not prohibiting the use of such trawls or closing specific areas. In 2001, two large areas off southern California were closed to most fishing activities as part of the plan to rebuild overfished cowcod, a species of rockfish . The closed areas (referred to as the Cowcod Conservation Areas or CCAs) encompass the primary habitat of cowcod and were intended to reduce the possible encounter with this species.

Management of the 2002 groundfish fishery was an even more radical departure from previous bycatch management practices. Trip limits and area closures were developed based on incidental catch rates and fishing patterns through the use of a NMFS "BYCATCH" MODEL. The model estimates the total amounts of overfished species that would be caught coincidentally with available target species. The new management approach structures the amount and timing of trip limits (cumulative landings limits) for "target" species so that the expected total catch of both target and overfished groundfish species will not exceed their allowable annual harvests. NMFS believes this new approach better accounts for the total mortality of the overfished stocks taken incidentally than the previous method of applying estimated discard rates to the annual OY to calculate landed catch HARVEST GUIDELINES.

This new bycatch and discard analysis calculated the co-occurrence of each of five overfished species with healthy targeted stocks. To make these co-occurrence calculations, the analysis evaluated data on a suite of trawl fishery target strategies (for example, targeting the DTS COMPLEX, targeting arrowtooth flounder, etc.). Each target strategy was separated into six two-month periods to set a baseline of co-occurrence rates of overfished stocks throughout an entire calendar year. The analysis found seasonal variations in the co-occurrence rates between healthy and overfished stocks. The Council used these baseline co-occurrence rates to set the discard rates for each of the overfished species that were deducted from their respective OYs. Management measures included combinations of trip limits and seasons intended to concentrate targeting on healthy stocks during times when incidental catches of overfished species were lowest in recent years. INSEASON adjustments to management measures were also guided by this analysis so that projected catches of overfished species would not exceed the specified limits.

For 2003, the Council and NMFS refined this approach to minimizing incidental catch and discard by establishing "Rockfish Conservation Areas" (RCAs) where fishing would be greatly restricted. Most species have limited depth and latitudinal (north-south) distributions, that is, they are mostly found within a limited depth range and a limited north-south range. By preventing fishing in areas where overfished species are most commonly encountered, the likelihood of catching them is greatly reduced. Outside the RCAs, more liberal fishing opportunities can be provided because few overfished stocks are present. This approach increases certain monitoring requirements and increases the complexity of the regulations, but avoids the need for an expanded on-board observer program.

The "bycatch model" uses expected catch amounts for each major fishing sector, calculated before the season opens. Groundfish trip limits for commercial sectors are set based on previously observed ratios with various other species; these trip limits may vary by season if previously observed ratios show seasonal patterns. State fishery management and enforcement personnel monitor commercial LANDINGS throughout the year by tabulating state fish landings receipts (FISH TICKETS). Although landings of many species are monitored inseason, the landings data for overfished species may not be not used for inseason management. Due to the strong economic incentives to avoid reaching an overfished groundfish species OY or cap, coupled with the opportunity to discard fish prior to their being counted, managers assume fish tickets will tend to underestimate the actual catches. There is currently no way to verify this inseason. However, onboard OBSERVERS ride selected vessels and collect information on amounts and rates of fish discarded at sea. Observer data are not tabulated during the season but are compiled in annual summaries after being matched with fish ticket and trawl LOGBOOK records. The new observed groundfish catch ratios are compared to the previous rates that were used to set the current trip limits. If the trip limit ratios differ substantially from the new observations, subsequent trip limits will be adjusted and other management measures may also require adjustments.

2.2.2 Alternative 2

> Alternative 2 would reduce groundfish bycatch by increasing the size of trip limits. This would be achieved by reducing the trawl fleet by 50%; the goal of maintaining a year-round fishery would continue. The focus on fleet reduction is based on the Council's *Strategic Plan for Groundfish*. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 2 would reduce groundfish REGULATORY DISCARD by increasing groundfish trip limit sizes and reducing the number of commercial fishing vessels, while maintaining as long a fishing season as practicable. Regulatory bycatch of groundfish (that is, groundfish that vessels must discard to avoid penalty), and particularly the rate of discard, increases as trip limits become smaller.

This alternative differs from the status quo in that the number of commercial groundfish trawl vessels would be reduced by 50% from the number that landed groundfish during 2002. Trip limits would be larger because the total allowable catch would be shared among fewer participants.

The preferred method of fleet reduction is an industry-sponsored buy-back program. If the buy-back program fails to achieve a 50% reduction in the number of trawl permits, the number of trawl permits would be reduced to the 50% level by other means. The Council has limited alternatives to reduce the number of trawl permits: eliminate permits by establishing eligibility criteria (for example, a minimum amount of groundfish landed in previous years, a minimum number of years of participation in the fishery, etc), require vessels to hold more than one trawl permit, or allow trawl permits to be converted to fixed-gear permits.

In establishing the current vessel license limitation program, the Council established minimum landing requirements for eligibility. Vessels that met the minimum requirements received licenses (permits). Only the most recent entrants and vessels with the smallest catch histories did not receive permits. It is likely that in reducing the number of eligible vessels, criteria based on amounts of groundfish landed landings would tend to eliminate those trawl vessels that have caught the fewest groundfish in recent years or participated less than other vessels. This reduction method could result in reducing effective fishing power of the trawl fleet by less than 50%.

If the 2003 trawl buy-back program is approved and implemented, the status quo (no action alternative) would become very similar to Alternative 2.

Alternative 3 would reduce groundfish bycatch by increasing the size of trip limits. This would be achieved by eliminating the goal of maintaining a year-round fishery and establishing a short season or series of seasons. This alternative reflects one of the conclusions in the Council's *Strategic Plan for Groundfish* that, if fleet size is not reduced, *"(m)aintaining a year-round fishery may not be a short-term priority."* This alternative includes the area/depth management and modeling approach of Alternative 1.

2.2.3 Alternative 3

Alternative 3 would reduce groundfish regulatory discard by increasing groundfish trip limit size and reducing fishing time (shortening seasons), without further reducing the number of trawl vessels. As with Alternative 2, this is based on the understanding that regulatory bycatch of groundfish, and particularly the rate of discard, increases as trip limits become smaller.

In contrast to Alternatives 2, the number of commercial fishery participants would not be reduced by 50% under Alternative 3. Instead, the commercial fishing season would be shortened as the method to create larger trip limits.

Methods of reducing fishing time are not specified in this alternative but are critical to the effects. For example, if the current 2-month periods are reduced to 1 month, larger vessels would not be affected much, and trip limits might not be much larger than current, because actual fishing time per vessel is already less than one month. Vessels could be restricted to fishing only 3 of the 6 2-month periods.

A different way of reducing commercial fishery fishing time to six months would be to allow limited entry sector fishing for six months and open access fishing for six months while the limited entry sector is closed. For example, the limited entry fishery (except the whiting fishery) could operate during two 3-month periods, one in the spring (some period between February and June) and one in the fall (perhaps September, October and November). These open seasons fall mainly outside the shrimp and crab seasons. Open access fisheries might fill in between, i.e., summer and winter.

2.2.4 Alternative 4

Alternative 4 would reduce bycatch by establishing catch limits for various fishery sectors in addition to vessel landing/retention limits. A portion of the overall allowable harvest would be held in reserve for those individuals with the lowest bycatch rates. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 4 would reduce discard by assigning a catch limit for each overfished groundfish species to each fishing sector, making each sector of the fishery responsible and accountable for all groundfish caught, rather than the amounts retained. An in-season catch monitoring or verification program would ensure sector catch limits are not exceeded. When a sector reaches any catch limit, further fishing by that sector would be prohibited.

Nine fishery sectors are identified under the current regulations: limited entry trawl; limited entry longline; limited entry pot; three whiting sectors (CATCHER/PROCESSOR, MOTHERSHIP and SHORE-BASED); open access; TRIBAL; and recreational. Additional sectors could be established by subdividing any of these sectors. Each sector would be monitored separately with stratified, partial observer coverage. Catch rates and closure dates for each sector would be projected based on observer reports.

This alternative would use continue to use vessel trip limits (as under the "no action" Alternative 1) but would also establish more direct bycatch controls (sector catch caps) for each sector. Direct measures affect bycatch by placing specific limits on the amount of groundfish caught (rather than the amount landed). Vessels would no longer be required to discard groundfish, although they could choose to discard. Thus, regulatory bycatch of groundfish would be effectively eliminated.

Economic (that is, non-regulatory) bycatch/discard could also be addressed under this alternative by prohibiting discard or limiting the amount of groundfish that may be discarded. If allowed, discard would be measured as accurately as possible. If discard were prohibited, economic (non-regulatory) bycatch of groundfish would be greatly reduced.

The option of creating more sectors could reduce the need for other controls to limit fishing activities. To accomplish this, vessels would be assigned to one or more sectors, perhaps through an endorsement attached to the limited entry permit. When a sector limit is reached, further fishing by those vessels would be prohibited or severely curtailed. Bycatch (discard) under such an approach could be controlled by requiring FULL RETENTION or placing limits on discards. The primary differences between Alternative 4 and the previous three alternatives are (1) Alternative 4 would set catch caps in addition to retention limits; (2) every vessel would be assigned to one or more sectors; (3) each sector would have a set of catch caps for overfished groundfish species and other stocks; (4) vessels in a sector would have to stop fishing when any cap for the sector is reached, while vessels in other sectors would continue fishing. Catches by each sector would be monitored inseason, with actual catch statistics available quickly (either inseason or before the next season) so that adjustments could be made. Total catch OYs and discard caps would be set for overfished STOCKS, and sub caps would be set for each sector. Initial groundfish catch limits would be calculated based on previously observed joint catch ratios of various groundfish species (similar to the method under status quo). Onboard observers would monitor a subset of vessels, recording and compiling catch and discard of overfished groundfish species (and other specified species) inseason. This catch data would be expanded to the entire sector. Each sector would be managed to its groundfish caps based on this expanded “real time” information rather than based on ratios from previous years.

Observers could be placed on a subset of each sector, and observed catch rates extrapolated (expanded) to the entire sector. This process would occur weekly, biweekly, or at some other appropriate frequency.

Under Alternative 4, a RESERVE could be set aside for vessels with low incidental catch and/or bycatch rates to provide incentive for individual vessels to fish more selectively. However, this would require mechanisms to ensure fair access. One mechanism might be for vessels to carry an observer (or observers) at the vessel's expense so the vessel's catch and bycatch could be monitored intensively.

2.2.5 Alternative 5

> Alternative 5 would reduce bycatch by establishing GROUNDFISH CATCH QUOTAS for individual commercial fishers and other qualified entities. Monitoring would be focused at the individual vessel level rather than at the sector level.

Alternative 5 would reduce bycatch by assigning CATCH LIMITS or INDIVIDUAL QUOTAS to each limited entry commercial fisher, vessel, or other qualified entity. These catch limits would primarily apply to overfished groundfish stocks, but quotas would also be established for other groundfish stocks. Certain gear restrictions and other regulations would be relaxed to allow fishers/vessels to develop their own best practices to catch healthy groundfish stocks while avoiding the catch of overfished groundfish stocks.

Under Alternative 5, it may or may not be useful to distinguish between IQs for overfished groundfish stocks and IQs for other groundfish. In the event that such distinction is appropriate, catch allowances for overfished stocks might be referred to as "restricted species catch quotas" or RSQs. In the long term, catch limits for other marine life could also be established (which might be referred to as prohibited species catch (PSC) limits), which could not be retained unless specifically authorized or required.

> For clarity, this EIS considers two categories of individual quotas; both types would be tradeable. Quotas of overfished groundfish are called RSQs (restricted species quotas), Quotas for all other groundfish species are simply called IQs. There is no other distinction between them.

An IQ would be considered an authorization to catch a specified share or amount of the OY for a specified groundfish stock. A portion of some or all overfished stock OYs would be reserved for vessels with the best bycatch performance. (The Council will define "best performance" or PERFORMANCE STANDARDS at a later date. It could, for example, be based on low catch or catch rates of overfished species, low bycatch of non-groundfish species, or other factors.) A robust monitoring or catch verification program would be established to ensure catch caps are not exceeded.

To increase the effectiveness of IQs as a bycatch management program, certain regulations would be relaxed to allow fishers to modify their fishing operations and/or gear to better utilize their quotas. For example, gear endorsements could be modified to allow trawl vessels to use nontrawl gear, or to covert their trawl endorsement to a new category of longline, pot or generic gear endorsement. Quota holders would be allowed to buy and sell incidental catch allowances (RSQs) and individual transferable fishing quotas (IQs/IFQs) for other (non-overfished) groundfish.

There are several potential methods and criteria for initial allocation of quota shares, as well as ownership requirements, transfer methods, etc. There are also different definitions of “individual” possible. For example, “individual” could refer to or include vessel, vessel owner, fisherman, person, firm, cooperative, community or other entity. These issues would have to be debated in developing an effective IQ/bycatch management program. These issues are not analyzed in this EIS.

Alternative 5 would use direct incidental catch and bycatch controls at the level of the individual vessel. To reduce economic (non-regulatory) bycatch, discard of groundfish could be prohibited or restricted; if discarding were allowed, it would be measured as accurately as possible. All groundfish catch, whether retained or discarded, would be charged against the appropriate RSQ/IQ. Fewer controls would be needed to limit fishing activities, except that when a vessel reaches any catch limit it would have to stop all fishing until it acquired additional IQ or RSQ. Also, if a groundfish OY were reached, further fishing would be prohibited or severely curtailed. Bycatch (discard) under this approach could be controlled by requiring INCREASED RETENTION or placing limits on discards.

Alternative 5 is similar to Alternative 4 except that each commercial limited entry permit would be assigned individual caps (RSQs) for overfished groundfish stocks and IQs/IFQs for other groundfish species.

Initially, RSQs would be set for all limited entry commercial vessels. Catch limits for other species would be calculated based on previously observed joint catch ratios of various groundfish species.. Onboard observers would monitor catch and discard of overfished groundfish species (and other specified species) inseason. Each vessel would be managed to its caps based on its own performance, using “real time” catch information rather than relying on ratios from previous years.

A reserve of various groundfish species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Also, any unused OYs of non-overfished groundfish would be made available to those vessels that had not taken their overfished species allowances.

Alternative 5 would require that every commercial groundfish vessel be closely monitored so all catch of overfished species would be observed and recorded. This close scrutiny would likely mean placement of fishery observers on every vessel. Alternative monitoring processes could be allowed if they resulted in the same level of data accuracy and completeness. For example, some vessels might be able to meet the standard by retaining all groundfish in conjunction with a video system to verify that no discard occurred.

Alternative 6 would reduce bycatch to near zero by (1) closing large areas where overfished groundfish are most likely to be encountered and other areas of high bycatch of non-groundfish species, (2) establishing individual vessel catch allowances (caps) for overfished groundfish species, and (3) requiring each commercial vessel to carry an onboard observer at all times the vessel fishes. This alternative would include expanded area/depth closures (MPAs or marine reserves), bycatch limits and discard prohibitions. Certain gear regulations would be relaxed to allow vessels to improve bycatch reduction methods. As in Alternative 5, vessels could continue fishing until any cap was reached, and vessels with low incidental or bycatch rates would be provided additional fishing opportunities.

2.2.6 Alternative 6

Alternative 6 would reduce bycatch of all species to very low levels by establishing long term closed areas where overfished groundfish and other sensitive species are most likely to be encountered, establishing incidental catch limits for individual vessels, prohibiting or severely restricting discard of groundfish species (and perhaps other species), and accurately accounting for all catch. The alternative would emphasize the identification and use of alternative fishing gears and methods that avoid capture of restricted species.

This alternative would use both indirect controls (MARINE PROTECTED AREAS or MPAs) and direct bycatch controls of each individual vessel. The areas encompassing most of the distribution of all overfished groundfish stocks would be established as long-term marine protected areas to reduce the possibility those fish could be caught.

Alternative 6 is similar to Alternative 5 except the focus would be on reducing bycatch of overfished groundfish and other identified species to near zero by closing areas where encounters of those species are most likely. These areas would be designated as long term closed areas that could be reopened only through a deliberative process based on the BEST SCIENTIFIC INFORMATION available. In addition, individual commercial groundfish vessels would be assigned a catch allowance of overfished groundfish species. These would be mortality limits or caps. Certain regulations would be relaxed to allow fishers to modify their fishing operations and/or gear to keep from exceeding their individual vessel caps.

A portion of the total allowable groundfish catch could be held in reserve for access by vessels with the lowest catch (or catch rates) of overfished species or bycatch rates of non-groundfish species. Initial groundfish catch limits for other species would be calculated based on previously observed joint catch ratios of various groundfish species. Discarding of groundfish would be prohibited or greatly restricted. Discarding of other species could be prohibited or restricted also. Onboard observers would monitor all vessels' catches of all species.

2.3 Summary of Environmental Impacts

Initial analysis of environmental impacts is provided in Tables 4.6.1 and 4.6.2.

Table 2.2 Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

Goals and Objectives	Alternative 1 Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	Alternative 2 Reduce bycatch by decreasing effort and permitting larger or more flexible trip limits (reduce commercial trawl fleet)	Alternative 3 Reduce bycatch by reducing effort and permitting larger or more flexible trip limits (reduce commercial season)	Alternative 4 Reduce all groundfish bycatch by establishing sector catch/ mortality caps	Alternative 5 Reduce all groundfish bycatch by establishing individual catch limits (individual quotas) for groundfish species	Alternative 6 Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY	Y	Y	Y	Y	Y	Y
Set **overfished groundfish catch caps**	N	N	N	Y	N	Y
Use **trip limits**	Y	Y	Y	Y*	N	N
Use **catch limits**	N	N	N	Y	Y	Y
Set individual vessel/permit catch caps	N	N	N	N	Y	Y
Set groundfish **discard caps**	N	N	N	N	Y	Y
Establish **IQs**	N	N	N	N	Y	Y
Establish bycatch **performance standards**	N	N	N	N	Y	Y
Establish a reserve	N	N	N	Y	N/Y	Y
Gear Restrictions						
Rely on **gear restrictions**	Y	Y	Y	Y	N	Y
Time/Area Restrictions	Y	Y	Y	Y	Y	Y
Establish **long term closures for all groundfish fishing**	N	N	N	N	N/Y	Y
Establish **long term closures for on-bottom fishing**	N	N	N	N	N/Y	Y
Capacity reduction (mandatory)	N	Y(50%)	N	N	N	N
Monitoring/Reporting Requirements						
Trawl logbooks	Y	Y	100%	Y	??	??
Fixed-gear logbooks	N	N	100%	Y	??	??
CPFV logbooks	N	N	N	Y		
Commercial **port sampling**	Y	Y	Y	>Y	N/Y	Y
Recreational	Y	Y	Y	>Y	Y	>>x
Observer coverage (commercial)	10%	10%	10%+logbook verification	60%?	100%	100%
CPFV observers	N	N	N	Y	Y	100%
VMS	Y	Y	Y	Y	Y	Y
Post-season observer data OK	Y	Y	Y	Y/N	N	N
Inseason observer data required	N	N	N	Y/N	Y	Y
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	Y	Y	Y	Y	N	N

3.0 The Affected Environment

Words printed in THIS TYPE are defined in the glossary at the end of this document. Other words are also defined.

3.1 Introduction

Groundfish BYCATCH and its characteristics (e.g., species, extent of harm, quantity, distribution in time and space) result from the dynamic and complex interaction of attributes of the species, the fisheries, and the affected environment, both physical and biological. Life history strategies can influence vulnerability to bycatch at the level of an individual, a population, or group of species. For example, fish morphology (e.g., size, shape, presence of spines, large gill cover), distribution (e.g., preferred temperature, in deepwater, along cliffs) and behavior (e.g., schooling, inhabiting crevices, fast-swimming) affect how vulnerable a fish or species is to capture or harm by a particular gear. Fishers continuously adjust their gears, fishing practices and areas, to the extent allowed by regulation, to take advantage of these attributes in order to efficiently maximize the harvest of targeted species, as well as to reduce the harvest of unwanted species. The physical and biological environment also influences the distribution and abundance of species, largely through the availability and abundance of suitable habitat, prey, predators, competitors, and reproductive opportunities.

Chapter 3 describes various components of the coastal marine ecosystem and how people and communities use and rely on the groundfish resources of this region. The groundfish **FMP** and management regime covers groundfish stocks off Cape Flattery, Washington to the California border with Mexico. Hundreds of plant and animal species occur along the West Coast and groundfish-related bycatch may affect many of them. To make this chapter easier to read and understand, much of the detail on the biology of species and associated literature citations, have been placed in an appendix (See Appendix A).

This chapter describes the affected environment, which is the baseline environmental condition. The baseline represents the status of environmental attributes at a time before the proposed action is implemented, and in Chapter 4 serves as a point of comparison to evaluate possible significant impacts.

How The Chapter Is Organized

3.1.1 How The Chapter Is Organized

The chapter begins with a brief description of the physical environment, including marine geology, climate and currents. This is followed by descriptions of the biology of selected species, including important groundfish species, protected species, and other relevant fish and shellfish species. Several species or species groups are given special emphasis in this chapter because of concerns regarding their population status and relevancy to bycatch issues. These include nine OVERFISHED groundfish species and protected marine species including Pacific salmon, marine birds, marine mammals and sea turtles. Other important species include those with substantive bycatch of groundfish in a non-groundfish fishery such as for pink shrimp; with substantive bycatch of the species in a groundfish fishery, such as Pacific halibut; especially vulnerable species such as Dungeness crab in softshell condition and long-lived and slowly reproducing species such as sharks and rays.

Chapter 3 also describes important non-groundfish species, particularly those potentially affected by groundfish fishing operations. It includes species targeted by other fisheries that may affect various groundfish stocks. Known TROPHIC relationships are identified, as are species that may be directly affected by groundfish fishing operations (for example, accidentally captured and/or killed by groundfish operations).

In Chapter 3, fishing activities, gears and patterns are described. Important interactions among species, gears and fisheries are also described, as well as types of management tools and their application to bycatch issues.

Chapter 3 also describes the human uses of West Coast groundfish stocks, and how these activities relate to other fishing activities in the region. The commercial and recreational fisheries, commercial fish buyers and processors, and coastal communities where groundfish-related activities occur are described.

3.2 The Physical Environment

3.2 The Physical Environment

Essential Fish Habitat (EFH) for groundfish is defined as the aquatic HABITAT necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ECOSYSTEM. This approach focuses on ecological relationships among groundfish species and between the species and their habitat. These habitat types are described primarily by physical features with the caveat that EFH also includes the associated biological communities. EFH for groundfish is identified by seven major habitat types: rocky shelf, non-rocky shelf, continental slope/basin, canyon, NERITIC zone, oceanic zone and ESTUARINE. EFH descriptions have been incorporated in the FMP in both section 11.10 and in a detailed appendix (available online at http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html. Groundfish EFH is currently being re-evaluated in a separate EIS.

Information to describe the physical environment is drawn primarily from the following sources: PFMC (in prep.), OCNMS and GFNMS websites and Fran Recht (PSMFC, personal communication).

The geological structure and ocean environment affect the distribution of fish, which affects catch, incidental catch, and bycatch.

Geology Bathymetry and physical topography help determine habitat by influencing its physical structure and also the CO-OCCURRENCE of other species. Groundfish species are harvested in the PELAGIC zone, close to the bottom, or on the bottom, mostly within 50 miles of the shoreline where maturing and adult stages are found. Mud, sand, gravel, and exposed rocky areas, along with associated biological COMMUNITIES, make up the varied benthic habitats for groundfish on the continental margin.

The continental shelf off the West Coast is relatively narrow. It is generally widest from Oregon north and narrow off California.

The continental margin and waters out to 200 miles, the seaward boundary of the **EEZ**, are important habitat for groundfish and other marine species affected by groundfish fishing. The continental margin is composed of the CONTINENTAL SHELF and CONTINENTAL SLOPE - the steeper, deeper part of the continental margin. The U.S. West Coast is characterized by a relatively narrow continental shelf. The 100 fathom (200 m) depth contour shows a shelf break closest to the shoreline off Cape Mendocino, Point Sur, and in the Southern California Bight; and widest from central Oregon north to the Canadian border, as well as off Monterey Bay. Deep submarine canyons pocket the EEZ, with depths greater than 4,000 m south of Cape Mendocino. Major estuaries along the coast include San Francisco Bay, Columbia River, Willapa Bay, Grays Harbor, and the Strait of Juan de Fuca. A number of small estuaries occur all along the West Coast.

The West Coast marine environment is part of the California Current ecosystem. The current is a major influence on the all marine plants and animals in the region.

California Current System Biological characteristics of species, combined with physiographic features, are important determinants of changes in distribution. More mobile and schooling species, such as Pacific whiting, may vary in location *en masse* as they move in response to environmental conditions and prey availability. Current regimes may also control the distribution of larvae, helping to determine the location of adult populations. As mentioned earlier, fish distribution is an influential factor in determining bycatch, and thus, currents and changes to them can affect bycatch.

The West Coast marine environment is part of the California Current ecosystem. Large scale ocean currents, the North Pacific and Alaska gyres in particular, create a dynamic coastal environment. The North Pacific Current crosses the Pacific Ocean from Japan to Canada where it encounters the continental margin near Vancouver Island. The current splits into a northward flowing current carrying water into the Gulf of Alaska and a southward flowing current carrying water along the coast from Washington to California. This broad, shallow surface current which flows southward is called the California Current. It is strongest during the summer and is opposed by a weaker northward flowing and deeper California Undercurrent.

The California Current system changes significantly during the winter. The California Current moves farther offshore and the continental shelf is dominated by a strong northward flowing Davidson Current associated with winter storms.

Coastal winds help create major nutrient upwelling as deep, nutrient-rich water rises against the coastline. This increases ocean production, especially in upwelling areas.

Influenced by the California Current system and coastal winds, waters off the U.S. West Coast are subject to major nutrient upwelling as deep, nutrient-rich water is upwelled against the coastline. During periods of strong upwelling, primary ocean productivity is enhanced, increasing overall ocean production throughout many different trophic levels including those occupied by groundfish species.

Shoreline topographic features such as Cape Blanco and Point Conception, and bathymetric features such as banks, canyons, and other submerged features, often create large-scale current patterns such as eddies, jets, and squirts. For example, a current jet off Cape Blanco drives surface water offshore, which is replaced by upwelling sub-surface water. One of the better known current eddies off the West Coast occurs in the Southern California Bight between Point Conception and Baja, California, wherein the current circles back on itself by moving in a northward and counterclockwise motion just within the Bight.

Long and short term climate conditions affect the size and distribution of fish populations as well as other marine animals.

Climate Climate can influence the distribution and abundance of marine species, which in turn, can be reflected in bycatch type and amount. Population data on some groundfish species seem to show a linkage between climate and recruitment. The effect of El Niño-Southern Oscillation (**ENSO**) events on climate and ocean productivity in the northeast Pacific is relatively well-known. For example, Pacific whiting tends to have stronger year classes following an El Niño event than in other years. Also, some localized larval rockfish populations have shown lower survival rates in years when coastal upwelling and plankton production was reduced by El Niño events.

Periods of warmer or cooler ocean conditions and the event of shifting from warm to cool or vice versa can all have a wide array of effects on marine species abundance. Ocean circulation varies during these different climate events, affecting the degree to which nutrients from the ocean floor mix with surface waters. Periods of higher nutrient mixing tend to have higher phytoplankton (primary) productivity, which can have ripple effects throughout the FOOD WEB. In addition to changes in primary production, climate shifts may affect zooplankton (secondary) production in terms of increasing or decreasing abundance of the zooplankton biomass as a whole or of particular zooplankton species. Again, these changes in secondary production ripple in effect through the food web. Upper trophic level species depend on different lower order species for their diets, so a shift in abundance of one type of prey species will often result in a similar shift in an associated predator species. This shifting interdependency affects higher order species like groundfish in different ways at different life stages. Some climate conditions may be beneficial to the survival of larvae of a particular species but may have no effect on an adult of that same species.

> Some species thrive in colder water, while others do better in warmer water. Both short term and long term climate events influence survival and reproduction.

EL NIÑO and LA NIÑA events are examples of short-scale climate change, six-month to two-year disruptions in oceanic and atmospheric conditions in the Pacific region. An El Niño is a climate event with trends such as a slowing in Pacific Ocean equatorial circulation, resulting in warmer sea surface conditions and decreased coastal upwelling. Conversely, a La Niña is a short-scale climate events characterized by cooler ocean temperatures. In years of poor upwelling or when El Niño warms the waters off the West Coast, ocean productivity is reduced. Under severe El Niño conditions, species distributions can change radically.

Recently, scientists have concluded that large scale regime shifts overlay shorter term El Niño and La Niña events, creating longer term changes in productivity associated with decades-long warm or cold periods. In the past decade a still longer period cycle, termed the PACIFIC DECADAL OSCILLATION or PDO, has been identified. Although similar in effect, instead of the 1 year to 2 year periodicity of ENSO, PDO events affect ocean conditions for 15 years to 25 years. The PDO shifts between warm and cool phases. The warm phase is characterized by warmer temperatures in the northeast Pacific (including the West Coast) and cooler-than-average sea surface temperatures and lower-than-average sea level air pressure in the central North Pacific; opposite conditions prevail during cool phases. Because the effects are similar, "in-phase" ENSO events (that is, an El Niño during a PDO warm phase) can be intensified.

3.3 The Biological Environment

3.3 The Biological Environment

Detailed descriptions of the life history and status of groundfish, other fish and shellfish, marine mammals, sea turtles and seabirds are provided in Appendix A. For ease of readability, these descriptions are summarized below and the associated information sources are only cited in the appendix. Information to describe productivity and vegetation is drawn primarily from the following sources: PFMC (in prep.), OCNMS and GFNMS websites and Fran Recht (PSMFC, personal communication).

3.3.1 Primary and Secondary Productivity

Primary production (phytoplankton abundance) and secondary production (zooplankton abundance) influence the abundance of higher trophic level organisms, including fish populations targeted by fishers. Changes in production in terms of increasing or decreasing abundance of the zooplankton biomass as a whole or of particular zooplankton species ripple through the food web.

Upwelling zones are generally considered the most productive in the ocean. Upwelling occurs in the spring and early summer off central California. Submarine canyons along the Washington coast are sites of increased upwelling.

3.3.2 Vegetation

3.3.2 Vegetation

Brown, red, and green algaes and coralline algaes are abundant in the intertidal areas of rocky shorelines. These algae provide rich food supplies and provide cover for diverse communities of animal species. Eel grasses are also important spawning and nursery areas in estuaries.

The vegetation zone extends to from shore to depths where light penetration becomes insufficient for substantial plant growth. Kelp forests provide cover for many groundfish species, especially rockfishes, and they attract other species that may be prey, predators, or competitors with groundfish. Kelp forests of the Washington, Oregon and northern California coasts are dominated by bull kelp (*Nereocystis*), which is an annual species, dying each winter. Kelp forests off central and southern California are comprised of giant kelp (*Macrocystis*), which is a perennial species. It can live for several years in deeper water, but can be removed by storms on exposed coasts.

3.3.3 Groundfish

3.3.3 Groundfish

The Pacific Coast groundfish FMP manages more than 80 species. These species occur throughout the EEZ and occupy diverse habitats at all stages in their life history. While a few species have been intensively studied, there is relatively little information on the life history, habitat, and stock status of most groundfish species.

More detailed information about groundfish and other species can be found in Appendix A.

The life history, distribution, and stock status of each important groundfish species are summarized in Appendix A. More detailed information on the status of each of the groundfish species or species groups is available in the stock assessments associated with the annual SAFE report, as well as in the Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Proposed Groundfish ABC and OY Specifications and Management Measures for the 2002 Pacific Coast Groundfish Fishery.

This EIS highlights nine overfished groundfish stocks and 11 other groundfish stocks.

In addition to the individual species descriptions in Appendix A, generalized descriptions are provided below for the following groundfish species groups: rockfishes, thornyheads, gadids, flatfishes, sharks, and skates. These generalized descriptions are followed by information on the stock status for each overfished species and “emphasis species.” The term "overfished" describes a groundfish stock whose abundance is below its overfished/rebuilding threshold. Nine groundfish species are below the overfished threshold in 2003: bocaccio, canary rockfish, cowcod (south of Point Conception), darkblotched rockfish, lingcod, Pacific whiting, Pacific ocean perch, widow rockfish, and yelloweye rockfish. We are using the term "emphasis species" to describe a groundfish stock (other than an overfished stock) that is particularly relevant to bycatch issues and specifically incorporated in analyses of the alternatives in this EIS. Our groundfish emphasis species are black, yellowtail and chilipepper rockfish, shortspine and longspine thornyhead, sablefish, cabezon, English, Dover, and Petrale sole and arrowtooth flounder. The impacts of the alternatives described in Chapter 4 on these species should be representative of the impacts on species with similar life histories and distributions.

> Rockfish typically grow slowly, reproduce sporadically, and some live 100 years or longer. They have swim bladders that expand when the are caught and brought up from deep water. Nearly all die if that happens.

> This section presents some basic groundfish biology facts, starting with rockfish.

Generalized Rockfish (*Sebastes* spp.) Biology

Rockfishes are a very diverse group of over 55 species that occur along the West Coast. Adults of many species are most common in nearshore areas, whereas others (e.g., yellowtail rockfish) inhabit deeper waters on the shelf. Most rockfishes are demersal, often solitary, and associated with rocky areas or other structure. Adults of these species tend to remain in localized areas and do not undertake significant migrations or movements. A few others (e.g, widow rockfish) are considered pelagic, schooling species. All bear live young. Most species mate in the fall and larvae are released in spring, often in rocky or reef habitats. Larvae are carried inshore to rear during the summer and fall. Typically young-of-the-year are associated with vegetated and/or rocky areas and may occur in groups or larger schools. As they grow older, they adapt the adult lifestyle. Most rockfishes are slow-growing, long-lived and produce relatively few young each year. For most species, average age of maturity is reached between five and ten years. Some species are estimated to have a life span well over 50 years, perhaps 100 years, and the longevity of many species is 20 years or more. More detailed life histories for many rockfish species are provided in Appendix A.

> Sometimes depths are given in meters (m) and sometimes in fathoms (fm). A fathom is 6 feet. A meter is slightly more than 3 feet. So, 1 fm is slightly less than 2 m.

> Thornyheads are also in the rockfish family. They live on the bottom in deep water. The two species overlap, but longspine occur mostly deeper than shortspine.

Generalized Thornyhead Biology Two species of thornyheads occur off the West Coast, shortspine thornyhead (*Sebastolobus alascanus*) and longspine thornyhead (*S. altivelis*). They are found from Baja California to the Bering Sea and occasionally to Japan. They are common from southern

California northward. Thornyheads are demersal and occupy soft bottoms in deep water. Their distributions overlap considerably although longspines also inhabit somewhat deeper waters. Off Oregon and California, shortspine thornyhead mainly occur between about 50 to 700 fm (100 and 1,400 m), most commonly from 50-500 fm (100-1,000 m), and longspine thornyhead mainly occur at depths of 200-700+ fm (400 - 1,400+m), most often between about 300-500 fm (600 -1,000 m) in the oxygen minimum zone. Off California, spawning occurs in February and March in deep water. Eggs rise to the surface to develop and hatch. Floating egg masses can be seen at the surface in March, April, and May. Larvae are pelagic for about 12-15 months. During January to June, juveniles settle onto the continental shelf and then move into deeper water as they become adults. Off California, shortspines begin to mature at 5 years; 50% are mature by 12-13 years; and all are mature by 28 years. Although it is difficult to determine the age of older individuals, they may live to over 100 years of age. Thornyheads eat a variety of invertebrates such as shrimps, crabs, and amphipods, as well as fishes and worms. Longspine thornyhead are a common item found in the stomachs of shortspine thornyhead and cannibalism of newly settled juveniles is important in the life history of thornyheads. Sablefish commonly prey on longspine thornyhead.

"Flatfish" includes 12 species of flounders and soles. They are typically found on sandy bottom areas. Some species are shallower than others, and some make seasonal migrations from deep to shallow water.

Generalized Flatfish Biology Twelve species of flatfishes are classified as West Coast groundfish: arrowtooth flounder, butter sole, curlfin sole, Dover sole, English sole, flathead sole, Pacific sanddab, Petrale sole, rex sole, rock sole, sand sole, and starry flounder. (Pacific halibut and California halibut are not classified as West Coast groundfish, and are considered in Section 3.2.4 below.) Flatfish are demersal, inhabiting sandy, muddy, or gravelly bottoms from estuarine areas seaward over the shelf and onto the continental shelf. Starry flounder is common in estuarine areas and shallow nearshore areas and Dover sole and arrowtooth flounder are common on the outer shelf and slope. Others are most common nearshore and on the shelf. Individuals of the same species often occur together in large, non-random associations. Some may make extensive migrations, especially between feeding and spawning grounds. Spawning is most common during late winter and early spring. Except for rock sole, flatfish spawn many pelagic eggs, from hundreds of thousands to a few million, depending on species and size of the fish. Rock sole reportedly spawn over a variety of substrates, from rocky banks to sand and mud; their eggs are demersal and adhesive. For many species, eggs rise in the water column and are carried shoreward with the currents as they develop, although rex sole settle mainly on the outer continental shelf. As they age and grow, most flatfish move from shallow nursery areas into deeper waters. Age of maturity varies from 2 to 10 years, depending on species and sex. Longevity varies from 10 to 20 years with Dover sole living potentially twice as long. Juveniles and adults are carnivorous.

"Gadid" means members of the cod family. Pacific whiting is the most abundant groundfish in the West Coast region.

Generalized Gadid Biology Two species of gadids are classified as groundfish off the West Coast: Pacific whiting (*Merluccius productus*) and Pacific cod (*Gadus macrocephalus*). (Another gadid, walleye pollock, is not classified as a West Coast groundfish under the FMP, but its biology is described in Section 3.2.4 below.) Pacific Whiting, also known as Pacific hake, range from Sanak Island in the western Gulf of Alaska to Magdalena Bay, Baja California Sur. Off the West Coast, Pacific cod are at the southern end of their range, which extends from northern China along the Pacific rim to the Bering Sea and southward to Santa Monica, California. Smaller populations of cod and whiting occur in several of the larger semi-enclosed inlets, such as the Strait of Georgia and Puget Sound. Whiting are semi-pelagic. The highest densities of Pacific whiting are usually between 50 and 500 m, but adults occur as deep as 920 m and as far offshore as 400 km. Whiting school at depth during the day, then move to the surface and disband at night for feeding. Coastal stocks spawn off Baja California in the winter, then the mature adults begin moving northward and inshore, as far north as southern British Columbia by fall. They then begin the southern migration to spawning grounds and further offshore. Spawning occurs from December through March, peaking in late January. Their eggs are neritic and float to neutral buoyancy. Age of maturity for makes and females is three years and longevity is about 25 years. All life stages feed near the surface late at night and early in the morning. Juveniles and small adults feed chiefly on euphausiids. Large adults also eat amphipods, squid, herring, smelt, crabs, and sometimes juvenile whiting. Eggs and larvae of Pacific whiting are eaten by pollock, herring, invertebrates, and sometimes whiting. Juveniles are eaten by lingcod, Pacific cod and rockfish species. Adults are preyed on by sablefish, albacore, pollock, Pacific cod, marine mammals, soupfin sharks and spiny dogfish. The life history of Pacific cod off the West Coast differs in some aspects from the life history of Pacific whiting. Adult Pacific cod occur as deep as 875 m, but the vast majority occurs between 50 and 300 m. They are not considered to be highly migratory, but individuals can move long distances. Eggs are demersal, and eggs and larvae can be found over the continental shelf between Washington and central California from winter through summer. Most mature by 3 years of age, and longevity is about 15 years. Juveniles and adults are carnivorous and feed at night.

Three species of sharks are classified as groundfish. These sharks bear live young and may live 30-70 years.

Generalized Shark Biology On the West Coast, three species of sharks are classified as groundfish: spiny dogfish, soupfin shark and leopard shark. (Other sharks off the West Coast are more oceanic and as an example, the biology of the common thresher shark is considered in Section 3.2.4 below.) Leopard shark inhabit nearshore waters, including shallow bays and estuaries in California; soupfin shark occur near bottom in nearshore areas and over the shelf; and spiny dogfish occur near bottom and at times, higher in the water column from inshore areas to the outer shelf. They are schooling species and may make long migrations. They bear live young, primarily during the spring. Leopard sharks can produce up to 36 pups; soupfin sharks average 35 pups and spiny dogfish produce up to 20 pups, although litters of 4-7 are common. The gestation period lasts for 10-12 months for leopard shark, but two years for spiny dogfish. Age at maturity also varies by species and sex, but is about 10 to 20 years for females. These sharks are long-lived, from 30 to 70 years, depending on species and sex.

Three species of skates are classified as groundfish. They live on sandy bottom areas at various depths.

Generalized Skate Biology Three species of skates are classified as West Coast groundfish: big skate, California skate, and longnose skate. Adults inhabit mud or sand bottom on the shelf, although California skate is more common in shallower areas, especially off California. They are oviparous, with fertilization occurring internally, and eggs are deposited on the bottom in egg cases. Young hatch and inhabit level, sandy or muddy bottoms. Age of maturity ranges from six to12 years and adults live for 20-30 years.

Lingcod is an overfished species that appears to be rebuilding quickly. They spawn in rocky reef areas during the winter, and male lingcod guard the eggs until they hatch. They do not have swim bladders, so many live if they are caught and released quickly and carefully.

Lingcod Biology Lingcod (*Ophiodon elongatus*), a top order predator of the family Hexagrammidae, ranges from Baja California to Kodiak Island in the Gulf of Alaska. Lingcod is demersal at all life stages. Adult lingcod prefer two main habitat types: slopes of submerged banks 10-70 m below the surface with seaweed, kelp and eelgrass beds and channels with swift currents that flow around rocky reefs. Juveniles prefer sandy substrates in estuaries and shallow subtidal zones. As the juveniles grow they move to deeper waters. Adult lingcod are considered a relatively sedentary species, but there are reports of migrations of greater than 100 km by sexually immature fish.

Mature females live in deeper water than males and move from deep water to shallow water in the winter to spawn. Mature males may live their whole lives associated with a single rock reef, possibly out of fidelity to a prime spawning or feeding area. Spawning generally occurs over rocky reefs in areas of swift current. After the females leave the spawning grounds, the males remain in nearshore areas to guard the nests until the eggs hatch. Hatching occurs in April off Washington but as early as January and as late as June at the geographic extremes of the lingcod range. Males begin maturing at about 2 years (50 cm), whereas females mature at 3+ years (76 cm). In the northern extent of their range, fish mature at an older age and larger size. The maximum age for lingcod is about 20 years. Lingcod are a visual predator, feeding primarily by day. Larvae are zooplanktivores. Small demersal juveniles prey upon copepods, shrimps and other small crustaceans. Larger juveniles shift to clupeids and other small fishes. Adults feed primarily on demersal fishes (including smaller lingcod), squids, octopuses and crabs. Lingcod eggs are eaten by gastropods, crabs, echinoderms, spiny dogfish, and cabezon. Juveniles and adults are eaten by marine mammals, sharks, and larger lingcod.

Sablefish is one of the most valuable groundfish to the commercial fishery. They are widespread, both shallow and deep, north to south, and may migrate seasonally.

Sablefish Biology Sablefish (*Anoplopoma fimbria*) are abundant in the north Pacific, from Honshu Island, Japan, north to the Bering Sea, and southeast to Cedros Island, Baja California. There are at least three genetically distinct populations off the West Coast of North America: one south of Monterey characterized by slower growth rates and smaller average size, one that ranges from Monterey to the U.S./Canada border that is characterized by moderate growth rates and size, and one ranging off British Columbia and Alaska characterized by fast growth rates and large size. Large adults are uncommon south of Point Conception. Adults are found as deep as 1,000 fm (1,900 m), but are most abundant between 100-500 fm (200 and 1,000 m). Off southern California, sablefish were abundant to depths of 1,500 m. Adults and large juveniles commonly occur over sand and mud in deep marine waters. They were also reported on hard-packed mud and clay bottoms in the vicinity of submarine canyons. Spawning occurs annually in the late fall through winter in waters greater than 300 m. Sablefish are oviparous with external fertilization. Eggs hatch in about 15 days and are demersal until the yolk sac is absorbed. After yolk sac is absorbed, the age-0 juveniles become pelagic. Older juveniles and adults are benthopelagic. Larvae and small juveniles move inshore after spawning and may rear for up to four years. Older juveniles and adults inhabit progressively deeper waters. The best estimates indicate that 50% of females are mature at 5-6 years (24 inches), and 50% of males are mature at 5 years (20 inches). Sablefish larvae prey on copepods and copepod nauplii. Pelagic juveniles feed on small fishes and cephalopods, mainly squids. Demersal juveniles eat small demersal fishes, amphipods and krill. Adult sablefish feed on fishes like rockfishes and octopus. Larvae and pelagic juvenile sablefish are heavily preyed upon by sea birds and pelagic fishes. Juveniles are eaten by Pacific cod, Pacific halibut, lingcod, spiny dogfish, and marine mammals, such as Orca whales. Sablefish compete with many other co-occurring species for food, mainly Pacific cod and spiny dogfish.

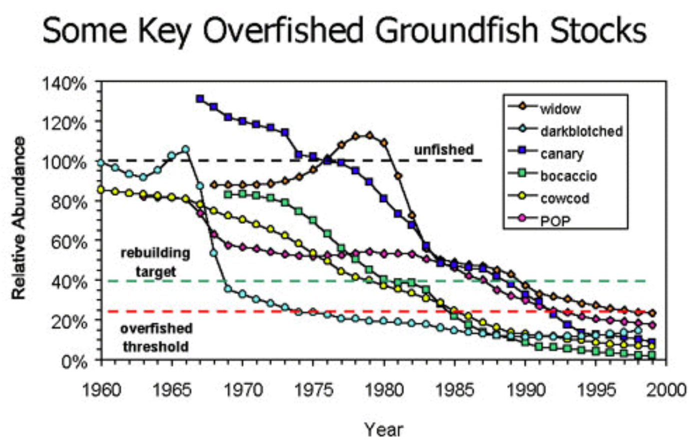
Cabezon is a type of sculpin that lives in shallow water.

Cabezon Biology Cabezon (*Scorpaenichthys marmoratus*) are found from central Baja California north to southeast Alaska. This species inhabits inshore waters from the intertidal out to depths of about 42 fm (76 m). It is most common at depths of 2.5 fm to 30 fm (5-59 m). Cabezon are found on rocky, sandy and muddy bottoms, and in kelp beds. They inhabit restricted home ranges. Age of maturity ranges from 3 to 6 years. Spawning takes place from late October to March in California, and from November through September in Washington. Fecundity ranges from 50,000 to 150,000 eggs, depending on size of the female. Eggs are deposited in clusters in shallow waters or in the low intertidal on bedrock, or in crevices. Males guard the nest after spawning and nest sites may be re-used from year to year. Eggs hatch two to three weeks after spawning. Small juveniles spend three to four months in the water column feeding on small crustaceans and other zooplankton. At about 1.5 inches (approximately 4 cm) they take up a demersal lifestyle. Adult cabezon primarily eat crustaceans (crabs, small lobster) but also mollusks (squid, octopus, abalone), smaller fishes, and fish eggs. Small cabezon are eaten by larger fishes including rockfishes, lingcod, adult cabezon, and other sculpins. Adults are eaten by pinnipeds.

This section talks about populations size and trends, starting with overfished groundfish.

Status of Overfished Groundfish Species

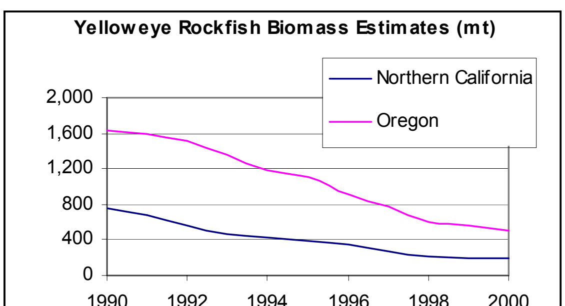
Nine groundfish species on the West Coast have been designated as overfished, based on estimates of their population abundance. A species is overfished if its abundance is less than 25% of its unfished population size. The rebuilding target for overfished species is 40% of its unfished population level.



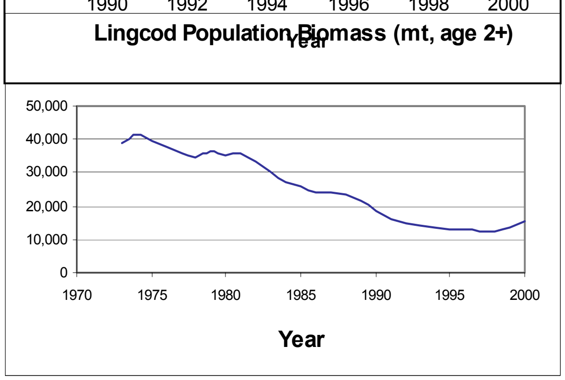
Adopted from Steve Ralston; NOAA/NMFS/SW Fisheries Science Center

Historical estimates of relative abundance for seven rockfish species are shown in the following figure (adapted from S. Ralston, personal communication). Trends in relative abundance of darkblotched rockfish, bocaccio and cowcod show relatively long, steady declines during the 1970s and 1980s to very low levels in1990s. Trends in relative abundance for Pacific ocean perch, widow rockfish and canary rockfish are more variable, but abundance generally declined during the late 1980s and through the1990s. More detailed information about the status of these species, including biomass estimates, are provided in Appendix A.

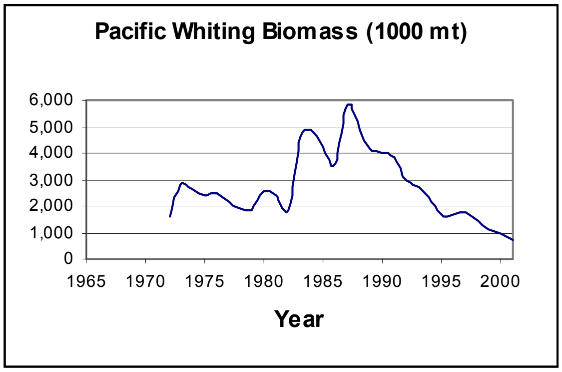
Yelloweye rockfish, lingcod and Pacific whiting have also been designated as overfished. Their population status is not incorporated in the previous figure, but is presented separately.



Yelloweye rockfish biomass estimates show a steady decline during the 1990s. The population was considerably below the unfished level when assessed in 2001, although there is relatively little information about yelloweye rockfish and uncertainties remain in the assessment. Regulations have severely restricted landings of yelloweye rockfish in recent years.



In 1997, lingcod was estimated to be at about 9% of its estimated unfished spawning potential. The estimated biomass of lingcod shown in the figure opposite shows a decline from approximately 40,000 mt of fish, age 2 years and older, in the mid-1970s to a low of approximately 12,000 mt during the late 1990s. More information about lingcod and its status is presented in Appendix A.

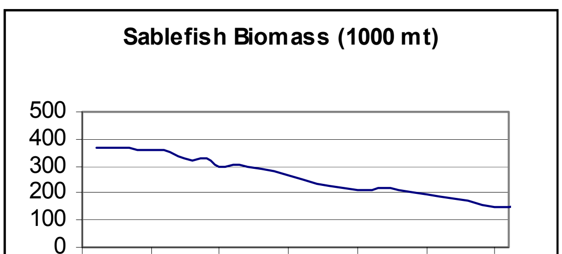


The abundance of Pacific whiting has been surveyed and assessed more frequently than for other groundfish species on the West Coast. Estimated biomass has declined fairly steadily from its historical peak of 5.7 million mt in 1987 to a low of about 1.7 million mt in recent years. Again, more information is provided about Pacific whiting and its status in Appendix A.

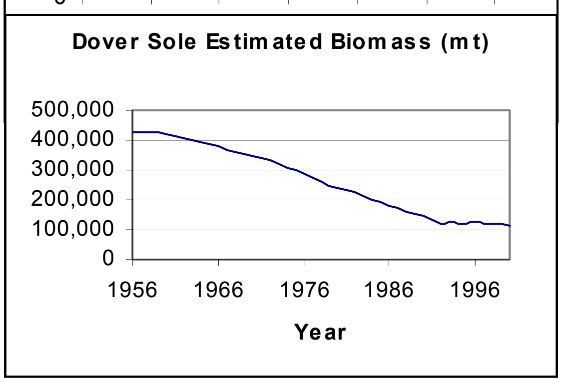
This section discusses the status of other highlighted groundfish species.

Status of Emphasis Groundfish Species

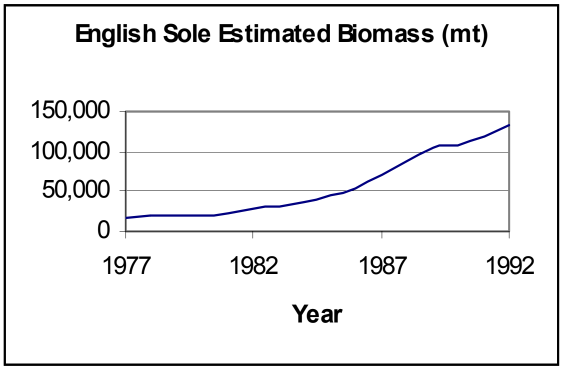
In addition to overfished species, eleven groundfish species are identified as “emphasis”species, those stocks that are particularly relevant to bycatch issues and specifically addressed in analysis of alternatives in this EIS. These species include sablefish, Dover sole, English sole, Petrale sole, arrowtooth flounder, chilipepper rockfish, yellowtail rockfish, shortspine thornyhead, longspine thornyhead, black rockfish and cabezon. Information about their population status is summarized below except for cabezon whose abundance has not been assessed. More detailed information about their life histories and population status is provided in Appendix A.



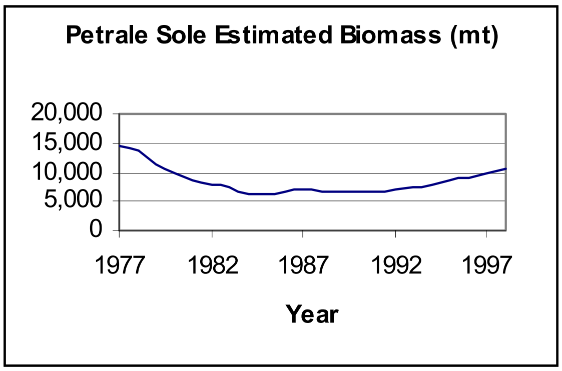
The estimated biomass of sablefish shows a slow, steady decline since the early 1970s. The stock is currently estimated to be between 27% and 38% of its unfished biomass and consequently, falls under “precautionary management” principles.



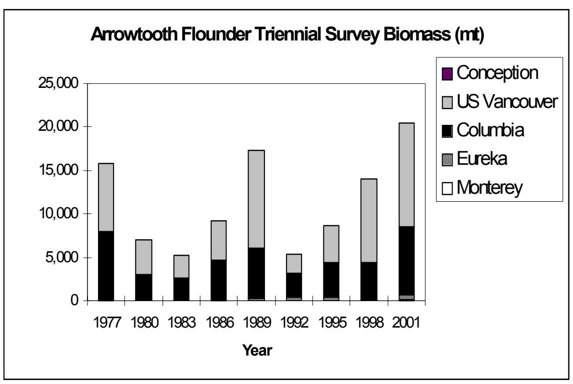
The most recent stock assessment for Dover sole completed in 2001 indicates that the current spawning stock size is about 29% of its unexploited biomass. Recent abundances appear to be without trend, but they were preceded by a steady decline since the late 1950s.



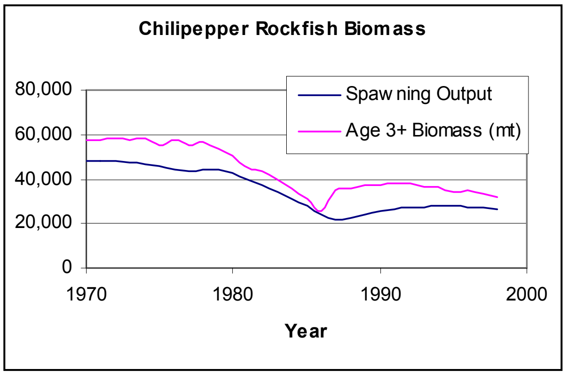
English sole has not been assessed since 1993. This assessment addressed English sole in northern areas (US Vancouver and Columbia) and indicated a nearly 7-fold increase in biomass since the 1970s to about 133,000 mt.



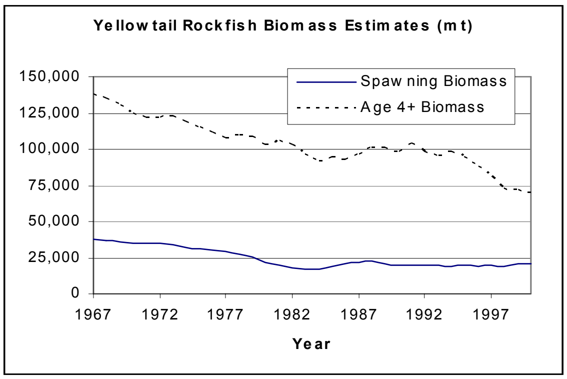
Current spawning biomass of Petrale sole is estimated to be in excess of 39% of its unfished spawning biomass. The most recent assessment addressed the northern stock (US Vancouver and Columbia areas). Biomass appears to be stable or increasing after an initial fishing down process.



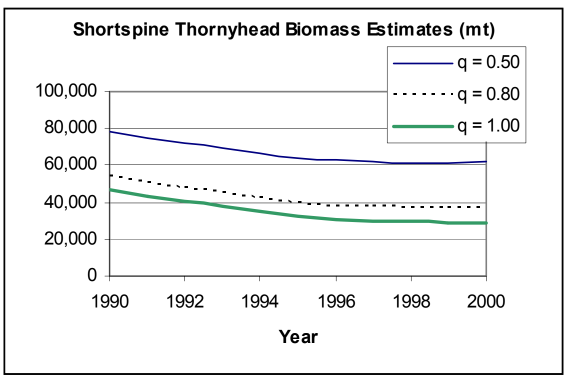
Arrowtooth flounder is at the southern end of its range in the Pacific region, and biomass off the West Coast appears to be highly variable, based on triennial trawl survey results. Most of the biomass occurs in the US Vancouver and Columbia areas, and a joint US/Canada assessment is recommended.



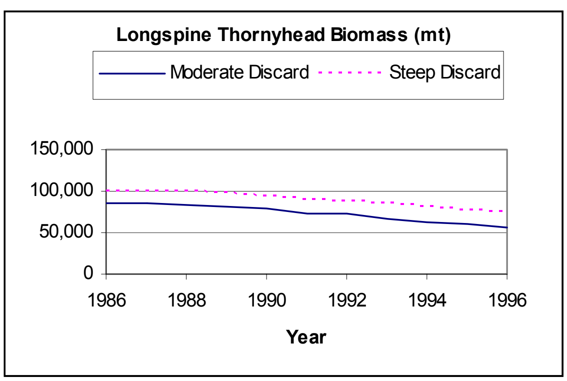
The most recent assessment of chilipepper rockfish in 1998 indicated a decline in biomass, but the stock remains above the target level. Chilipepper is managed as part of a complex, and regulations to protect bocaccio rockfish have probably reduced catches of chilipepper rockfish.



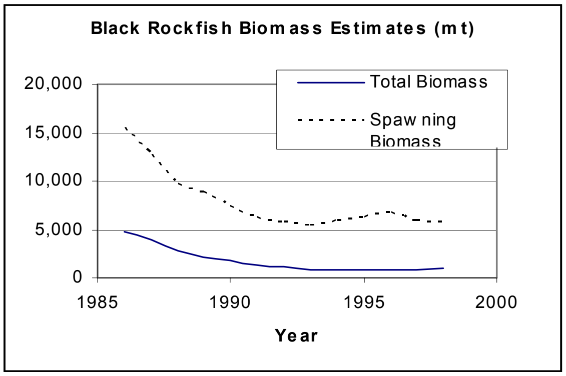
The most recent assessment for yellowtail rockfish in 2000 indicated that there has been a long-term decline in biomass, but the stock remains above the target level. Considerable uncertainty remains in the assessment, particularly over the relationship of yellowtail rockfish off the West Coast to those off Canada.



The most recent assessment for shortspine thornyhead in 2001 shows that the stock remains above the overfished level, between 24% and 48% of its unfished biomass. Considerable uncertainties remain in the assessments, particularly on the estimates of "q", the survey catchability coefficient.



Longspine thornyhead is estimated to be above 40% of its unfished biomass, according to the most recent assessment completed in 1997. One of the uncertainties in the assessment is the level of discard. The biomass trend is similar for both levels of discard, although estimated biomass is lower when a moderate level of discarding is assumed.



The black rockfish stock off Washington and Oregon are above the target biomass level. Estimated spawning biomass and total biomass declined during the 1980s , but appear to remain relatively stable during the 1990s. However, major uncertainties remain in the assessment.

3.3.4 Other Relevant Fish, Shellfish and Squid

3.3.4 Other Relevant Fish, Shellfish and Squid

These 12 non-groundfish have been selected to represent other fish species in order to illustrate the impacts of the alternatives.

We have selected twelve non-groundfish species (excluding protected species described in Section 3.2.5 below), identified as "emphasis species," to capture the impacts of the alternatives. These twelve species are Pacific halibut, California halibut, pink shrimp, spot prawn, ridgeback prawn, Dungeness crab, jack mackerel, Pacific mackerel, walleye pollock, common thresher shark, and eulachon. These species represent the range of impacts likely experienced by a broader range of species, but with similar life histories, distributions, and vulnerabilities to bycatch impacts. Life histories of emphasis species are summarized below and more detailed descriptions, including available information on stock status, are given in Appendix A. Similar descriptions are also provided in Appendix A for seven additional species that likely experience similar impacts of the Alternatives. These seven are blue shark, shortfin Mako shark, Pacific angel shark, Pacific herring, longfin smelt, night smelt, and surf smelt.

Pacific halibut are large flatfish that mostly live north of the West Coast. Most are born off Alaska or Canada and migrate to this area. Most found off the West Coast are adults.

Pacific Halibut (*Hippoglossus stenolepis*) ranges from California to the Bering Sea and extends into waters off Russia and Japan. The International Pacific Halibut Commission (IPHC) is responsible for Pacific halibut in the Northeast Pacific ocean. Pacific halibut are demersal and inhabit sand and gravel bottoms, especially banks, on the continental shelf. Halibut from California through the Bering Sea are considered to form one homogeneous population. Halibut off the West Coast are at the extreme southern end of their range and those that inhabit West Coast waters result from the southerly migration of juveniles. Halibut spawn during the winter in deep water (1,000 feet or 300 m). Their eggs and larvae rise and drift great distances with the ocean currents in a counter-clockwise direction around the northeast Pacific Ocean. Young fish settle to the bottom in shallow feeding areas. After two or three years, young halibut tend to counter-migrate to more southerly and easterly waters. Adult fish tend to remain on the same grounds year after year, making only a seasonal migration from the more shallow feeding grounds in summer to deeper spawning grounds in the winter. Pacific halibut are large, up to about 500 pounds (227 kg). Females typically grow faster and live longer than males; nearly all halibut over 100 pounds (45 kg) are females. Age of maturity for females is approximately 12 years. Most halibut are less than 25 years old. Halibut are carnivorous. Adults prey upon cod, sablefish, pollock, rockfishes, sculpins, turbot, and other flatfish. They also leave the bottom to feed on sand lance and herring in the water column. Octopus, crabs, clams, and occasionally small halibut are also eaten. Large juvenile and adult halibut are occasionally eaten by marine mammals but are rarely prey for other fish.

California halibut is another large flatfish that live mostly off central to southern California in relatively shallow water.

California Halibut (*Paralichthys californicus*) range from the Quillayute River, Washington to Almejas, Baja California, but their abundance and commercial fishery in U.S. waters are concentrated from Bodega Bay to San Diego, California. California Dept. of Fish and Game (CDFG) manages fisheries for California halibut off its coast; little fishing and catch occurs off Oregon and Washington. Adults live on soft bottom habitats in coastal water generally less than 300 feet (91 m) deep, with greatest abundance at depths less than 100 feet (30 m). California halibut live up to 30 years and reach 60 inches (153 cm). Male halibut mature at one to three years of age and eight to twelve inches (20 - 30 cm), whereas females mature at four to five years and 15 to 17 inches (38 - 43 cm). Adults spawn throughout the year with peak spawning in winter and spring. Pelagic eggs and larvae drift over the shelf but are in greatest densities within four miles of shore. Newly settled and larger juvenile halibut are usually found in unvegetated shallow-water embayments. Juveniles emigrate from the bays to the coast at about one year of age and 6.9 to 8.7 inches (17.5 - 22 cm). Adult California halibut primarily prey upon Pacific sardine, northern anchovies, squid, and white croaker. Small juvenile halibut eat primarily crustaceans.

Shrimp and prawns eaten by groundfish and other species. Fisheries for shrimp and prawns often catch groundfish.

Pink shrimp (*Pandalus jordani*), also called ocean shrimp, occur from the Aleutian Islands to San Diego, California. State agencies plus the Washington treaty tribes manage the pink shrimp resource and fisheries off their respective coasts. Pink shrimp occur at depths from 150 to 1,200 feet (46 - 366 m) but are generally found at depths from 240 to 750 feet (73 - 229 m).

Concentrations of shrimp remain in well-defined areas or beds from year to year. These areas are associated with green mud and muddy-sand bottoms. Most pink shrimp spend the first year and a half of life as males, then pass through a transitional phase to become females. Pink shrimp adjust their sex ratio to fluctuating age distributions. Mating takes place during September and October. Fertilization takes place when the females begin extruding eggs in October. Females usually carry between 1,000 and 2,000 eggs until the larvae hatch in March and April. The larval period lasts 2½ to three months. Developing juvenile shrimp occupy successively deeper depths, and often begin to show in commercial catches by late summer. Pink shrimp grow in steps by molting or shedding their shells and growth rates vary by region, season, sex and year class. Pink shrimp feed mainly at night on planktonic animals, such as euphausiids and copepods. Many species of fish prey on pink shrimp, including Pacific whiting, arrowtooth flounder, sablefish, petrale sole and several species of rockfish. Predation by whiting may affect the abundance of pink shrimp.

Spot Prawn (*Pandalus platyceros*) ranges from the Aleutian Islands to San Diego, California, and extends to the Sea of Japan and the Korea Strait. Spot prawns are typically found at depths between 653 and 772 feet (198-234 m). Juvenile shrimp concentrate in shallower, inshore areas (<297 feet or 90m) and migrate offshore as they mature. Spot prawn distribution is very patchy and related to water temperature, salinity and physical habitat. Spot prawns typically inhabit rocky or hard bottoms, including reefs, coral or glass-sponge beds, and the edges of marine canyons. Spot prawns can live up to six years off California but longevity decreases in more northerly areas; the average age off Canada is only four years. Spot prawns change sex in midlife. They mature first as males, mate, and then change to females after a transition phase. Sexual maturity is reached during the third year (about 1.5 inches or 38 mm carapace length). By the fourth year (about 1.75 inches or 44 mm carapace length), many males begin to change sex to the transitional stage. By the end of the fourth year, the transitionals become females. Each individual mates once as a male and once or twice as a female. Spawning occurs once each year, typically in late summer or early autumn. Spawning takes place at depths of 500 to 700 feet (151-212 m). Females carry eggs for a period of four to five months before they hatch. Spot prawns produce a few thousand eggs. Eggs hatch over a 10-day period and is completed by April. The larvae spend up to three months in the water column and then begin to settle out at shallow depths. Spot prawns typically feed on other shrimp, plankton, small mollusks, worms, sponges and fish carcasses. They usually forage on the bottom throughout the day and night.

Ridgeback prawn is primarily a southern California species that lives at depths of about 30 - 90 fm.

Ridgeback Prawn (*Sicyonia ingentis*) occurs from Monterey, California, to Cedros Island, Baja California. They inhabit depths ranging from less than 145 feet to 525 feet (44 - 160 m). Major concentrations occur in the Ventura-Santa Barbara Channel area, Santa Monica Bay, and off Oceanside. Other pockets of abundance occur off Baja California. Ridgeback prawns inhabit substrates of sand, shell and green mud. Because they are relatively sessile, little or no intermixing occurs. Their maximum life span is five years and sexes are separate. Females reach a maximum carapace length of 1.8 inches (46 mm) and males 1.5 inches (38 mm). Ridgeback prawns are free spawners, in contrast to other shrimps which carry eggs. Both sexes spawn as early as the first year, but most spawn during the second year at a size of 1.2 inches (30 mm). On average, females produce 86,000 eggs. Following spawning, both sexes undergo molting. The food habits of the ridgeback prawn are unknown, but it may feed on detritus like closely related species. Likely predators include rockfish, lingcod, octopus, sharks, halibut, and bat rays.

Dungeness Crab occur from Alaska to Mexico, typically on sandy bottom in relatively shallow water.

Dungeness Crab (*Cancer magister*) and their respective fisheries are managed by the West Coast states and Washington treaty tribes. Dungeness occur in coastal waters along North America from Unalaska Island to Magdalena Bay, Mexico. They are widely distributed over sandy or muddy bottom, generally in waters shallower than 90 feet (27.4 m), but they have been found as deep as 600 feet (183 m). Crabs grow each time they molt. Juveniles molt 11 or 12 times prior to sexual maturity, which may be reached at three years. At four to five years, a Dungeness crab can be over 6.5 inches (16.5 cm) in carapace width and weigh between 2 and 3 pounds (0.9 - 1.4 kg). The estimated maximum life span is between 8 and 13 years. Males mate only with female crabs that have just molted, from spring through fall. A large female crab can carry 2.5 million eggs under her abdomen until hatching. Young planktonic crabs go through six developmental stages before they molt into their first juvenile stage. After molting, the juveniles inhabit shallow coastal waters and estuaries with large numbers living among eelgrass or other habitats with aquatic vegetation. Shell hash is also important habitat for young Dungeness crabs. Dungeness crabs scavenge along the sea floor and their diet includes shrimp, mussels, small crabs, clams, and worms. Cannibalism is common. Young planktonic crabs are important prey for salmon and other fishes. Juveniles are eaten by a variety of fishes in the nearshore area, especially starry flounder, English sole, rock sole, lingcod, cabezon, skates and wolf eels. Octopus may also be an important predator.

Market squid are small, short-lived molluscs that grow to about 12 inches (30 cm) total length, including arms. Most mature and spawn when about one year old, then die. Spawning squid concentrate in dense schools.

Market Squid (*Loligo opalescens*) is a coastal pelagic species (CPS) managed by the Council. They occur throughout the California and Alaska current systems from the southern tip of Baja California, Mexico, to southeastern Alaska. Market squid are most abundant from Punta Eugenio, Baja California and Monterey Bay, California. Although generally considered pelagic, they are found over the continental shelf from the surface to depths of at least 2,625 feet (800 m). Adults and juveniles are most abundant between temperatures of 10 °C and 16° C. Market squid are small, short-lived molluscs reaching a maximum size of 12 inches (30 cm) total length, including arms. Most mature and spawn when about one year old, then die. Spawning along the West Coast occurs year-round. Spawning squid concentrate in dense schools. Known major spawning areas are shallow semi-protected nearshore areas with sandy or mud bottoms adjacent to submarine canyons. In these locations, egg deposition occurs between 1.5 and 17 feet (5-55 m). Females produce 20 to 30 capsules and each capsule contains 200 to 300 eggs. Females attach each egg capsule individually to the substrate. As spawning continues, mounds of egg capsules covering more than 100 square meters (1076 sq. ft.) may be formed. Hatchlings are dispersed by currents, and their distribution after leaving the spawning areas is largely unknown. Market squid are important forage to a long list of fish, birds, and mammals. Some of the more important squid predators are chinook salmon, coho salmon, lingcod, rockfish, harbor seals, California sea lions, sea otters, elephant seals, Dall's porpoise, sooty shearwater, Brandt's cormorant, rhinoceros auklet and common murre.

Jack mackerel was previously managed as a groundfish, but now is in the CPS FMP. Older fish sometimes are found north of California.

Jack Mackerel (*Trachurus symmetricus*) is a coastal pelagic species (CPS) managed by the Council. It is a widely distributed, schooling fish throughout the northeastern Pacific Ocean and much of their range lies outside the EEZ. Young fish, up to six years old, are most abundant in the Southern California Bight and school over shallow rocky banks. Older fish, 16 to 30 years old are generally found offshore in deep water and along the coastline to the north of Point Conception. They are more available on offshore banks in late spring, summer, and early fall than during the remainder of the year. They remain near the bottom or under kelp canopies during daylight and move into deeper nearby areas at night. Young juveniles sometimes are found in small schools beneath floating kelp and debris in the open ocean. Jack mackerel live 35 years or more. Half or more of all females reach sexual maturity during their first year of life. The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July. Larval jack mackerel feed almost entirely on copepods. Small jack mackerel off southern California eat large zooplankton, juvenile squid, and anchovy. Large mackerel offshore primarily prey upon euphausiids, but also on small fishes. Large predators, such as tuna and billfish, and some marine mammals, like seals and sea lions, prey upon jack mackerel.

> Pacific mackerel is primarily a southern species but may range north to the central Oregon coast, especially in warm water years.

Pacific (Chub) Mackerel (*Scomber japonicus*) is a coastal pelagic species (CPS) and one of three spawning stocks along the Pacific coasts of the US and Mexico. Only the northeastern Pacific stock extending northward from Punta Abreojos, Baja California is harvested by US fishers and managed by the Council. This stock is common from Monterey Bay to Cabo San Lucas. Pacific mackerel usually occur within 20 miles of shore, but have been taken as far offshore as 250 miles. Adults inhabit water ranging from 10°C to 22.2°C and they may move north in summer and south in winter between Tillamook, Oregon and Magdalena Bay, Baja California. They are found from the surface to depths of 300 meters and commonly occur near shallow banks. Juveniles are found off sandy beaches, around kelp beds, and in open bays. Larvae are found in water around 14°C. Pacific mackerel often school with other pelagic species, particularly jack mackerel and Pacific sardine. Pacific mackerel may reach 63 cm in length and 11 years in age. Age of maturity is two to four years. Spawning peaks from late April to July. Juvenile and adult Pacific mackerel prey upon small fish, fish larvae, squid and pelagic crustaceans. Juveniles and adults are eaten by larger fish, marine mammals, and seabirds. Pacific mackerel larvae are preyed upon by a number of invertebrate and vertebrate planktivores.

> Pollock are not common off the West Coast of the U.S., but sometimes the population expands into this region. They live near the bottom on the shelf and slope.

Walleye Pollock (*Theragra chalcogramma*) are found in the waters of the Northeastern Pacific Ocean from the Sea of Japan, north to the Sea of Okhotsk, east in the Bering Sea and Gulf of Alaska, and south along the Canadian and U.S. West Coast to Carmel, California. Adult walleye pollock are generally semi-demersal species on continental shelf and slope. A variety of environmental factors, including hydrographic fronts, temperature, light intensity, prey availability, and depth determine the distribution of juveniles and adults. They are not common off the West Coast, but occasionally sufficiently large enough numbers move south from Canadian waters to be targeted by West Coast commercial fishers. Adults most commonly occur between 100 and 300m. Most pollock are mature by age three. Spawning takes place at depths of 50 to 300m. Walleye pollock are oviparous and females spawn several batches of eggs, usually in deep water over a short period of time. Eggs are pelagic and are found throughout the water column. Larvae and juveniles are pelagic, and are generally found in the upper water column to depths of 60m. Adults are carnivorous and feed primarily on euphausiids, small fishes, copepods, and amphipods. In some areas, cannibalism can be an important food source for adults.

Thresher shark is a large pelagic species that migrates seasonally from southern California to Oregon and Washington.

Common Thresher Shark (*Alopias vulpinus*) is a highly migratory species (HMS). It is a large pelagic shark with a circumglobal distribution. In the northeastern Pacific, it occurs from Goose Bay, British Columbia south to Baja California. Abundance is thought to decrease rapidly beyond 40 miles from the coast, although catches off California and Oregon do occur as far as 100 miles offshore. This species is often associated with areas of high biological productivity, strong frontal zones separating regions of upwelling and adjacent waters, and strong horizontal and vertical mixing of surface and subsurface waters. They may migrate north-south seasonally between San Diego/Baja Mexico and Oregon and Washington. Large adults may pass through southern California waters in early spring of the year, remaining in offshore waters from one to two months for pupping. Pups are then thought to move into shallow coastal waters. Adults then continue to follow warming water and perhaps prey northward, and by late summer, arrive off Oregon and Washington. Subadults appear to arrive in southern California waters during the early summer, and as summer progresses move up the coast as far north as San Francisco, with some moving as far as the Columbia River. In the fall, these subadults are thought to move south again. Little is known about the presumed southward migration of the large adults, which do not appear along the coast until the following spring. The common thresher shark bears live young, usually 2-4 pups. Birth is believed to occur in the spring months off California. Size and age of first maturity for females is likely between 8.5-9 feet (260-270 cm) and about 4 or 5 years old. For males, size and age of first maturity is between 8-11 feet (246-333 cm) and

3 to 6 years. This species has been variously reported to reach a maximum age of from 19 to 50 years old. Primary prey items in the diet of the common thresher shark taken in the California-Oregon drift gillnet fishery included anchovy, sardine, Pacific whiting, mackerels, shortbelly rockfish, and market squid.

Eulachon is a type of smelt that migrates from the ocean into fresh water to spawn.

Eulachon (*Thaleichthys pacificus)* range from central California to Alaska. Off the West Coast, eulachon are managed by the respective states. Eulachon are anadromous, spending most of their life in the open ocean, schooling at depths of 150 to 750 feet (46 - 229 m). They migrate to lower reaches of coastal rivers and streams to spawn in fresh water; the largest run occurs in the Columbia River, where occasionally they travel over 100 miles upriver. Eulachon may live up to five years and reach 12 inches (30.5 cm) in length. Most eulachon reach maturity in two to three years and die after spawning. Each female lays about 25,000 eggs which stick to the gravel and hatch in two to three weeks. Upon hatching, larvae begin migrating to the sea. Eulachon feed mainly on euphasiids, copepods and other crustaceans, and they are a very important food for predatory marine animals, including salmon, halibut, cod and sturgeon.

3.3.5 Protected Species

3.3.5 Protected Species

Several species of marine mammals, seabirds, sea turtles and salmon on the West Coast have been listed as threatened or endangered under the ESA. A species is listed as "ENDANGERED" if it is in danger of extinction throughout a significant portion of its range and "THREATENED" if it is likely to become an endangered species within the foreseeable future throughout all, or a significant portion, of its range. The following species are subject to the conservation and management requirements of the ESA:

Table 3.2.5. West Coast Endangered Species
Marine Mammals
Threatened: • **Steller sea lion (*Eumetopias jubatus*) Eastern Stock,** • **Guadalupe fur seal (*Arctocephalus townsendi*), and** • **Southern sea otter (*Enhydra lutris*) California Stock.**
Seabirds
Endangered: • **Short-tail albatross (*Phoebastria (=Diomedea) albatrus*),** • **California brown pelican (*Pelecanus occidentalis*), and** • **California least tern (*Sterna antillarum browni*).** **Threatened:** • **Marbled murrelet (*Brachyramphs marmoratus*).**
Sea Turtles
Endangered: • **Green turtle (*Chelonia mydas*)** • **Leatherback turtle (*Dermochelys coriacea*)** • **Olive ridly turtle (*Lepidochelys olivacea*)** **Threatened:** • **Loggerhead turtle (*Caretta caretta*)**
Salmon
Endangered: • **Chinook salmon (*Oncorhynchus tshawytscha)*** Sacramento River Winter; Upper Columbia Spring • **Sockeye salmon (*Oncorhynchus nerka)*** Snake River • **Steelhead trout (*Oncorhynchus mykiss)*** Southern California; Upper Columbia **Threatened:** • **Coho salmon (*Oncorhynchus kisutch)*** Central California, Southern Oregon, and Northern California Coasts • **Chinook salmon (*Oncorhynchus tshawytscha*)** Snake River Fall, Spring, and Summer; Puget Sound; Lower Columbia; Upper Willamette; Central Valley Spring; California Coastal • **Chum salmon (*Oncorhynchus keta)*** Hood Canal Summer; Columbia River • **Sockeye salmon (*Oncorhynchus nerka)*** Ozette Lake • **Steelhead trout (*Oncorhynchus mykiss)*** South-Central California, Central California Coast, Snake River Basin, Lower Columbia, California Central Valley, Upper Willamette, Middle Columbia, Northern California

In addition to these federally protected species, California lists several seabirds as endangered or species of special concern under the California Endangered Species Act. These include brown pelican, marbled murrelet, Xanthus murrelet, rhinoceros auklet, and tufted puffin.

Some of these species and other marine mammals and seabirds are taken incidentally in West Coast groundfish fisheries and are therefore, especially relevant to bycatch issues. They are termed “emphasis species” (or species groups) for purposes of discussion of the Alternatives in Chapter 4 and include 6 marine mammals, 4 seabirds and 2 salmon species. The marine mammals are Stellar sea lion, California sea lion, northern elephant seal, harbor seal, Dall’s porpoise and Pacific white-sided Dolphin. Although more than 100 species of seabirds occur along the West Coast, little information is available about the incidental take of seabirds by West Coast groundfish fisheries. Observers aboard groundfish vessels off the West Coast during August 2001-October 2002 reported four cormorants and one gull were taken by the limited entry trawl fleet. To approximate the impact of Alternatives in Chapter 4, it is assumed that any species taken by West Coast longline fisheries will be similar to the incidental takes by Alaskan longliners, for which some information is available. Seabirds taken by Alaska longliners, and considered “emphasis species” are northern fulmars, gulls, Laysan albatross, and black-footed albatross. No sea turtles are included as “emphasis species” because there is minimal take by West Coast fisheries for groundfish. Chinook (king) and coho (silver) salmon are included as emphasis species.

Life histories are described below for each of these emphasis species. More detailed information is provided in Appendix A, as well as descriptions for other marine mammals, sea birds, and sea turtles that occur on the West Coast.

Sea lions and seals occur off the West Coast.

Steller (Northern) Sea Lion *(Eumetopias jubatus*) range along the North Pacific Ocean from Japan to California. Two stocks are designated in U.S. waters with the eastern stock extending from Cape Suckling, Alaska to southern California with a total of 6,555 animals off Washington, Oregon and California. They do not make large migrations, but disperse after the breeding season (late May-early July), feeding on rockfish, sculpin, capelin, flatfish, squid, octopus, shrimp, crabs, and northern fur seals.

California Sea Lion *(Zalophus californianus)* range from British Columbia south to Tres Marias Islands off Mexico. Breeding grounds are mainly on offshore islands from the Channel Islands south into Mexico. Breeding takes place in June and early July within a few days after the females give birth. The population is estimated at 214,000 sea lions. During the summer breeding season, most adults are present near rookeries principally located on the southern California Channel

Islands and Año Nuevo Island near Monterey Bay. Males migrate northward in the fall, going as far north as Alaska and returning to their rookeries in the spring. Adult females generally do not migrate far away from rookery areas. Juveniles remain near rookery areas or move into waters off central California. Diet studies indicate that California sea lions feed on squid, octopus, and a variety of fishes: anchovies, sardine, mackerel, herring, rockfish, Pacific whiting, and salmon.

Harbor Seal *(Phoca vitulina richardsi*) inhabit nearshore and estuarine areas ranging from Baja California, Mexico, to the Pribilof Islands, Alaska. MMPA stock assessment reports recognize six stocks along the U.S. West Coast: California, Oregon/ Washington outer coastal waters, Washington inland waters, and three stocks in Alaska coastal and inland waters. The California stock is estimated at 30,293 seals; the Oregon/ Washington Coast stock at 26,180 seals; and the Washington inland-water stock at 16,056 seals. Harbor seals do not migrate extensively, but have been documented to move along the coast between feeding and breeding locations. The harbor seal diet includes herring, flounder, sculpin, cephalopods, whelks, shrimp, and amphipods.

Several species of porpoises occur off the West Coast.

Dall's Porpoise *(Phocoenoides dalli*) are common in shelf, slope and offshore waters in the north eastern Pacific Ocean down to southern California. As a deep water oceanic porpoise, they are often sighted nearshore over deepwater canyons. These porpoise are abundant and widely distributed with at least 50,000 off California, Oregon, and Washington; however because of their behavior of approaching vessels at sea, it may be difficult to obtain an unbiased estimate of abundance. Dall's porpoise calf between spring and fall after a 10-11 month gestation period. North-south movement between California, Oregon and Washington occurs as oceanographic conditions change, both on seasonal and inter-annual time scales. Dall's porpoise feed on squid, crustaceans, and many kinds of fish including jack mackerel.

Harbor Porpoise *(Phocoena phocoena*) are small and inconspicuous. They range in nearshore waters from Point Conception, California into Alaska and do not make large scale migrations. Harbor porpoise in California are split into two separate stocks based on fisheries interactions: the central California stock, Point Conception to the Russian River, and the northern California stock in the remainder of northen California. Oregon and Washington harbor porpoise are combined into a coastal stock and there is designated an inland Washington stock for inland waterways. The most recent abundance estimates, based on aerial surveys are: central California 7,579; northern California 15,198; Oregon/ Washington coastal 44, 644; and inland Washington 3,509 harbor porpoise. There are no clear trends in abundance for these stocks. Harbor porpoise are not listed as threatened or endangered under the ESA nor as depleted under the MMPA. The average annual mortality for 1996-99 (80 harbor porpoise) is greater than the calculated Potential Biological Removal (56) for central California harbor porpoise; therefore, the central California harbor porpoise population is strategic under the MMPA. Although usually found in nearshore waters, distinct seasonal changes in abundance along the West Coast have been noted, and attributed to possible shifts in distribution to deeper offshore waters during late winter. The harbor porpoise diet is comprised mainly of cephalopods and fishes and they prefer schooling non-spiny fishes, such as herrings, mackerels, and sardines. Harbor porpoise are very susceptible to incidental capture and mortalities in setnet fisheries. Off Oregon and Washington, fishery mortalities of harbor porpoise have been recorded in the northern Washington marine set and drift gillnet fisheries.

Pacific White-Sided Dolphin *(Lagenorhynchus obliquidens*) are abundant, gregarious and found in the cold temperate waters of the North Pacific Ocean. Along the West Coast of north America they are rarely observed south of Baja California, Mexico. Aerial surveys have exceeded 100,000 white-sided dolphins over the California continental shelf and slope waters. Little is known of their reproductive biology. Longevity is not known although a 29- year-old pregnant female has been reported. White-sided dolphins inhabit California waters during winter months moving northward into Oregon and Washington during spring and summer. Shifts in abundance likely represent changes in prey abundance or migration of prey species. They are opportunistic feeders and often work collectively to concentrate and feed small schooling fish including anchovies, Pacific whiting, herrings, sardines, and octopus.

Short-Beaked Common Dolphin *(Delphinus delphis)* commonly inhabit tropical and warm temperate oceans. Their distribution along the U.S. West Coast extends from southern California to Chile and westward to 135° West longitude. The 1991-96 weighted average abundance estimate for California, Oregon and Washington waters based on three ship surveys is 373,573 short-beaked common dolphins. They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (79) is less than the 3,188 dolphins allowed under the Potential Biological Removal formula. Reproductive activity is non-seasonal in tropical waters with peaked calving in spring and summer in more temperate waters. Short-beaked common dolphins feed nearshore on squid, octopus and schooling fish like anchovies, hake, lantern fish, deep-sea smelt or herring. These dolphins are often seen in very large schools of hundreds or thousands and are active bow riders. Common dolphin mortality has been estimated for set gillnets in California; however, the two species (short-beaked and long-beaked) were not reported separately. Short-beaked common dolphins have been reported as a bycatch in some trawl fisheries.

Long-Beaked Common Dolphin *(Delphinus capensis)* were recognized as a distinct species in 1994. Their distribution overlaps with the short-beaked common dolphin, although they are more typically observed in nearshore waters. The 1991-96 weighted average abundance estimate for California, Oregon and Washington waters based on three ship surveys is 32,239 long-beaked common dolphins. They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (14) is less than the 250 dolphins allowed under the Potential Biological Removal formula. Reproductive activity is similar to short-beaked: non-seasonal in tropical waters with peaked calving in spring and summer in more temperate waters. Long-beaked common dolphins feed nearshore on squid, octopus and schooling fish like anchovies or herring. They are also active bow riders and break the water surface frequently when swimming in groups averaging 200 animals. Common dolphin mortality has been estimated for set gillnets in California; however, the two species (short-beaked and long-beaked) were not reported separately. Long-beaked common dolphins have been reported as a bycatch in some trawl fisheries.

Northern Elephant Seal *(Mirounga angustirostris*) range from Mexico to the Gulf of Alaska. Breeding and whelping occurs in California and Baja California, during winter and early spring on islands and recently at some mainland sites. The population was estimated at 127,000 elephant seals in the U.S. and Mexico during 1991. The population is growing and fishery mortality may be declining, and the number of pups born may be leveling off in California during the last five years.

Northern elephant seals are polygynous breeders with males forming harems and defending them against other mature males in spectacular battles on the beach. Female give birth in December and January, mate about three weeks later, after which the pups are weaned. They feed mainly at night in very deep water to consume whiting, skates, rays, sharks, cephalopods, shrimp, euphasiids, and pelagic red crab. Males feed in waters off Alaska, and females off Oregon and California.

Many species of seabirds occur off the West Coast. Some are resident and some migrate through the region. Some are listed under the Endangered Species Act.

Black-Footed Albatross (*Phoebastria nigripes*) ranges throughout the North Pacific. Breeding occurs on northwestern Hawaiian Islands and Torishima Island and the species disperses from the Bering Sea south along the Pacific Coast to California. Black-footed albatross is the most numerous albatross species along the Pacific Coast and is present throughout the year. The global black-footed albatross population is estimated at about 56,500 breeding pairs and thought to be decreasing. Black-footed albatross fed on fish, sea urchins, amphipods, and squid; foraging is done at night and prey is caught at the ocean's surface. This species will also follow fishing vessels and feed on discard.

Laysan Albatross (*Phoebastria immutabilis*) is the most abundant North Pacific albatross species. The vast majority of the Laysan albatross population breeds on the northwestern Hawaiian Islands, fewer numbers breed on the Japanese Ogasawara Islands, and still fewer pairs breed on islands off Baja California, Mexico (Guadalupe Island, Alijos Rocks, and in the Revillagigedo Islands). When at sea, the Laysan albatross ranges from the Bering Sea, to California, to Japan. Surveys at three sites indicate breeding populations total about 400,000 breeding pairs, but this represents an average decline of 3.2% per year since 1992. Laysan albatross feed on schooling fish and squid at the ocean's surface.

Cormorants that occur along the Pacific Coast include Brandt's cormorant (*Phalacrocorax penicillatus*), double-crested cormorant (*Phalacrocorax auritus*), and pelagic cormorant (*Phalacrocorax pelagius*). Brandt's cormorants are by far the most abundant cormorant species nesting along the coast of Oregon and California. Brant's cormorants are typically found in inshore, coastal areas, especially in areas having kelp beds, brackish bays, sheltered inlets, and quiet bays. Brandt's cormorant usually nests on offshore islands or, less frequently, on inaccessible mainland bluffs and wide cliff ledges near the water. Resident throughout the year near nesting areas, birds range more widely during non-breeding periods. Double-crested cormorants are widespread and breeding populations along the Pacific Coast seem to be increasing in number. They can be found along seacoasts, marine islands, coastal bays, swamps, lagoons, rivers, and lakes. Along the coast, they nest on offshore rocks and islands, exposed dunes, abandoned wharf timbers, and power poles. Birds are usually found within a few hours of their roosting or breeding sites. Breeding populations of pelagic cormorants are relatively evenly distributed from Washington to California and in recent years, populations have been increasing in number. Pelagic cormorants occur in outer coastal habitats, bays, and inlets, especially in rock-bottom habitats and often in water less than 100 m and within 1 - 2 km of shore. These birds will often nest with other pelagic cormorants or near other species of seabirds. Nesting occurs on island cliff ledges, crevices, and in sea caves by building nests out of seaweed. Cormorants are classified as diving birds; their strong swimming ability enables them to pursue and capture their prey underwater. Their diet includes small fishes, squid, crabs, marine worms, and amphipods.

Northern fulmar *(Fulmarus glacialis)* ranges along the Pacific Coast from Alaska to Oregon and they are primarily pelagic. The estimated total population of northern fulmars in the North Pacific is between 3 and 3.5 million individuals. This species primarily breeds in Alaska at colonies on sea cliffs and, less frequently, on low, flat rocky islands. Northern fulmars show strong mate and nest site fidelity. Nests are often raided by weasels and gulls. Northern fulmars are surface feeders, they swim or float upon the ocean's surface while feeding on organisms found just below the surface. The diet of this species includes fishes, mollusks, crustaceans, and cephalopods. Northern fulmars have also been observed following fishing vessels, presumably to feed on offal.

Gulls (*Larus* spp.) that occur along the Pacific Coast include the glaucous gull (*Larus hyperboreus*), glaucous-winged gull (*Larus glaucescens*), western gull (*Larus accidentalis*), herring gull (*Larus argentatus*), California gull (*Larus californicus*), Thayer's gull (*Larus thayeri*), ring-billed gull (*Larus delawarensis*), mew gull (*Larus canus*), Heermann's gull (*Larus heermanni*), Bonaparte's gull (*Larus philadelphia*), and

Sabine's gull (*Larus sabini*). For most marine-nesting species in the North Pacific, only rough estimates of nesting populations exist and reproductive success has only been investigated for one to two years. However, it is thought that most gull populations along the Pacific Coast are stable and not considered to be at risk. Most gulls along the Pacific Coast occur during the non-breeding season or are non-breeding individuals. Birds can be found at sea, along the coast, on rocky shores or cliffs, bays, estuaries, beaches, and garbage dumps. Only two species of gulls breed along the Pacific Coast. The glaucous-winged gull has breeding colonies in British Columbia and Washington and the western gull has breeding colonies in California (most are located on the Farallon Islands), Oregon, and Washington. Breeding habitat for these gulls includes coastal cliffs, rocks, grassy slopes or offshore rock or sandbar islands. Pacific Coast gulls feed at the ocean's surface and their diet typically includes fishes, mollusks, crustaceans, carrion, and garbage.

Chinook and coho salmon are important species in the West Coast ecosystem. Ocean conditions are critical to their abundance and distribution.

Chinook (King) Salmon (*Oncorhynchus tshawytscha*) range widely throughout the north Pacific Ocean and the Bering Sea, and as far south as the U.S./Mexico border. After leaving the freshwater and estuarine environment, juvenile chinook disperse to marine feeding areas. Some tend to be coastal-oriented, preferring protected waters and waters along the continental shelf. In contrast, others pass quickly through estuaries, are highly migratory, and may migrate great distances into the open ocean. Chinook salmon typically remain at sea for one to six years. They have been found in ocean waters. They are most abundant at depths of 30-70m and often associated with bottom topography. However, during their first several months at sea, juveniles are predominantly found at depths less than 37 m and are distributed in the water column. Juvenile chinook are generally found within 55 km of the U.S. West Coast, with the vast majority of fish found less than 28 km offshore. Concentrations may be found in areas of intense upwelling. The historic southern edge of their marine distribution appears to be near Point Conception, California. Throughout their range, adult chinook salmon enter freshwater during almost any month of the year. For example, chinook enter the Columbia River between March and November and the Sacramento River between December and July. Chinook salmon mature at a wide range of ages, from two to eight years. Most adult females are 65-85 cm in length and males are 50-85 cm, although fish larger than 100cm are not uncommon. Chinook salmon are the most piscivorous of the Pacific salmon. Fish make up the largest part of their diet, but squids, pelagic amphipods, copepods, and euphausiids are also important.

Coho (Silver) Salmon (*Oncorhynchus kisutch*), also called silver salmon, are a commercially and recreationally important species. They are found in small rivers and streams throughout much of the Pacific Rim, from central California to Korea and northern Hokkaido, Japan. Coho salmon spawn in freshwater streams, juveniles rear for at least one year in fresh water and spend about 18 months at sea before reaching maturity as adults. North American populations are widely distributed along the Pacific coast and spawn in tributaries to most major river basins from the San Lorenzo River in Monterey Bay, California, to Point Hope, Alaska. Two primary dispersal patterns have been observed in coho salmon after emigrating from freshwater. Some juveniles spend several weeks in coastal waters before migrating northwards into offshore waters of the Pacific Ocean while others remain in coastal water near their natal stream for at least the first summer before migrating north. The latter dispersal pattern is commonly seen in coho salmon from California, Oregon, and Washington. Coho salmon rarely use areas where sea surface temperature exceeds 15° C and are generally found within the uppermost 10 m of the water column. While juvenile and maturing coho are found in the open north Pacific, the highest concentrations appear to be found in more productive waters of the continental shelf within 60 km of the coast. Adults enter fresh water during October and November in Washington and Oregon and during December and January in California. Marine invertebrates, such as copepods, euphausiids, amphipods, and crab larvae, are the primary food when coho first enter salt water. Fish represent an increasing proportion of the diet as coho grow and mature.

3.3.6 Miscellaneous Species

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Commercial and recreational fisheries for groundfish take various fish, including finfish, shellfish, corals and other invertebrates. There is little information about the amounts or distribution of such bycatch. Although gear size and configuration and fishing operations are not the same as for commercial fisheries, information available from groundfish assessment surveys with bottom trawl gear can give an indication of the potential types of bycatch of benthic animals. In these surveys, a variety of benthos are taken, including sea urchins, starfish, snails, octopuses, various crustaceans and small fishes. At times, coral, sponges, and other animals may be taken or damaged during fishing (and survey) operations, but the distributions of these benthic animals are poorly known on the West Coast. Pot and longline fisheries may also take some of these animals, but little is known about this bycatch.

3.3.7 Biological Associations

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Most bottom-dwelling groundfish are currently managed based on distinction between nearshore, continental shelf, and continental slope species. For example, rockfishes are managed as assemblages of species grouped into nearshore, shelf, and slope categories (PFMC 2002). These categories reflect differences in fisheries catch compositions and are based primarily on depth which, in combination with distance from shore, roughly characterizes ecological zones. In addition, groundfish that live higher in the water column are managed differently than those living on the bottom. Some groundfish, such as Pacific whiting and shortbelly rockfish inhabit midwater along the coast. For many species, the biogeographic zone varies by life history stage; many groundfish produce pelagic larvae, and juveniles of many species are more commonly found in nearshore areas than as adults. These biogeographic zones also have a north south component, with Cape Mendocino representing an important break in the distribution of many groundfish species (particularly rockfish), hence the use of the 40°10' N line of latitude to separate northern and southern management regions. Finally, particular species may exhibit seasonal migrations, producing some annual variation in the characteristics of these different ecological zones. The nearshore, shelf, slope and pelagic environments can be characterized by combinations of the habitats described below, the species associations (and life stages) particular to these environments, and the trophic relationships between these species. Biological associations are dynamic, changing with time of day, season, life history stage, prey availability, mating opportunities, and environmental variables. Within each of the five regional environments, species associations also vary with depth and latitude. Of necessity, characterization of biological associations in the following sections provides only broad generalizations based on the available information. Most of the information also only pertains to adults; references to other life stages are noted as such.

Non-groundfish species, including other finfish, shellfish, marine mammals, marine birds, and sea turtles, also occupy specific biogeographic zones, often similar to those occupied by various groundfish species. For example, pink shrimp and Pacific halibut co-occur with several flatfish species on the northern shelf. Marine mammal communities are pelagic, but some are found primarily in nearshore waters, whereas others are more common over the shelf or slope. Sea turtles occur in midwater and sea birds are found primarily in or near surface waters all along the West Coast.

Information collected to understand biological associations of West Coast groundfish comes primarily from three sources: fishing activities, research surveys, and research studies. All of the means to collect information have limitations for the purpose of characterizing biological associations. Fishing, survey activities and research studies are often quite limited by gear selectivities, and temporal and spatial scales. Consequently, our understanding of biological associations and ecological relationships for West Coast groundfish is very incomplete.

3.3.7.1 Northern Shelf Environment

The boundaries of the northern shelf environment are 40° 10' N. Lat. (Cape Mendocino) on the south and the US/Canada border to the north, and between 20 and 109 fm, up to 5.5 fm off the sea floor.

Emphasis species that commonly occur on the northern shelf include four overfished groundfish species, as well as arrowtooth flounder, English sole, yellowtail rockfish, Pacific halibut and pink shrimp. The overfished groundfish species are lingcod, canary rockfish, yelloweye rockfish, and bocaccio. Associations among these and other species, as well as habitat on the northern shelf, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the northern shelf and are not considered in the northern shelf environment. These species are considered as part of the pelagic environment (Section 3.3.7.4).

Habitat Off the West Coast, the continental shelf generally broadens from south to north. It widens from a few miles at Cape Mendocino to about 50 miles off northern Washington and generally slopes gently westward. Bordering the nearshore zone, the shelf extends seaward to about 100 fm.

The shoreward edge of the shelf off Oregon is usually composed of soft substrates, primarily sand or green mud. This expanse of soft substrate is interrupted by prominent rocky banks, especially at the seaward edge of the shelf. These banks, such as Heceta Bank, Coquille Bank, Daisy Bank and Stonewall Bank, contain unique habitats formed by varied combinations of rock ridges, boulders, cobbles and pebbles. For example, submersible operations at Heceta Bank showed that diagonally stacked ridges are separated by sand, pebble, and cobble-filled depressions. A narrow band of precipitous pinnacles is located on the edge of the bank and large, round boulders are found on the eastward slope, which gradually fades to cobble and finally mud. In comparison, Coquille Bank is comprised largely of siltstone and mudstone and characterized by eroded, flat, slab-like boulders which were mostly covered by a layer of silt. No rocky ridges were observed on the bank (Barss 1994).

Off Washington, broad fans of gravel created by retreating glaciers from the northern Cascade and Olympic mountains, produce structural habitat on the seafloor. Similarly, empty shells from mussels and gastropods, and deposits of other biogenic debris, such as coral skeletons, sponge spicules, urchin tests, and worm tubes, provide some shelter for fish and attachment substrate for invertebrates.

Submarine canyons, such as Astoria Canyon off the Columbia River, are also prominent features of the northern shelf. Canyon habitat is structurally complex and diverse. It is characterized by vertical walls (textured with joints, fractures and overhangs), ledges, talus slopes, and the canyon floor covered with cobble, boulder and mud substrates.

Climatic conditions influence productivity; the duration and strength of winds favorable for upwelling along the West Coast diminish northward. Wind velocities and upwelling are variable but tend to be at a maximum in the spring to early summer in the region between Point Conception (34.5° N) and the Oregon border (42° N). Off Washington upwelling is relatively minor and is largely restricted to the late spring to early fall; winter storms there result in intense downwelling events (Leet, *et al.* 2001).

Bottom water temperatures on the northern shelf make good habitat for sub-arctic and cold-temperate species. Summertime bottom temperatures observed during the 1986-1998 West Coast triennial bottom trawl surveys ranged between about 7° C and 8.5° C (Shaw, *et al.* 2000).

Biological Associations Plant life on the shelf is small and sparse. Light does not usually penetrate below 60 fm, so algae are not found below that depth (Barss1994).

Non-rocky substrates are commonly utilized by pink shrimp, sea pens, and weathervane scallops. In addition, English sole, petrale sole, arrowtooth flounder, Pacific halibut, big skate and longnose skate frequently co-occur on or very near the bottom in these areas. Hagfish also occur over soft substrates. All flatfish species inhabit the non-rocky substrates on the northern shelf (EFH appendix), but their distributions differ by depth and substrate type (e.g., mud versus sand). Although their distributions overlap, adult arrowtooth flounder, rex sole, curlfin sole, Dover sole, rock sole and petrale sole also occupy deeper waters than sand sole and starry flounder (EFH appendix). Sablefish (particularly juveniles), spiny dogfish, ratfish and soupfin shark also cruise over these soft bottom habitats, in search of prey. Some nearshore species, such as blue rockfish, and deeper dwelling species like yellowtail rockfish, Pacific Ocean perch and Pacific whiting move into these areas to feed.

Banks create locally shallow areas in the otherwise deeper water of the shelf and are highly productive. Rocky substrates are often covered with a distinct and diverse suite of invertebrate species including sponges, corals, anemones, crinoids, hydroids, tunicates, bryozoans, tube worms, mussels, and other animals. These creatures form a structurally complex environment for other animals, such as brittle stars, shrimp, clams, mussels, barnacles, worms, crabs and fishes.

Common fish species in rocky habitats on the northern shelf include yellowtail, canary, sharpchin, greenstriped, pygmy and rosethorn rockfishes, kelp greenling, and lingcod. Many juvenile rockfishes inhabit these areas, and at Heceta Bank, dense schools above the shallower rocky ridges have been observed. These isolated rocky areas may serve as nursery grounds especially in areas where other suitable nursery habitat is unavailable.

Common fish and invertebrates seen in submersible operations at various habitat types on Heceta Bank and Coquille Bank are summarized in the following table (Barss 1994).

Table 3.3.7.1-1 Species observed in submersible operations at Heceta and Coquille Bank.

NEARSHORE-SAND & GREEN MUD	ROCK RIDGE & PINNACLES	BOULDER-COBBLE	MUD
English sole petrale sole rex sole slender sole hagfish ocean shrimp sea pens scallops	juvenile rockfishes yellowtail rockfish widow rockfish basketstars anemones coral sponges crinoids	pygmy rockfish sharpchin rockfish juvenile rockfishes yellowtail rockfish canary rockfish widow rockfish rosethorn rockfish lingcod greenling yelloweye rockfish bocaccio crinoids sponges anemones shrimp sea cucumbers sea stars octopus	Dover sole rex sole slender sole sablefish thornyheads splitnose rockfish ratfish poachers eelpouts hagfish fragile urchins sea cucumbers snails sun stars brittle stars euphausiids box crabs hermit crabs

Species associations vary during the year, generally related to feeding, growth, and reproduction. Many species make seasonal spawning migrations; for example, female lingcod move to shallow water during the winter to lay their eggs in nests. Dover sole and sablefish are common on the continental slope but make seasonal migrations onto the shelf. Juveniles of many groundfish species also move to deeper areas as they grow and take advantage of new prey sizes and species.

As on rocky banks, invertebrates, such as crinoids, sea anemones, and sponges create additional structural habitat and diversity in submarine canyons. Information about species that commonly inhabit canyons on the northern shelf is very limited, although soupfin sharks and sablefish reportedly are associated with canyons, along with other habitats (See EFH appendix).

Emphasis Species Canary, yellowtail, widow and silvergray rockfish, lingcod and sablefish are frequently associated. Although widow rockfish often occur near bottom, they more commonly inhabit midwaters and are considered a component of the pelagic complex (Section 3.3.7.4).

Yelloweye rockfish are generally a solitary, rocky reef fish. Researchers have observed adult yelloweye rockfish associated with bocaccio, cowcod, greeenspotted, and tiger rockfish (Appendix A).

Adult bocaccio have two primary habitat preferences: some are semipelagic, forming loose schools above rocky areas; and some are non-schooling, solitary individuals (EFH appendix). Solitary bocaccio have been found in association with large sea anemones. Bocaccio are often caught with chilipepper rockfish and have been observed schooling with speckled, vermilion, widow and yellowtail rockfish (Appendix A).

English sole, petrale sole, arrowtooth flounder, Pacific halibut, big skate and longnose skate frequently co-occur. Although distributions of English sole and arrowtooth flounder overlap, arrowtooth flounder are much more abundant at deeper depths in the northernmost areas, especially off Cape Flattery, Washington. English sole are most common in the shallower waters all along the shelf. Although fishing and survey reports indicate Pacific halibut frequently occur at Heceta and other banks on the northern shelf, they probably occupy areas of low-relief and soft substrates on these banks.

Pink shrimp are associated with green mud and muddy-sand bottoms and are important prey for many species. Arrowtooth flounder, petrale sole, sablefish, and Pacific whiting are some of the groundfish that prey heavily on pink shrimp. Predation by whiting may affect the abundance of pink shrimp (Appendix A).

The list of common groundfish species inhabiting rocky and non-rocky substrates in the Northern Shelf Environment is presented in Table 3.3.7.1-1 below. Other relevant fish and shellfish species to groundfish bycatch on the northern shelf are also included in the list.

Table 3.3.7.1-2 Species associations in the **Northern Shelf Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Lingcod	**Arrowtooth Flounder**
Canary Rockfish	**English Sole**
Yelloweye Rockfish	**Pacific Halibut**
Yellowtail Rockfish	**Ocean Shrimp**
Bocaccio	Sablefish
Chilipepper Rockfish	Dover Sole
Greenstriped Rockfish	Pacific Sanddab
Redstripe Rockfish	Petrale Sole
Rosethorn Rockfish	Rex Sole
Silvergray Rockfish	Sand Sole
Tiger Rockfish	Soupfin Shark
Vermilion Rockfish	Spiny Dogfish
Spiny Dogfish	Big Skate
Ratfish	Dungeness Crab
Spot Prawn	

3.3.7.2 Southern Shelf Environment

The boundaries of the southern shelf environment are 40°10' N. Lat. (Cape Mendocino) on the north and the US/Mexico border to the south, and between 20 and 109 fm, up to 5.5 fm off the sea floor.

Emphasis species that commonly occur on the southern shelf include two overfished species, as well as chilipepper rockfish and ridgeback prawn. The overfished groundfish species are bocaccio and cowcod. Associations among these and other species, as well as habitat on the southern shelf, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the southern shelf and are not considered in the southern shelf environment. These species are considered as part of the pelagic environment (Section 3.3.7.4).

Habitat The continental shelf diminishes southward along the California coast, from its widest (about 50 nm) at Cape Mendocino to its narrowest, only a few miles wide along the Southern California Bight. The shelf also forms very narrow rings around several islands in the Southern California Bight which rise sharply from the deep sea floor.

The southern shelf is comprised of similar substrate types as the northern shelf, although species assemblages are often different, largely due to the warmer waters south of Cape Mendocino. In addition to banks, reefs, and sandy or muddy bottoms like those described for the north, canyons are a prominent feature of the shelf. Submersible observations at depths from 40 to 150 fm in Soquel Canyon, Monterey Bay revealed a structurally diverse habitat, comprised of vertical walls (with joints, fractures, and overhangs), ledges, talus slopes, and a canyon floor with cobble, boulder and mud substrates. Invertebrates such as crinoids, sea anemones, and sponges create additional structural diversity.

Biological Associations Many of the species that co-occur on rocky and non-rocky substrates on the northern shelf similarly co-occur on the southern shelf, particularly between Cape Mendocino and the Southern California Bight. Redstripe, rosethorn, and silvergray rockfish are minor species associated with rocky substrates on the southern shelf but are considered more important on the northern shelf. In contrast, greenblotched, greenspotted, and Mexican rockfish and California scorpionfish are important species associated with rocky substrates on the southern shelf, but not in the north. Non-rocky substrates are more abundant on the northern shelf and consequently, flatfishes and pink shrimp are typically more important in the north.

Submersible observations of benthic rockfishes in Soquel Canyon revealed six distinct habitat guilds. In general, small species were associated with mud and cobble substrates of low relief and larger species were associated with high-relief habitat (Table 3.3.7.2-1). Some of these guilds observed at Soquel Canyon were remarkably similar to observations at several other sites along the Pacific Coast from Central California to Alaska. Sedentary fishes, such as bocaccio, lingcod, cowcod, greenblotched, greenspotted and yelloweye rockfish, were primarily sheltered under ledges, in crevices, and among large sea anemones on an isolated rock outcrop (Yoklavich, *et al.* 2000).

Table 3.3.7.2-1 Main habitat guilds observed in Soquel Canyon (from Yoklavich, *et al.* 2000.

Mud	Cobble-Mud Mud-Pebble	Mud-Cobble Mud-Rock	Boulder-Mud	Mud-Boulder Rock-Mud Rock Ridge	Rock- Boulder
Stripetail R Dover sole Agonidae Shortspine Th	Halfbanded R Greenstriped R Greenspotted R Pygmy R	Stripetail R Rosethorn R Agonidae Greenspotted R Greenstriped R	Rosethorn R Greenspotted R Bocaccio	Bocaccio Rosethorn R Greenspotted R	Pygmy R Bocaccio

Emphasis Species Bocaccio occur in a wide variety of habitats: often on or near bottom features but sometimes over muddy bottoms. Adult bocaccio are often caught with chilipepper rockfish and have been observed schooling with speckled, vermilion, widow and yellowtail rockfish. Chilipepper rockfish occur over the lower shelf and upper slope at depths between 41 and 168 fm. They are semi-pelagic and are found on deep rocky reefs as well as sand and mud bottoms. At times, they form large schools. Adult cowcod inhabit the lower shelf and upper slope, primarily at depths between 82 and 164 fm in the Southern California Bight. They are often found on bottoms with high relief such as rocky reefs. A cowcod conservation area encompassing most of their known habitat was established to provide protection to this overfished species. Ridgeback prawns occur only south of Monterey, California, at depths ranging from 24 to 87 fm. They inhabit substrates of sand, shell and green mud. Species associations for common groundfish and other species in the Southern Shelf Environment are listed in Table 3.3.7.2-2.

Table 3.3.7.2-2 Species associations in the **Southern Shelf Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Bocaccio **Cowcod** **Chilipepper** Lingcod Canary Rockfish Yelloweye Rockfish California Scorpionfish Greenblotched Rockfish Greenspotted Rockfish Greenstriped Rockfish Mexican Rockfish Tiger Rockfish Vermilion Rockfish Yellowtail Rockfish Spiny Dogfish Ratfish Spot Prawn	**Ridgeback Prawn** Sablefish California Scorpionfish Dover Sole English Sole Pacific Sanddab Petrale Sole Rex Sole Spiny Dogfish Big Skate Pacific Halibut Dungeness Crab

3.3.7.3 Slope Environment

The slope environment is bounded by the US/Canada and US/Mexico borders to the north and south, respectively, and depths greater than 109 fm, up to 11 fm off the sea floor. The slope extends westward onto the deep continental basin (>1000 fm), which covers most of the EEZ.

Emphasis species that commonly occur on the slope include two overfished species, as well as Dover sole, sablefish, shortspine thornyhead, longspine thornyhead, and spot prawn. The overfished groundfish species are darkblotched rockfish and Pacific ocean perch. Associations among these and other species, as well as habitat on the slope, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the slope and are not considered in the slope environment. These species are considered as part of the pelagic environment (Section 3.3.7.4).

Habitat The continental slope forms a narrow, steep strip at the seaward edge of the continental shelf. Except for the Southern California Bight, the slope drops rapidly from approximately 100 fm to 1,000 fm, less than 50 miles from shore. The islands of the Southern California Bight rise sharply from depths of about 1,000 fm. Beyond 1,000 fm, the bottom gradually slopes downward, to depths of 2,000 fm to form the continental basin which comprises most of the EEZ.

Relatively little is known about bottom types and their distributions on the continental slope. Descriptions of bottom type have been generally identified as “hard” or “soft,” often based on experiences with bottom gear during fishing operations. An oxygen minimum zone occurs on the deep slope; thornyheads spawn in this zone at about 300-500 fm.

Biological Associations Little is known about biological associations on the deep, steep slope. Most information comes from co-occurrence of species in fisheries catches. Aurora, bank, blackgill, rougheye, sharpchin, shortraker and yellowmouth rockfish are considered important slope groundfish species on hard bottom. Bank, redbanded, rougheye, and splitnose are also important groundfish species on soft bottom. Bronze-spotted, chilipepper, greenblotched, redstripe, rosethorn, and stripetail rockfish occur on the slope, but are not a major component of fisheries catches. Other groundfish including petrale sole, rex sole, finescale codling and Pacific rattail are also considered minor species on the slope. Little is known about other fish and shellfish species on the slope, except spot prawns. Spot prawns typically inhabit rocky or hard bottoms, including reefs, coral or glass-sponge beds and the edges of marine canyons.

Emphasis Species Dover sole, shortspine thornyhead, longspine thornyhead, and sablefish comprise a deepwater assemblage (DTS) managed as a complex under the FMP. These species occur primarily over soft bottom on the slope. Shortspine thornyhead also co-occur with Pacific ocean perch, darkblotched, splitnose, redbanded and rougheye rockfishes.

Pacific ocean perch occur on the upper slope (109-150 fm) during the summer and somewhat deeper (164-246 fm) during the winter. Adults sometimes aggregate up to 16 fm above hard-bottom features and my then disperse and rise into the water column at night. Most adult darkblotched rockfish are associated with hard substrates on the lower shelf and upper slope at depths between 77 and 200 fm. As mentioned above, spot prawns are also associated with hard bottoms.

The list of common groundfish species inhabiting hard and soft substrates in the Slope Environment is given in Table 3.3.7.3-1 below. Other fish and shellfish species relevant to groundfish bycatch are also included.

Table 3.3.7.3-1 Species associations in the **Slope Environment**. Emphasis species are shown in bold; minor species are not included.

HARD SUBSTRATES	SOFT SUBSTRATES
Pacific Ocean Perch	**Sablefish**
Darkblotched Rockfish	**Longspine Thornyhead**
Spot Prawn	**Shortspine Thornyhead**
Aurora Rockfish	**Dover Sole**
Bank Rockfish	Bank Rockfish
Blackgill Rockfish	Redbanded Rockfish
Rougheye Rockfish	Rougheye Rockfish
Sharpchin Rockfish	Splitnose Rockfish
Shortraker Rockfish	
Yellowmouth Rockfish	

3.3.7.4 Pelagic Environment

The pelagic environment includes waters overlying the slope, shelf, and nearshore environments, all along the West Coast EEZ. Emphasis species that commonly occur in the pelagic environment include two overfished species, as well as market squid, mackerels, sharks, Eulachon, and 16 protected species/species groups. The overfished groundfish species are widow rockfish and Pacific whiting. The protected species include Stellar sea lion, California sea lion, harbor seal, harbor porpoise, Dall's porpoise, Pacific white-sided dolphin, short-beaked common dolphin, long-beaked common dolphin, northern elephant seal, black-footed albatross, Laysan albatross, cormorants, northern fulmar, gulls, chinook salmon and coho salmon. California's protected species also include marbled murrelet, Xanthus murrelet, and rhinoceros auklet.

Habitat The California Current System and climate are the most influential factors in determining the diversity and distribution of marine life in the pelagic environment. Currents and climate off the West Coast are briefly described earlier in Section 3.2. The California current generally moves from north to south along the West Coast, transporting cooler water toward the equator. It flows near the coast north of Point Conception during most of the year, except in winter when southeast winds force it farther offshore, producing the Davidson Current that flows north near the coast. In some years, this counter current is stronger than normal and is forced as far north as British Columbia, Canada. South of Point Conception, in the Southern California Bight, the coast bends sharply to the east. There the California Current breaks away from the coast and flows offshore along the continental edge until it swings back toward the mainland south of San Diego. In the Southern California Bight, the usual surface flow, called the California Countercurrent, moves north along the coast resulting in a counterclockwise gyre that mixes offshore and nearshore surface waters off southern California (Leet, *et al.* 2001).

Temperature is the most commonly correlated climatic variable used to determine associations with biological processes. The colder, northern waters are good habitat for sub-arctic and cold-temperate species, such as Dungeness crab, Pacific salmon, and petrale sole. The warmer, southern waters are suited to warm-temperate and sub-tropical species, such as California halibut and spiny lobster. The offshore environment is often more stable than nearshore and estuarine environments, where the distribution of warm and cold waters can be highly variable. For example, average monthly sea surface temperatures offshore of San Francisco indicate a distinct summer upwelling pattern with cold sea surface temperatures nearshore, as well as large yearly variations. Within this strong upwelling cell, sea surface temperatures can be colder during the summer in cold years than they are during the winter in warm years (Leet, *et al.* 2001). Local physical processes including intense winds, extended periods of calm, infusions of freshwater runoff, and currents also greatly affect the growth, survival and distribution of many marine species. In addition, seasonal-scale influences are so important to many species that their life cycle is often largely adapted to these seasonal cycles.

Biological Associations Many marine species in the pelagic environment are sub-arctic and cold-temperate species, others are warm-temperate or sub-tropical and still others prefer nearshore areas, perhaps living on land at times. In addition, some pelagic species commonly occur all along the West Coast. Consequently, these species are grouped into northern offshore, southern offshore, and/or nearshore categories to approximate species associations.

Few groundfish species are considered pelagic: Pacific whiting, Pacific cod, widow rockfish, shortbelly rockfish, soupfin shark, leopard shark and spiny dogfish. Some marine mammals are residents (e.g., seals, California sea lions) and others are migrants (gray and humpback whales). Groundfish species provide an important prey source for most marine mammals. Seabirds can search large expanses of the ocean for prey and generally take the most abundant and high energy prey available, especially sardines, herring, smelt, anchovies, squid, some crustaceans and juveniles of many larger fish species. Some seabirds feed near the surface, especially on large fish schools, and others may dive for their prey. More detailed information about the life histories and distributions of the numerous seabirds and marine mammals found on the West Coast is provided in Appendix A. Although protected species are wide-ranging, their distributions have been categorized as primarily northern offshore, southern offshore and/or nearshore and included in the species associations listed in Table 3.3.7.4-1 for the Pelagic Environment.

Emphasis Species Pacific whiting forms very large aggregations and migrates long distances between feeding grounds off the northern coast and winter spawning grounds off southern California. Pacific whiting and widow rockfish can co-occur; midwater trawl fisheries for Pacific whiting also catch widow rockfish and sometimes small quantities of canary, darkblotched, and yelloweye rockfish, Pacific ocean perch, and lingcod. Widow rockfish sometimes form large schools, sometimes associated with bottom features. At other times, they may be dispersed in mid waters or on the bottom. Adults are often caught with yellowtail rockfish off Washington.

Relevant species of other fish, shellfish, and squid include jack mackerel, Pacific mackerel, market squid, and walleye pollock. Fisheries for these species may take groundfish species, especially some overfished species, vice versa. In addition, the coastal pelagic species provide an important prey source for Pacific whiting and other marine species. At times, fisheries for Pacific whiting have taken chinook and coho salmon as bycatch and pelagic sharks, such as the common thresher shark, may be vulnerable to capture in groundfish fisheries.

The list of common groundfish species inhabiting offshore and nearshore waters in the Pelagic Environment is given in Table 3.3.7.4-1 below. Other fish and shellfish species relevant to groundfish bycatch are also included. All of the protected species of salmon, marine mammals, sea turtles, and sea birds that have been identified as potentially vulnerable as bycatch (takes) in groundfish fisheries off the West Coast are included in this list.

Table 3.3.7.4-1 Species associations in the **Pelagic Environment**. Emphasis species are shown in bold; minor species are not included.

NORTHERN OFFSHORE	SOUTHERN OFFSHORE	NEARSHORE
Widow Rockfish **Pacific Whiting** **Jack Mackerel** **Walleye Pollock** **Thresher Shark** **Chinook Salmon** **Coho Salmon** **Stellar Sea Lion** **California Sea Lion** **Dall's Porpoise** **Harbor Porpoise** **Pacific White-Sided Dolphin** **Northern Elephant Seal** **Black-Footed Albatross** **Laysan Albatross** **Northern Fulmar** **California Gull** **Bonaparte's Gull** Shortbelly Rockfish Soupfin and Blue Sharks Spiny Dogfish Eulachon Northern Fur Seal Risso's Dolphin Short-Finned Pilot, Gray, Minke, Sperm, Humpback, Fin, and Killer Whales Leatherback Sea Turtle Short-Tailed Albatross Arctic, Common, and Black Terns Marbled, Xantu's, and Ancient Murrelets Fork-Tailed, Leach's, Sooty, Short-Tailed, Pink-Footed, Flesh-Footed, and Buller's Shearwaters Pomarine, Parasitic and Long-Tailed Jaegers Black-Legged Kittiwake Common Murre Pigeon Guillemot Parakeet, Rhinoceros, and Cassin's Auklets Horned and Tufted Puffins South Polar Skua	**Widow Rockfish** **Pacific Whiting** **Market Squid** **Jack Mackerel** **Pacific Mackerel** **Thresher Shark** **Stellar Sea Lion** **California Sea Lion** **Dall's Porpoise** **Harbor Porpoise** **Pacific White-Sided Dolphin** **Short-Beaked Common Dolphin** **Northern Elephant Seal** **Black-Footed Albatross** **Laysan Albatross** **California Gull** **Bonaparte's Gull** Shortbelly Rockfish Soupfin, Blue, and Shortfin Mako Sharks Spiny Dogfish Chinook and Coho Salmon Guadalupe and Northern Fur Seals Risso's Dolphin Short-Finned Pilot, Gray, Minke, Humpback, Blue, Fin, Killer, and Sei Whales Loggerhead, Green, Leatherback, and Olive Ridley Sea Turtles California brown pelican Short-Tailed Albatross Arctic, Common, and Black Terns Marbled, Craveri's, Xantu's and Ancient Murrelets Black, Fork-Tailed, Ashy, Least, Galapagos, Wilson's and Leach's Storm-Petrels Townsend, Black-Vented, Wedge-Tailed, Sooty, Short-Tailed, Pink-Footed, and Bugler's Shearwaters Polarize, Parasitic and Long-Tailed Gaugers Black-Legged Kittiwake Common Murre Pigeon Guillemot Rhinoceros and Casein's Auklets Horned and Tufted Puffins South Polar Skua	**Jack Mackerel** **Pacific Mackerel** **Chinook Salmon** **Coho Salmon** **California Sea Lion** **Harbor Seal** **Dall's Porpoise** **Harbor Porpoise** **Long-Beaked Common Dolphin** **Black-Footed Albatross** **Brandt's Cormorant** **Double-Crested Cormorant** **Pelagic Cormorant** **Glaucous Gull** **Glaucous-Winged Gull** **Western Gull** **Herring Gull** **California Gull** **Thayer's Gull** **Ring-Billed Gull** **Mew Gull** **Heerman's Gull** **Bonaparte's Gull** **Sabine's Gull** Soupfin Shark Spiny Dogfish Pacific Angel Shark Pacific Herring Eulachon Southern Sea Otter, Sea Otter Risso's Dolphin Fin and Killer Whales California Brown Pelican Black, California Least, Caspian, Forster's, Gull-Billed, Royal and Elegant Terns Marbled Murrelets Wedge-Tailed Shearwater Parasitic Jaeger Black-Legged Kittiwake Common Murre Pigeon Guillemot Rhinoceros Auklet Black Skimmer

3.3.7.5 Nearshore Environment

The nearshore environment extends from the high tide line seaward to 20 fm, from the US/Canada border on the north to the US/Mexico border on the south. It also includes estuarine habitats along the West Coast.

Emphasis species that commonly occur nearshore include cabezon, Dungeness crab, and California halibut. Associations among these and other species, as well as habitat in the nearshore environment, are more fully described below.

Many protected species occur in the nearshore environment, but most are highly mobile and are frequently found in offshore areas, as well. To capture their wide distribution, they are considered as part of the pelagic environment (Section 3.3.7.4).

Habitat The nearshore environment is comprised of a variety of habitats ranging from high-relief rocky reefs to broad expanses of sand and mud. The diversity of physical habitat in the nearshore environment is similar to that of the continental shelf, but being shallower, sunlight, tides, and waves are also important features. Intertidal and subtidal plant communities are highly productive and provide food and shelter for a wide variety of fish, shellfish, and invertebrates. The dominance and diversity of species varies latitudinally with temperature, as well as levels of solar radiation, wave exposure, rainfall and tidal range.

San Francisco Bay, Willapa Bay, and Grays Harbor are large estuaries and important nursery areas for many species of fish and shellfish. Flows from the Columbia River and Strait of Juan de Fuca influence the variety of marine life and are seasonally affected by the direction of the current system off the West Coast.

Biological Associations Nearshore areas north of Cape Mendocino are often dominated by black rockfish, cabezon, redtail perch, and night and surf smelt. Quillback and china rockfish, kelp greenling, and monkeyface prickleback are common in northern nearshore areas, but rarely seen in southern areas. South of Cape Mendocino, where rocky-reef habitat dominates, kelp beds are home to a variety of nearshore rockfish, abalone and sea urchins. California scorpionfish, black-and-yellow, gopher, grass, kelp, olive and calico rockfishes, and treefish are common in southern nearshore areas, but uncommon in northern areas.

Estuaries provide nursery areas for California halibut, surfperches, Dungeness crab, leopard sharks, starry flounder, and other marine species.

Emphasis Species Cabezon commonly inhabit rocky bottoms and kelp beds, although they may also be found on sandy and mud bottoms. To spawn, they deposit eggs in shallow waters on bedrock or in crevices. Adult black rockfish are semi-pelagic and commonly associated with kelp forests and rocky pinnacles. They frequently form midwater schools, but at other times they may be on the bottom. Adults are often caught with other fish, such as yellowtail and widow rockfish. Lingcod is an overfished groundfish species that is common in nearshore areas, and has been considered as an emphasis species in the Northern Shelf Environment (Section 3.3.7.1).

California halibut and Dungeness crab are abundant on sandy bottoms in the southern and northern nearshore environment, respectively. Both species co-occur with a variety of flatfishes may be taken as bycatch in some fisheries for groundfish. California halibut is commonly associated with white seabass. Dungeness crab, through all its life history stages, is an important prey species for many groundfish.

The list of common groundfish species inhabiting rocky and non-rocky substrates in the Nearshore Environment is presented in Table 3.3.7.5-1 below. Other fish and shellfish species relevant to groundfish bycatch are also included in the list among the emphasis species.

Table 3.3.7.5-1 Species association in the **Nearshore Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Cabezon **Black Rockfish** Lingcod Kelp Greenling Black-and-Yellow Rockfish Blue Rockfish Brown Rockfish Calico Rockfish California Scorpionfish China Rockfish Copper Rockfish Gopher Rockfish Grass Rockfish Kelp Rockfish Olive Rockfish Quillback Rockfish Treefish Vermilion Rockfish	**California Halibut** **Dungeness Crab** California Scorpionfish Pacific Sanddab Rock Sole Sand Sole Starry Flounder White Seabass Spiny Dogfish California Skate Big skate Rays

3.4 Fishing Activities, Gears and Patterns

3.4 Fishing Activities, Gears and Patterns

Information sources to characterize th groundfish industry and fishery included Leet *et al.* (2001), Nordeen (in prep.) and several draft PFMC documents: FEIS for Annual Optimum Yield Specifications and Management Measures PFMC (2003), FMP Amendment #17 for Multi-Year Managment (PFMCa, in prep), and the Environmental Assessment for a Vessel Monitoring System of Groundfish Fisheries (PFMCb, in prep.).

3.4.1 Characteristics of the Groundfish Industry and Fishery

3.4.1 Characteristics of the Groundfish Industry and Fishery

The Pacific Coast groundfish fishery is a year-round, multi-species fishery that takes place off the coasts of Washington, Oregon, and California. Pacific Coast groundfish support or contribute to a wide range of commercial, recreational, and tribal fisheries.

Non-tribal commercial fisheries include those that target groundfish, which for the most part are regulated under a license limitation program ("limited entry") implemented in 1994, and other fisheries that, while targeting other species, may catch groundfish. This latter category is termed "open access" because it does not require a federal license and participation is not limited by the federal license program. Most of the Pacific coast non-tribal, commercial groundfish harvest is taken by the limited entry fleet. The groundfish limited entry program applies to midwater and bottom trawl, longline, and trap (or pot) gears. Gears used by participants in open access commercial fisheries include longline, vertical hook-and-line, troll, pot, setnet, trammel net, shrimp and prawn trawl, California halibut trawl, and sea cucumber trawl gears. The Council allocates harvest specifications (OYs) between these limited entry and open access categories.

Of 4,579 West Coast commercial fishing vessels active during November 2000 through October 2001, 1,341 vessels (37% of the fleet) landed some groundfish. This segment of the fleet was responsible for 47% of the value of all West Coast landings (groundfish and non-groundfish species).

Members of the Makah, Quileute, Hoh, and Quinault tribes participate in commercial, ceremonial and subsistence fisheries for groundfish off the Washington coast. Participants in the tribal commercial fishery use similar gear to non-tribal commercial fishers who operate off Washington, and groundfish caught in the tribal commercial fishery is typically sold through the same markets as non-tribal commercial groundfish catch.

Participants in marine recreational fisheries fish from CPFV/charter and private vessels, as well as from shore. CPFV/charter vessels are larger vessels for hire that can typically fish farther offshore than most vessels in the private recreational fleet. Both nearshore and shelf opportunities are important for West Coast recreational groundfish fisheries.

Limited Entry Fisheries

Limited Entry Fisheries There are about 500 vessels with Pacific coast groundfish limited entry permits, of which approximately 55% are trawl vessels, 40% are longline vessels, and 5% are pot/trap vessels. Each permit is endorsed for a particular gear type and that gear endorsement cannot be changed, so the distribution of permits among gear types is fairly stable. The number of total permits can only change if multiple permits are combined to create a new permit with a longer length endorsement, or if a permit is not renewed. Limited entry permits can be sold and leased out by their owners, so the distribution of permits among the three states often shifts. At the beginning of 2000, roughly 39% of the limited entry permits were assigned to vessels making landings in California, 37% to vessels making landings in Oregon, and 23% to vessels making landings in Washington.

West Coast limited-entry trawl vessels use midwater gear to target Pacific whiting, and sometimes yellowtail and widow rockfish, and use bottom trawl gear for benthic species on the shelf and the slope, such as flatfish and DTS complex (Dover sole, thornyheads, and sablefish). Some of the other slope and shelf rockfish species also have been important targets in the limited-entry trawl fishery.

Limited-entry, fixed-gear vessels use longline or trap (pot) gear, whichever is endorsed on their permit. Sablefish has long been an important target species in this sector; however, some shelf and slope rockfish species have also been important and valuable targets. In recent years, nearshore rockfish and other species have been harvested by the live-fish fishery. Bottom longlines and pots are classified as “fixed gear” in the limited entry program. The size selectivity and species selectivities of the gears vary, with longline gear having somewhat more bycatch of non-sablefish species during the sablefish fishery and being capable of targeting groundfish other than sablefish. Although about 230 permits are issued, only about 180 limited-entry, fixed-gear vessels are active in a given year.

Harvest rates in the limited entry fishery are constrained by annual harvest guidelines, two-month or one-month cumulative period landings limits, individual trip limits, size limits, species-to-species ratio restrictions, and other measures, all designed to control effort so that the allowable catch is taken at a slow rate that will stretch the season out to a full year. Cumulative period catch limits are set by comparing current or previous landings rates with the year’s total available catch. Landing limits have been used to slow the pace of the fishery and stretch the fishing season out over as many months as possible, so that the overall harvest targets are not reached until the end of the year.

Limited entry fishers target on many different species, with the largest landings by volume (other than Pacific whiting) from these species: Dover sole, sablefish, thornyheads, widow rockfish, and yellowtail rockfish. There are 55 rockfish species managed by the Pacific coast groundfish FMP and, taken as a whole, rockfish landings represent the highest volume of non-whiting landings in the Pacific coast commercial groundfish fishery. Trawlers take the vast majority of the groundfish harvest by weight but somewhat less by value. In 2001, groundfish trawlers landed 97% of total groundfish harvest by weight (including whiting) but only 75% by value. Trawling is much more dominant north of Cape Mendocino (U.S./Vancouver, Columbia, and Eureka INPFC areas) than south of Cape Mendocino (Monterey and Conception INPFC areas). While non-trawl vessels took only 2% of the coastwide groundfish harvest by weight, their harvest accounted for about 25% of the exvessel value due to the prevalence of relatively high value sablefish and live fish landed in this fishery. When high-volume, but low-value whiting is excluded from the totals, non-trawl landings are in the 10% to 12% range by weight and in the 25% to 27% range by value (percent of coastwide total groundfish excluding whiting).

In addition to these mixed-species fisheries, there is a distinct mid-water trawl fishery that targets Pacific whiting. Pacific whiting landings are significantly higher in volume than any other Pacific coast groundfish species. In 1998, whiting accounted for approximately 66% of all Pacific coast commercial groundfish shoreside landings by weight. The Pacific whiting fleet includes catcher boats that deliver to shore-based processing plants and to at-sea processor ships, as well as catcher-processor ships. Whiting is a high volume species, but it commands a relatively low price per pound, so it accounts for only about 9% of all Pacific coast commercial groundfish shoreside landings by value.

Catcher vessel owners and captains employ a variety of strategies to fill out a year of fishing. Fishers from the northern ports may fish in waters off of Alaska, as well as in the West Coast groundfish fishery. Others may change their operations throughout the year, targeting on salmon, shrimp, crab, or albacore, in addition to various high-value groundfish species, so as to spend more time in waters close to their communities.

With the exception of the portion of Pacific whiting catch that is processed at sea, all other Pacific coast groundfish catch is processed in shore-based processing plants along the Pacific coast. By weight, 1998 commercial groundfish landings were distributed among the three states as follows: Washington, 13%; Oregon, 69%; California, 18%. By value, 1998 commercial groundfish landings are distributed among the three states as follows: Washington, 15%; Oregon, 43%; California, 41%. The discrepancies between the Oregon and California portions of the landings are expected because Oregon processors handle a relatively high percent of the shore-based whiting landings, a high volume, low value fishery. Conversely, California fishers land more of the low volume, high value species as a proportion of the total state-wide catch than Oregon fishers.

Directed Open Access – Groundfish Fishery

Open Access – Directed Groundfish In the open access fishery that targets groundfish, certain gears are used to target specific species. Hook-and-line gear, the most common gear type, is generally used to target sablefish, rockfish, and lingcod, whereas pot gear generally targets sablefish and some thornyheads and rockfish. In southern and central California, setnet gear has been used to target rockfish, including chilipepper, widow rockfish, bocaccio, yellowtail rockfish, and olive rockfish, and to a lesser extent vermilion rockfish. Dogfish, soupfin and other sharks, and skates are taken by gill net fishers.

Fishing intentions or strategies are not explicitly reported and so it is difficult to determine if the fisher is targeting groundfish. A given trip or vessel is classified as part of the directed fishery based on the species composition detailed in logbook records and landing receipts. A vessel is considered to target groundfish in the open access fishery during a fishing trip if it is fishing with any gear other than groundfish trawl and if over 50% of the revenue from landings in that trip were from groundfish species. In recent years, there have been approximately 1,500 vessels per year that have been making small groundfish landings against open access allocations. Of these vessels, about 1,000 land their catch in California, about 400 land their catch in Oregon, and about 100 land their catch in Washington. In California, commercial fishers have been required to purchase a nearshore fishery permit since 1999, to land shallow nearshore rockfish, California scorpionfish, cabezon, greenlings, and California sheephead. Since then, the number of open access vessels landing these groundfish has decreased from 1,100 in 1999 to 202 in 2003.

In the directed open access fishery, fishers target groundfish in the “dead” and/or “live” fish fishery using a variety of gears. The terms dead and live fish fisheries refer to how the fish are landed and sold. The dead fish fishery has historically been the most common way to land fish and made up 80% of the directed open access landings by weight coastwide in 2001. More recently, the greater market value for live fish has led to increased landings of live groundfish.

Live fish harvests are a recent but growing component of the directed fishery. Fish are caught using pots, stick gear, and rod-and-reel, and kept aboard the vessel in a seawater tank, to be delivered to foodfish markets—such as the large immigrant Asian communities in California—that pay a premium for live fish. Determining landings from this fishery is difficult because fishing intentions or strategies are not known. In practice, only those sales of species other than sablefish that garner a landed price above $2.50 per pound are classified in the live fish sector. Using this criterion 20% of coastwide directed open access landings by weight in 2001 are considered live fish, compared to only 6% in 1996. This growth in landings may be attributed to the price premium awarded live fish.

Recreational Fisheries

Recreational Fisheries Groundfish are both targeted and taken incidentally when other species, such as salmon, are targeted. Recreational fishing is conducted from shore, such as beaches, banks, piers, docks, and jetties and from boats, including private, rental, party and charter boats. Historically, most recreational fishing along the northern coast targeted salmon although groundfish, especially rockfish, were often taken incidentally. Some effort shift from salmon to groundfish likely occurred prior to 1996 when salmon seasons were shortened.

Fishing effort, both private and charter, is related to weather, with relatively more effort occurring in the milder months of summer and less in winter. This seasonal trend is more pronounced in higher latitudes, although the reasons include opportunity as well as climate. Salmon seasons are longer in California than in Oregon, which in turn are longer than in Washington. Groundfish seasons, until recently were also more restrictive in Washington; the lingcod season is closed from November through March.

Recreational fishing in the open ocean has been on an increasing trend since 1996; however, charter effort has decreased while private effort increased during this period. Coastwide, about twice as many angler trips for groundfish were taken by private anglers (1.33 million) as charter anglers (0.63 million) in 2001. Of these trips, 33,000 private angler trips for groundfish were taken off Washington and Oregon combined, with the remaining 1.3 million trips taken off California. Similarly, a total 59,000 angler trips aboard charter vessels were taken off Washington and Oregon in 2001 and 569,000 private angler trips for groundfish were taken off California. Angler trips for groundfish comprise 43% of all charter trips but only 16% of all private trips.

In 2001, the total catch of all groundfish species coastwide was very similar for charter (1,445 mt) and private recreational anglers (1,632 mt). About half of these catches were comprised of nearshore rockfish species, followed by lesser amounts of shelf rockfish, other nearshore groundfish and lingcod.

Tribal Fisheries

Tribal Fisheries The bulk of tribal groundfish landings, other than Pacific whiting, occur during the March-April halibut and sablefish fisheries. A small number of tribal fishers use bottom trawl gear. Most continental shelf species taken in the tribal groundfish fisheries are taken during the halibut fisheries, and most slope species are similarly taken during the tribal sablefish fisheries. About one-third of the tribal sablefish allocation is taken during an open competition fishery, in which member vessels from the sablefish tribes all have access to this portion of the overall tribal sablefish allocation. The open competition portion of the allocation tends to be taken during the same period as the major tribal commercial halibut fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation is split between the tribes according to a mutually agreed-upon allocation scheme. Tribe-specific sablefish allocations are managed by the individual tribes, beginning in March and lasting into the autumn, depending on vessel participation management measures used. Participants in the halibut and sablefish fisheries tend to use hook-and-line gear, as required by the International Pacific Halibut Commission (IPHC) for halibut.

In 2002, tribal sablefish longline fisheries were allocated 10% of the total catch OY (436.7 mt) and then were discounted 3% of that allocation for discard mortality, for a landed catch allocation of 424 mt. For the commercial harvest of black rockfish off Washington State, the treaty tribes have a harvest guideline of: 20,000 lb (9,072 kg) north of Cape Alava (48°09'30" N. lat.) and 10,000 lb (4,536 kg) between Destruction Island (47°40'00" N. lat.) and Leadbetter Point (46°38'10" N. lat.).

In addition to these hook-and-line fisheries, the Makah tribe annually harvests a whiting allocation using midwater trawl gear. Since 1996, a portion of the U.S. whiting OY has been allocated to the Pacific Coast treaty tribes. To date, only the Makah tribe has fished on the tribal whiting allocation.

In 1999 and 2000, 32,500 mt of whiting was set aside for treaty Indian tribes on the coast of Washington state, resulting in a commercial OY of 199,500 mt for 2000. In 2001 and 2002, the landed catch OY declined to 190,400 mt and 129,600 mt, respectively, and the tribal allocations for those years were also reduced to 27,500 mt and 22,680 mt, respectively. Makah vessels fit with midwater trawl gear have also been targeting widow rockfish and yellowtail rockfish in recent years.

Twelve western Washington tribes possess and exercise treaty fishing rights to halibut, including the four tribes that possess treaty fishing rights to groundfish. Specific halibut allocations for the treaty Indian tribes began in 1986. The tribes did not harvest their full allocation until 1989, when the tribal fleet had developed to the point that it could harvest the entire Total Allowable Catch (TAC) off Washington, Oregon and California. In 1993, judicial confirmation of treaty halibut rights occurred and treaty entitlement was established at 50% of the harvestable surplus of halibut in the tribes' combined Usual and Accustomed fishing grounds. In 2000, the courts ordered an adjustment to the halibut allocation for 2000-2007, to account for reductions in the tribal halibut allocation from 1989-1993. For 2000 through 2007, the non-tribal fisheries will transfer at least 25,000 lb per year to the tribal halibut fisheries, for a total of 200,000 lb to be transferred to the tribal fisheries over the period. Tribal allocations are divided into a tribal commercial component and the year-round ceremonial and subsistence component.

Tribal commercial halibut fisheries have historically started at the same time as Alaskan and Canadian commercial halibut fisheries, generally in mid-March. The tribal halibut allocation is divided so that approximately 80–85% of their allocation is taken in brief open competition derbies, in which vessels from all halibut tribes compete against each other for landings. In 2002, three of these “unrestricted” openings were held in the spring: a 48-hour opening on March 18, a 24-hour opening on April 2, and a 36-hour opening on April 30. In addition to these unrestricted openings, 15-20% of the tribal halibut allocation is reserved for “restricted” fisheries, in which participating vessels are restricted to a per trip and per day poundage limit for halibut. Two restricted opening opportunities were available in 2002, from March 20 - April 19 and from May 5 - 9. Similar to the unrestricted openings, these restricted openings are available for vessels from all halibut tribes.

3.4.2 Characteristics of Other Fisheries that Affect Groundfish

3.4.2 Characteristics of Other Fisheries that Affect Groundfish

Many fishers catch groundfish incidentally when targeting other species, because of the kind of gear they use and the co-occurrence of target and groundfish species in a given area. To distinguish landings and vessels from fisheries targeting species other than groundfish but take groundfish incidentally from the directed open access fishery for groundfish, the following criterion is used. If revenues from groundfish represent less than half of total revenue for a vessel landing some amount of groundfish, those landings are considered incidental, and the corresponding vessel can be classified in the incidental open access sector.

These incidental open access fisheries may also account for substantive amounts of bycatch, especially for overfished groundfish species. A range of fisheries, identified by the target species, comprise this sector. These include ocean (pink) shrimp, spot prawn, ridgeback prawn, California and Pacific halibut, Dungeness crab, salmon, sea cucumber, coastal pelagic species, highly migratory species, and the gillnet complex. A summary description of these fisheries follows.

California Halibut Fishery

California Halibut The commercial California halibut fishery extends from Bodega Bay in northern California to San Diego in Southern California, and across the international border into Mexico. California halibut, a state-managed species, is targeted with hook-and-line, setnets and trawl gear, all of which intercept groundfish. Trawling for California halibut is permitted in federal waters (3-200 nm from shore) using trawl nets with a minimum mesh size of 4.5 inches. Trawling is prohibited within state waters (0-3 nm) except in the designated "California halibut trawl grounds," which encompass the area between Point Arguello (Santa Barbara County) and Point Mugu (Ventura County) in waters beyond 1 nm from shore. Bottom trawls used in this area must have a minimum mesh size of 7.5 inches and trawling is closed here from March 15 to June 15 to protect spawning adults. Also, California requires a nearshore trawl bycatch permit to land shallow nearshore rockfish, California scorpionfish, California sheephead, cabezon and greenlings. An open access trawler with a bycatch permit may land a maximum of 50 pounds per landing of these species.

Historically, commercial halibut fishers have preferred setnets because of these restrictions. Setnets with 8.5-inch mesh and maximum length of 9,000 feet are the main gear type used in Southern California. Setnets are prohibited in certain designated areas, including a Marine Resources Protection Zone (MRPZ), covering state waters (to 3 nm) south of Point Conception and waters around the Channel Islands to 70 fm, but extending seaward no more than 1 mile. In comparison to trawl and setnet landings, commercial hook-and-line catches are historically insignificant. Over the last decade they have ranged from 11% to 23% of total California halibut landings. Most of those landings were made in the San Francisco Bay area by salmon fishers mooching or trolling slowly over the ocean bottom.

Dungeness Crab Fishery

Dungeness Crab The Dungeness crab fishery is divided between treaty sectors, covering catches by Indian Tribes, and a non-treaty sector. The crab fishery is managed by the states of Washington, Oregon, and California with inter-state coordination through the Pacific States Marine Fisheries Commission. This fishery is managed by season, sex and size of crab. Only male crabs may be retained in the commercial fishery (thus protecting the reproductive potential of the populations), the fishery has open and closed seasons, and a minimum size limit is imposed on commercial landings of male crabs. In Washington, the Dungeness crab fishery is managed under a limited entry system with two tiers of pot limits and a December 1 through September 15 season. In Oregon, 306 vessels made landings in 1999 during a season that generally starts on December 1. In California, distinct fisheries occur in Northern and Central California, with the northern fishery covering a larger area. California implemented a limited entry program in 1995 and as of March 2000, about 600 California residents and 70 non-residents had limited entry permits. Nonetheless, effort has increased with the entry of larger multipurpose vessels from other fisheries. Landings have not declined, but this effort increase has resulted in a “race for fish” with more than 80% of total landings made during the month of December.

California Gillnet Complex Fishery

Gillnet Complex The gillnet complex is managed by the State of California and comprises two gear types. Fishers use setnets to target California halibut (discussed above), white seabass, white croaker, and sharks. Driftnets are used for California halibut, white croaker, and angel shark. Most of the commercial catch is sold in the fresh fish market, although a small amount is used for live bait. Currently, the only restriction on catches of white croaker off California is a small no-take zone off Palos Verdes peninsula. In the early 1990s, California's set gillnet fishery was subject to increasingly restrictive state regulations addressing high marine bird and mammal bycatch mortality. This forced the fleet into deeper water where shelf rockfish became their primary target. However, as open access rockfish limits became smaller, there was a shift from targeting shelf rockfish with setnets to the use of line gear in the more lucrative nearshore live-fish fishery. Thus, many fishers that were historically setnet fishers have changed their target strategy in response to increasing restrictions and changing market value.

Pink Shrimp Fishery

Pink shrimp The pink (ocean) shrimp fishery is managed with uniform coastwide regulations by the states of Washington, Oregon, and California. The Council has no direct management authority. The season runs from April 1 through October 31. Pink shrimp may be taken for commercial purposes only by trawl nets or pots. Most of the pink shrimp catch is taken with trawl gear with minimum mesh size of 3/8 inch to one inch between knots. In some years the pink shrimp trawl fishery has accounted for a significant share of canary rockfish incidental catch. Since canary rockfish was designated as overfished, all canary rockfish harvests have been greatly restricted. To reduce bycatch of canary rockfish in the shrimp trawl fishery, the states have mandated the use of finfish excluders.

Pacific Halibut Fishery

Pacific Halibut Pacific halibut harvest levels and gear restrictions are set by the International Pacific Halibut Commission (IPHC), with implementing regulations set by Canada and the U.S. in their own waters. A license from the IPHC is required to participate in the commercial Pacific halibut fishery. Commercial halibut fishers use bottom setline gear; any halibut caught in trawls or traps must be released. The commercial sector off the West Coast, IPHC Area 2A, has both a treaty and non-treaty sector. The directed commercial fishery in Area 2A is confined to south of Point Chehalis, Washington, Oregon, and California. In the non-treaty commercial sector, 85% of the harvest is allocated to the directed halibut fishery and 15% to the salmon troll fishery to cover incidental catch. When the Area 2A total allowable catch (TAC) is above 900,000 pounds, halibut may be retained in the limited entry primary sablefish fishery north of Point Chehalis, Washington (46°53'18" N latitude). In 2001, the TAC was above this level for the first time, and 56% (47,946 pounds) of the allocation was harvested. Area 2A licenses, issued for the directed commercial fishery, have decreased from 428 in 1997 to 320 in 2001.

Salmon Troll Fishery

Salmon Troll The ocean commercial salmon fishery, both non-treaty and treaty, is under federal management with a suite of seasons and total allowable harvest. The Council manages fisheries in the EEZ while the states manage fisheries in their waters (within three nm). All ocean commercial salmon fisheries off the West Coast states use troll gear. Chinook and coho are the principal target species with limited pink salmon landings in odd-years. However, commercial coho landings fell precipitously in the early 1990s and remain very low. Reductions in landings are mainly due to diminished opportunity as salmon populations declined. Many natural salmon runs on the West Coast have been listed under the ESA. Ocean fisheries are managed based on zones which reflect the distribution of salmon stocks and are structured to allow and encourage capture of hatchery-produced stocks while depressed natural stocks are avoided. The Columbia River, on the Oregon/Washington border, the Klamath River in Southern Oregon, and the Sacramento River in Central California support the largest runs of returning salmon.

Spot Prawn Fishery

Spot Prawn Spot prawn, which are targeted with both trawl and pot gear, are state-managed. The prawn trawl fishery is categorized in the groundfish open access (exempted trawl) sector. California has the largest trawl prawn fishery with about 54 vessels operating from Bodega Bay south to the U.S./Mexico border. Standard gear is a single-rig shrimp trawl with roller gear, varying in size from eight-inch disks to 28-inch tires. Washington state is phasing out its trawl fishery by converting its trawl permits to pot/trap permits. Washington also prohibits spot prawn trawlers from landing groundfish to discourage incidental catch. In California, area and season closures for the trawl fleet are implemented to protect spot prawns in the Southern California Bight during their peak egg-bearing months of November through January. These closures, along with the development of ridgeback prawn, sea cucumber, and other fisheries, and also greater demand for fresh fish, have kept spot prawn trawl landings low and facilitated growth of the trap fishery with a live prawn segment. The fleet operates from Monterey Bay - where 6 boats are based - to Southern California, where a 30 to 40 boat fleet results in higher production. In both fishing areas traps are set at depths of 600 feet to 1,000 feet along submarine canyons or along shelf breaks. Between 1985 and 1991 trapping accounted for 75% of statewide landings; trawling accounted for the remaining 25% (Larson and Wilson-Vandenberg 2001). Landings continued to increase through 1998, when they reached a historic high of 780,000 pounds. Growth in participation and a subsequent drop in landings led to the development of a limited entry program, which is still in the process of being implemented. Other recent regulations include closures, trap limits, bycatch reduction measures for the trawl fishery, and an observer program.

California Ridgeback Prawn Fishery

Ridgeback Prawn The ridgeback prawn fishery is managed by the State of California and, similar to spot prawn and pink shrimp, is considered an "exempted" trawl gear in the federal open access groundfish fishery, entitling the fishery to groundfish trip limits. Ridgeback prawns are also managed by state regulation and thus considered an open access (exempted trawl) fishery. Ridgeback prawns occur from Monterey, California to Cedros Island, Baja, California, at depths ranging from less than 145 feet to 525 feet. According to Sunada *et al.* (2001) this fishery occurs exclusively in California, centered in the Santa Barbara Channel and off Santa Monica Bay. In 1999, 32 boats participated in the ridgeback prawn fishery. Traditionally, a number of boats fish year-round for both ridgeback and spot prawns, targeting ridgeback prawns during the closed season for spot prawns and vice versa. Most boats typically use single-rig trawl gear.

The fishery is closed during June through September to protect spawning female and juvenile ridgeback prawns. An incidental take of 50 pounds of prawns or 15% by weight is allowed during the closed period. During the season, a maximum of 1,000 pounds of other finfish may be landed with ridgeback prawns, of which no more than 300 pounds per trip can be groundfish, per federal regulation. Other regulations include a prohibition on trawling within state waters, a minimum fishing depth of 25 fm, a minimum mesh size of 1.5 inches for single-walled codends or 3 inches for double-walled codends and a logbook requirement.

Sea Cucumber Fishery

Sea Cucumber Along the West Coast, sea cucumbers are harvested by diving or trawling. Only the trawl fishery for sea cucumbers, which is also classified as an open access (exempted trawl) fishery, is allowed an incidental catch of groundfish. Sea cucumbers are managed by the states. In Washington, the sea cucumber fishery only occurs inside Puget Sound and the Straight of Juan de Fuca. Most of the harvest is taken by diving, although the tribes can also trawl for sea cucumbers in these waters.

Two species of sea cucumbers are fished in California: the California sea cucumber, also known as the giant red sea cucumber, and the warty sea cucumber. The warty sea cucumber is fished almost exclusively by divers. The California sea cucumber is caught principally by trawling in southern California , but is targeted by divers in northern California. In 1997 the state established separate, limited entry permits for the dive and trawl sectors. Permit rules encourage transfer to the dive sector, which now accounts for 80% of landings. There are currently 113 sea cucumber dive permittees and 36 sea cucumber trawl permittees. Many commercial sea urchin and/or abalone divers also hold sea cucumber permits and began targeting sea cucumbers more heavily beginning in 1997. At up to $20 per pound wholesale for processed sea cucumbers, there is a strong incentive to participate in this fishery.

Coastal Pelagic Fishery

Coastal Pelagic Species (CPS) CPS include northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel and market squid. They are largely landed with round haul gear (purse seines and lampara nets). Vessels using round haul gear are responsible for 99% of total CPS landings and revenues per year. The southern California round haul fleet is the most important sector of the CPS fishery in terms of landings. This fleet is primarily based in Los Angeles Harbor, along with fewer vessels in the Monterey and Ventura areas. The fishery harvests Pacific bonito and tunas as well as CPS. The fleet consists of about 40 active purse seiners averaging 20 m in length. Although these fisheries are concentrated in California, CPS fishing also occurs in Washington and Oregon. In Washington, the sardine fishery is managed under the Emerging Commercial Fishery provisions as a trial commercial fishery. The target of the trial fishery is sardines; however, anchovy, mackerel, and squid are also landed. The fishery is limited to vessels using purse seine gear. It is also prohibited inside of three miles and logbooks are required. Eleven of the 45 permits holders participated in the fishery in 2000, landing

4,791 mt of sardines. Three vessels accounted for 88% of the landings. Of these, two fished out of Ilwaco and one out of Westport. In Oregon, the sardine fishery is managed under the Developmental Fishery Program with annually-issued permits, which have ranged from 15 in 1999 and 2000 to 20 in 2001. Landings, almost all by purse seine vessels, have rapidly increased in Oregon: from 776 mt in 1999 to 12,798 mt in 2001. The number of vessels increased from three to 18 during this period.

The Council manages these fisheries under its CPS FMP. Because stock sizes of these species can radically change in response to ocean conditions, the CPS FMP takes a flexible management approach. Pacific mackerel and Pacific sardine are actively managed through annual harvest guidelines based on periodic assessments. In 2003, the Council established an interim management line for allocation of the annual Pacific sardine harvest guideline. The management line splitting the northern and southern components of the fishery occurs now at Point Arena (~39° N latitude). Northern anchovy, jack mackerel, and market squid are monitored through commercial catch data. If appropriate, one third of the harvest guideline is allocated to Washington, Oregon, and northern California (north of 35°40' N latitude) and two-thirds is allocated to southern California (south of 35°40' N latitude). An open access CPS fishery is in place north of 39° N latitude and a limited entry fishery is in place south of 39° N latitude. The Council does not set harvest guidelines for anchovy, jack mackerel, or market squid.

Highly Migratory Species Fisheries

Highly Migratory Species (HMS) HMS include tunas, billfishes, dorado and sharks. Management of HMS is complex due to the multiple management jurisdictions, users, and gear types targeting these species. Adding to this complexity are oceanic regimes that play a major role in determining species availability and which species will be harvested off the U.S. West Coast in a given year. The states currently regulate the harvest of HMS but the Council is in the process of implementing an FMP for fisheries prosecuted in the West Coast EEZ or by vessels originating from West Coast ports fishing beyond the EEZ. There are five distinctive gear types used to harvest HMS commercially, with hook-and-line gear being most common. Other gear types used to target HMS are driftnet, pelagic longline, purse seine, and harpoon. While hook-and-line can be used to take any HMS species, traditionally it has been used to harvest tunas. Drift gillnet for swordfish, tunas and sharks off California and Oregon is most likely to intercept groundfish, including spiny dogfish and yellowtail rockfish.

Albacore is commonly caught with troll gear. The majority of albacore are taken by troll and jig-and-bait gear (92% in 1999), with a small portion of fish landed by gillnet, drift longline, and other gear. These gears vary in the incidence of groundfish interception depending on the area fished, time of year, as well as gear type. Overall, nearly half of the total landings of albacore (millions of pounds coastwide) were landed in California. Other gear includes pelagic longline, used to target swordfish, shark and tunas; and harpoon for swordfish off California and Oregon. Some vessels, especially longliners and purse seiners, fish outside of the U.S. EEZ, but may deliver to West Coast ports.

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4.0 Impacts of the Alternatives

4.1 Introduction

In this chapter, the potential impacts of the six alternatives, including no action, are analyzed by evaluating seven types of effects required by NEPA: direct and indirect, cumulative, short and long term, and irreversible and irretrievable effects.

Words printed in THIS TYPE are defined in the glossary at the end of this document. Other words are also defined.

Each of the six alternatives would establish a bycatch mitigation program, including mitigation policies and the types of measures that would be used to reduce bycatch and bycatch mortality as much as practicable. Each alternative also would establish the bycatch reporting methodology necessary to support the bycatch mitigation program.

Bycatch mitigation effects fall into four broad categories:

- Avoid catching fish that will not be kept and other animals
- Reduce the mortality of fish and other animals that are caught and released
- Reduce the waste of fish that are caught and are dead or will die as a result of being caught
- Avoid unobserved mortality of fish and other animals that directly results from fishing gear.

The highest priority of bycatch mitigation is to reduce unintended or unwanted capture.

The highest priority of bycatch mitigation is to reduce the capture of any marine plant or animal that is unintended or unwanted. The goal is to harvest desired fish with the minimum impact on all other fish and animals. The second priority is to minimize damage to fish and animals that should or would not be caught in a perfectly selective fishery.

To evaluate the effects and effectiveness of various mitigation tools, it is useful to understand some basic relationships and linkages. The amount of catch of any fish or other animal is related to the amount of effort, the selectivity of the gear, and the number of animals present. To reduce catch, any or all of these three factors can be modified.

Catch is related to the amount of fishing effort, the selectivity of the gear and methods, and species abundance.

The complicated relationships among these factors becomes evident when one considers more than one species at a time. No gear is equally selective for two species because of differences, however small, in species shape, size and behavior. Also, species abundance and distribution are never identical. This means that with any amount of fishing effort, the catch of two species will never be the same. The extent of geographic overlap affects the co-occurring catch, as does the degree of similarity in size and shape.

> This chapter describes fishing gears, non-fishing regulations, potential effects and mitigation tools. Mitigation tools and ranked, then the ranks are applied to the six alternative bycatch management programs. The alternatives are ranked as to how well they achieve the desired results, noting the administrative and user costs associated with each.

We describe the capture methods of the various fishing gears, including selectivity features and placement factors (that is, where and in what conditions can they be used?). We identify non-gear related regulations that can be used, such as harvest specifications, allocation, retention limits, catch/mortality limits, time/are management, and limiting access (reducing fleet size). Collectively, we refer to these management measures as the "mitigation toolbox." Potential effects of each tool are then described. Next we rank the effects and effectiveness of each tool, and then apply those ranks to each alternative. In this stepwise process, we provide the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes.

We describe in some detail the effects of each tool, focusing on effectiveness, cost, collateral/side effects, etc.

Recognizing that each alternative is a combination of objectives, emphasis, and mitigation tools, we then describe the combined effects of each alternative. Synergistic and antagonistic effects are identified and described to the extent possible.

Next, we rank the alternatives as to how well they achieve the desired results, noting the administrative and user costs associated with each.

The emphasis, levels of effects, and degree of impacts on biological and fishing communities vary among the different alternatives. One objective of this analysis is to illustrate this tension and evaluate pros and cons, benefits and costs of each alternative. Impacts of alternatives to groundfish, non-groundfish, ecosystem and habitat, and social/economic environment will be evaluated. As this EIS is programmatic in nature, critical comparative methods will be used. Possible analytical methods that might be used to quantify impacts of more specific plans to reduce bycatch, bycatch mortality, and to improve accountability are described. Cost estimates of alternative monitoring programs, where available, are provided.

4.1.1 How this Chapter is Organized

How this chapter is organized

Section 4.1.2 describes the critical comparative methods used to analyze the effects of the various bycatch mitigation tools and the six alternatives. Section 4.1.3 identifies the available mitigation tools, and Section 4.1.4 describes the effects and effectiveness of the tools. The effects and effectiveness of each tool are ranked, and then ranks applied to each alternative. In this stepwise process, we provide the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes.

This chapter outlines the tools available and general impacts of their application. The methods used to evaluate alternatives are described next. Each alternative is presented with corresponding tools used to mitigate for bycatch, bycatch mortality, and to address bycatch accountability. Direct and indirect effects are described in Sections 4.2 through 4.11 Impacts to ecosystem and biodiversity are outlined in section 4.2. Impacts of the six alternatives are described in section 4.3. Detailed effects of alternatives on groundfish are contained in Appendix B. Section 4.5 summarizes impacts of each alternative proposed monitoring program. Section 4.6 summarizes impacts to the biological environment. Section 4.7 describes socioeconomic impacts. Effects on catch and bycatch distribution are discussed in section 4.8. Cumulative effects are summarized in section 4.9 and irreversible and irretrievable effects are discussed in Section 4.10. Finally, impacts to management and environmental management issues are discussed in section 4.11.

4.1.2 Description of Critical Comparative Methods Used

Fishing has both intended effects (catching desirable fish) and unintended effects. The costs and benefits of these effects can rarely be measured or evaluated precisely, and are often subjective, based on the perspective of the observer. Bycatch and bycatch mortality of living resources are unintentional side effects of fishing; they can be viewed as collateral damage to other living marine resources. These effects can broadly be described as direct effects, indirect effects, and cumulative; short-term and long-term; reversible and irreversible. Some effects equate to irretrievable costs, meaning permanent change that cannot be undone, or would require such a huge investment that attempted retrieval/correction would be futile.

Fisheries data reporting and monitoring are human activities to determine the effects of fishing activities. Some can be accomplished by the fishers themselves; other monitoring is most effectively done by professionals trained in data recording and/or monitoring. Often it is impossible for the fisher or vessel crew to perform both fishing activities and data activities simultaneously; it requires additional manpower. Some data collection and monitoring can be done on shore, some can only be done at-sea. Enforcement programs are also an element of an effective management plan.

The fishery management tools chosen to mitigate intentional and unintentional effects of fishing, such as bycatch and bycatch mortality, are compared for each alternative. In addition, different approaches to fishery monitoring used to estimate total catch and improve accountability are compared.

The following steps will be used to evaluate the tools and alternatives that use them:

- **Identify bycatch factors** - Bycatch and bycatch mortality are the products of several factors related to stock status, past and present management strategies, fishing strategies, fish behavior, and other biological characteristics. In combination, these factors make fish more or less vulnerable to bycatch and bycatch mortality. Key bycatch issues for each species are identified at the beginning of each species section.
- **Rationalize mitigation effect** - Each tool has a way of reducing bycatch, bycatch mortality, or improving accountability. Where possible, direct and indirect effects for different tools are justified or rationalized. Rationale is based on literature, case studies, and testimony of experts familiar with bycatch issues. Rationale for a tools effect in reducing bycatch and bycatch morality, and in improving accountability are summarized in Tables 4.1.1 and 4.1.2.
- **Identify direct and indirect effects by bycatch issue, and species impacted for various tools** - Application of different management tools has the potential of reducing bycatch in different ways. Table 4.1.3 lists some of the ways bycatch may be reduced by particular applications of tools. Bycatch and bycatch mortality reduction

strongly and directly affected by the tool are indicated by 'D'. A lesser but still indirect effect is indicated by 'd'. Likewise, strong or less pronounced indirect effects are indicated by 'I' or 'I' , respectively.

- **Rank effects of tools and alternatives -** Some tool alternatives are explicit in terms of level of effect anticipated. If a tool/alternative can reasonably be expected to have significant impact compared to status quo, it would be ranked higher than status quo. If a tool/alternative has a significant impact compared to status quo and another alternative it would be ranked higher than status quo and the other alternative. Significance performance of an effect is justified based on evidence provided in literature, reports, or expert opinion. This EIS describes methods that could be used to quantify measures where possible.
- **Rank effects of approaches used to improve accountability -** Data reporting, recordkeeping, and monitoring approaches are also evaluated for each alternative. The tools and potential effects on improving accountability are identified in Table 4.3.1. Each alternative is then ranked at to its relative effect at improving a particular bycatch accountability issue (Table 4.3.2)
- **Summarize cumulative and indirect effects.**
- **Rank tools and alternatives -** Mitigation effect, rational, and scores are summarized for tools within each alternative and between alternatives. First tools are ranked by alternative as to their relative ability to reduce bycatch, bycatch mortality, and improve accountability (Table 4.4.1). A lower number indicates better ability to reduce bycatch or improve accountability. Ranking includes summary effects of different monitoring approaches used by each alternative. Next, each alternative is ranked as to its relative effect at addressing a particular bycatch issue (Table 4.4.2). Relative ease of enforcement and anticipated compliance costs are ranked for each alternative as well.

4.1.3 Bycatch Mitigation Tools

BYCATCH MITIGATION TOOLS
The Mitigation Toolbox

Harvest Levels
- ABC/OY
- sector allocations
- trip (landing) limits
- catch limits
- individual quotas

Gear Restrictions
- **Trawl**
  - mesh size
  - footrope diameter/length
  - net height
  - codend mesh and dimensions
  - design: on-bottom or pelagic
  - bycatch reduction devices (BRDs)
- **Line**
  - number of hooks
  - hook size
  - line length
  - retrieval requirements
- **Pot/trap**
  - number of pots
  - pot size
  - escape panel in net/pot
  - retrieval requirements
- **Other**
  - setnets (gill and trammel nets)

Time/Area Restrictions
- seasons
- area closures
- depth closures
- marine reserves

Capacity (number of participants)
- permits/licenses/endorsements
- limited entry

Capacity (Vessel Restrictions)
- vessel size
- engine power
- vessel type

Monitoring/Reporting Requirements
- permits/licenses
- registrations
- Fish tickets (commercial landings/ sales receipts)
- Vessel logbooks
- Surveys
- Punch cards/tags (recreational)
- Port sampling/on-shore observers
- On-board observers
- Vessel monitoring systems (VMS)
- Onboard video recording devices
- Enforcement

Management measures, referred to here as mitigation "tools," are the rules and requirements to control the fishing activities and to mitigate the effects of fishing on the fishery resources and other components of the natural environment. Management measures are the tools used to achieve the goals and objectives of a management program. In the context of this EIS, they are the means for reporting, monitoring, and reducing bycatch and bycatch mortality. Their purpose is to contribute to achievement of the bycatch management strategy.

Establishing Definitions to Characterize Management Strategies

In analyzing the utility, effects and effectiveness of various management measures, it is necessary to understand the cause and effect relationships as well as the linkages between tools, toolboxes, objectives, policies and goals. Tools and toolboxes are most easily described by their function, along with a specific vocabulary for function-related characteristics. For example, we can describe a wrench as a tool used to tighten or loosen nuts. Although it could also be used to pound, pry, and dig, it does not do those activities as effectively as other tools would. Similarly, we can describe a hammer as a tool used to pound nails, flatten metal, align parts, and separate attached components. Combined with a chisel, it can be used to shape objects. Incorrect or careless use of a hammer or management tool can result in unintended results; thoughtful or imaginative use can result in several desired effects simultaneously.

Description of Bycatch Mitigation Tools

Description of Bycatch Mitigation Tools

The primary components of a fishery that can be "managed" are gear, vessels, harvest levels, times and areas fished, and capacity (number of vessels and potential effectiveness of those vessels). Other management tools include monitoring/ reporting requirements. Bycatch mitigation tools, or measures, are the means used to manage these components. The following is a description of the different tools.

Harvest Level Specifications: ABCs, OYs and Allocations

Harvest Level Specifications: ABCs, OYs and Allocations Groundfish harvest specifications are the first level of conservation and management to ensure that harvest stays within sustainable levels. Harvest specifications are typically set annually[1/] and are based on stock assessments whenever possible.[2/] Rigorous scientific procedures are followed throughout the stock assessment and harvest specification process, including adjustments to mitigate for uncertainty in available data, models and other factors. Briefly, where enough information is available to prepare a quantitative biomass assessment, a harvest rate is applied to the best estimate of current stock abundance, taking into account age structure of the population, anticipated reproduction in future years, and other information on stock condition. The baseline harvest rates differ among species and species groups to compensate for differences in productivity, growth and mortality rates, longevity and other critical demographic factors. The baseline harvest rate for each species is the best scientific estimate of the harvest rate if the stock were at the population size that would create its MAXIMUM SUSTAINABLE YIELD (MSY). The best estimate of the MSY harvest rate is called "F_{MSY}" and is usually expressed as a percentage (for example, $F_{45\%}$). Harvest rates for rockfish are lower than harvest rates for more productive species such as Dover sole and other flounders. The F_{msy} is multiplied times the current BIOMASS estimate ("B") to calculate the ACCEPTABLE BIOLOGICAL CATCH (ABC).

[1/] The Council is considering (in 2003) an FMP amendment to create two-year harvest specifications.

[2/]The stock assessment process is described in detail in the groundfish FMP and SAFE documents. Comprehensive stock assessments have been prepared for only about 20 species due to data limitations. In some cases, harvest specifications are based on historical harvest levels.

Next, the harvest control rule requires calculation of the OPTIMUM YIELD (OY) for the stock. OY, as defined in federal regulations at 50 CFR 660.302, means "the amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and, taking into account the protection of marine ecosystems, is prescribed as such on the basis of the maximum sustainable yield (MSY) from the fishery, as reduced by any relevant economic, social, or ecological factor; and, in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the MSY in such fishery." An OY may be numerical or non-numerical. The default formula for calculating OY is described in detail in the FMP and SAFE document, and is commonly referred to as the "40-10" OY adjustment. It reduces the harvest of any stock that is currently smaller than 40% of its estimated pristine (unfished) size. Any stock smaller than 25% of its estimated unfished size is classified as OVERFISHED, which requires that OY be set to quickly rebuild the stock to its MSY biomass.

OY can apply to total catch of a single species or species group; it can apply throughout the entire region or to smaller management areas. Estimated bycatch (discard) levels are also taken into account so the best estimates of total catch do not exceed the intended levels.

In some cases, the calculated OYs of species in an assemblage are out of proportion with the typical catch ratios in the fishery. This is especially true in assemblages that include overfished stocks. In those cases, harvest rates for abundant stocks may need to be restricted in order to protect the weak stock(s). In such cases, the OY for an abundant stock may be reduced to reflect the expected smaller harvest.

OY can be subdivided and allocated to sectors of the fishery. Numerical OYs are typically allocated among Tribal, recreational and commercial fisheries. The commercial allocation is typically further subdivided between the limited entry and open access sectors. In a few cases, most notably sablefish and whiting, a limited entry allocation may be further subdivided.

Trip limits, Bag limits, and Catch Limits

Trip Limits, Bag Limits, and Catch Limits

Trip limits are retention and landing limits (by species or species complex) that apply to individual commercial fishers, vessels, permits, gear groups, or other defined groups in a given area for a given period of time. Bag limits are the equivalent for recreational fishers. Any groundfish captured beyond a specified trip or bag limit are classified as bycatch (if discarded) or a violation (if retained). Trip and bag limits, as they have traditionally been applied, do not require fishers to stop fishing when the specified limit has been reached. As long as the fisher/vessel does not retain more fish than the limit, additional fishing is allowed. The intention and trip and bag limits is to remove the incentives to catch more fish. Any fish beyond the limit must be released or discarded, even if it is dead. This creates an incentive to avoid catching the fish; or, conversely, a level of disincentive based largely on the cost of sorting and extra handling or a feeling of being wasteful. The incentive/ disincentive is not a specified monetary amount, and is not equal in all individuals. On the other hand, failure to release or discard excess groundfish (or other species) is a fishing violation. Each fisher has (potentially) the same monetary incentive to discard, which may be stronger than the incentive to avoid catching.

Trip limits and bag limits refer to the amount of fish that may be kept; they are intended to discourage further fishing, but do not prohibit continued fishing. Any additional fish caught must be released/discarded. All those fish are bycatch.

Over the years, the Council and NMFS have revised the definition and use of trip limits, partly in response to fishermen's concerns about discard and waste of useable fish. Fishers and managers realized that wastage would occur and, as a policy decision, the FMP acknowledged a level of discard was inevitable and acceptable. This was reflected in the definition of OY, which included only those fish that could be captured and retained under the gear and retention limits adopted each year. The public ethic has changed over the years, as reflected in the 1996 Sustainable Fisheries Act mandate to minimize bycatch to the extent practicable.

Initially, trip limits were designated as per-trip limits, and sometimes the number of trips was also restricted (for example, not more than one trip per week might be allowed).

Catch limits or fishing mortality limits are very different from trip limits!

Catch limits, on the other hand, restrict the amount of fish that may be *caught*, whether landed or discarded. Catch limits require fishers to stop fishing when a limit is reached. Catch limits have not been used in the federal groundfish management program.

INDIVIDUAL QUOTAS (IQS)**,** sometimes referred to as INDIVIDUAL FISHING QUOTAS or IFQS, are a tool that can be set up to be driven by market/economic incentives. IQs can be allocated to an individual, group, corporation, or vessel. IQs can be transferable ("ITQs") or non-transferable. They can be based on a share of the total OY, or a specified amount of fish. They can grant ownership, or grant an opportunity to catch.

IQs can be defined as landing limits or as catch limits. If they are applied as catch limits, fishermen still have the option to discard unwanted fish, but those fish would count against their quota. This would increase the incentive to keep the fish rather than use them as bycatch. It would also mean the quota holder would have to stop fishing immediately or acquire additional quota share.

It may be useful to distinguish between species based on stock status or other factors. For example, overfished species would likely be more restricted than healthy stocks. A designation such as RESTRICTED SPECIES QUOTA ("RSQs") might be useful to distinguish from prohibited species. IQs or catch limits applied to prohibited species are typically called PSC limits or caps.

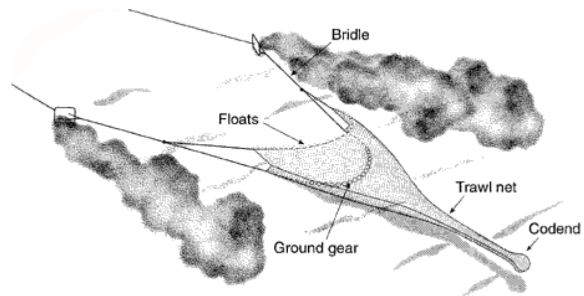
Gear Definitions and Restrictions

Gear Definitions and Restrictions

West Coast groundfish fishermen are allowed to use 4 basic gear types to catch groundfish: trawls, hook-and-line, traps ("pots"), and, in part of California, set nets. (Recreational fishers may also use spears.) These gears are described in detail in **Appendix B**, which includes detailed diagrams. These gears capture fish in different ways, and fishermen know how their gear catches fish, what types of fish the gear catches better, and how to best operate the gear to maximum advantage. Every commercial fisherman's intent is to catch fish to make money, and each has an idea of how to make more money at less cost. Catching unwanted species creates costs of sorting the wanted from the unwanted. Fishing in an area with many seafloor hazards can increase costs through damaged or lost gear; refining the gear by adding protective components or "tuning" it can reduce the risks. Gear definitions, requirements and restrictions can be effective in achieving some management objectives, often at the expense of harvest efficiency. Much of the history of fishing and fishery management is the result of fishermen's efforts to improve their catching efficiency and management trying to reduce their efficiency.

Trawl

West Coast commercial fishers use a variety of otter trawl types. This diversity of gear types is a result of the diversity of fisheries (fishing strategies) and bottom types in the region. The specific gear design used is typically a result of the target



species complex (whether they are on the seafloor or higher in the water column) and whether the seafloor is smooth or rough, soft or hard.

Otter trawls are not just simple sieves used to collect everything in their path; they are actually very complex systems designed to target specific types of fish in specific conditions. Trawl gear has several components, including the doors (otter boards), bridles, footrope ("ground gear"), and the net body, including the codend. Trawl doors can be of various sizes and designs to match the target strategy and net. Their purpose is to help sink the net to the desired depth, hold the "mouth" open, and help move fish towards the net. Bridles connect the doors to the net and can be chain, bare wire, or covered wire. The footrope is attached to the bottom front of the net and can include chain-wrapped wire, rubber cookies, rollers, bobbins, and tickler chains.

Bottom trawls are designed to capture fish that are on or near the seafloor, such as flatfish (flounders). Fish herding is an important aspect of trawl design and depends upon the hydrodynamic forces of the doors and the sediment clouds generated by the ground rigging and footrope. In bottom trawls, the footrope is designed to get the fish up off the bottom. The net body can vary based on the head rope height, the amount of overhang, and the mesh sizes of the various net panels. The top of the net typically has floats attached to help hold it open. The doors, ground rigging behind the doors, and the footrope can come into contact with the seafloor. With the exception of the doors, trawl gear must be relatively light on the bottom to maintain its shape and effectiveness. The net itself typically does not drag along the bottom but may sometimes contact the seafloor, especially when there are obstructions. Chafing gear, a protective covering fastened to the underside to prevent abrasion, tearing, and other damage, may be attached to protect the underside of the net from snagging and tearing.

In a "cutback" trawl, the floats are behind the footrope (ground gear) or the top of the net above the footrope is constructed of wide meshes (or open) so that any fish can escape by swimming upward. This type of net is being tested for its ability to avoid rockfish, which typically are slightly off-bottom or swim up when frightened. Flatfish tend not to swim as far upward, and therefore may not escape as readily.

Midwater (pelagic) nets are used to target Pacific whiting. Smaller mesh (3 inch minimum) is used, compared to 4½ inch mesh used for bottom trawls. Prior to about 1987, midwater nets used for whiting were smaller than those typically used since then. Midwater nets use the doors, bridles, and large mesh to herd fish towards the codend, rather than sediment clouds, and typically do not come into contact with the seafloor.

Bycatch reduction devices are typically not used in West Coast groundfish trawls but are used by groundfish trawlers in Alaska (to reduce bycatch of Pacific halibut) and by West Coast shrimp and prawn trawlers (to reduce groundfish bycatch).

Potential tools to mitigate trawl gear bycatch

Potential tools for mitigating trawl gear bycatch address several components of a typical trawl that address selectivity and/or placement: mesh size, type of footrope, net size and shape, chafing gear, type or design (on-bottom or off-bottom/pelagic), and use of bycatch reduction devices (BRDs).

<u>Mesh size</u> - The size and shape of a net's mesh are related to the size and shape of fish it will capture, and these can be adjusted to select for fish of different sizes and shapes. Larger mesh increases the chances for small fish to escape. Smaller trawl mesh catches more small fish along with the larger fish. Mesh selectivity can never be perfect, but much research over the years has been conducted to improve the catching efficiency and selectivity of trawl gear. For the past several years, regulations have specified 4½ inches as the minimum mesh size in West Coast groundfish bottom trawls and 3 inches minimum in midwater trawls. The minimum mesh size in bottom trawls was increased in the early 1990s from 4 inches to 4½ inches to increase escapement of small fish, especially those below marketable size.

Potential tools to mitigate trawl gear bycatch

Footrope diameter- The footrope of a bottom trawl is line along the bottom front edge of the net that contacts the ocean floor. The footrope is important in making sure the trawl stays in contact with the seafloor but does not dig into the mud or snag on rocks or other structures. The diameter of the footrope can be increased by attaching rollers or bobbins; larger diameter footropes tend to move over the seafloor more smoothly and easily. Larger diameter footropes allow trawls to be used in areas where the seafloor is rough, such as rock piles. Without the protection of large rollers, trawls cannot be fished effectively in those areas. This relationship between footrope diameter and fishing location has been used since 2000 to reduce trawl fishing in rocky areas where overfished rockfish tend to be concentrated. Based on an industry proposal, the Council and NOAA Fisheries reduced trip limits for most species for vessels that used footropes over 8 inches in diameter. This would reduce trawl encounters with fish species in rocky ("high relief") areas, especially on the continental shelf.

Trawl size/configuration - Trawls range in size from relatively flat, small, bottom trawls to very wide, tall midwater trawls. The catching capacity of a trawl is related to the dimensions (width and height) of the net; a small net cannot catch as much as a large net. One way to reduce catching capacity would be to limit net size. This could be accomplished by restricting the maximum length of the footrope, which must match the width of the net.

Taller nets cover more of the water column; in bottom trawls, they tend to catch species (such as some rockfish) that hover above the bottom or try to escape upwards. Trials with flatter nets are being conducted to see if rockfish can be avoided.

The size of the codend is related to the amount of fish that can be captured and held at any one time. In the early years of the whiting joint venture fishery (e.g., with the USSR and Poland), the processing ships produced fillets and headed/gutted products. Both the size of deliveries and the rate of delivery were controlled to match the processing rates. Production rates were limited by the equipment to prepare these products, and bruised, crushed whiting were too difficult to cut. American catcher vessels were required to make small deliveries using relatively small codends (compared to those used later by vessels delivering to processing ships that produced surimi). In

Potential tools to mitigate trawl gear bycatch

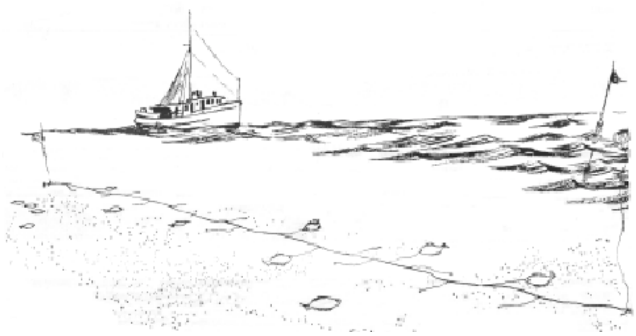
an attempt to keep the high-volume surimi operations out (in order to maintain a longer season), some U.S. fishers proposed setting a limit on the size (volume) of codends that could be used. The suggested regulation was not approved for several reasons including the allocative effects and impact on economic efficiency. Effects of small trip limits, need for reduced harvest of overfished stocks, and bycatch reduction requirements may provide justification to consider adoption of size restrictions for bottom trawls.

<u>Chafing gear</u> - Chafing gear is used to protect the underside ("belly") of the net, including the codend. They types of material are restricted by regulation to prevent chafing gear from reducing the effectiveness of minimum mesh regulations (i.e., reducing selectivity). Currently (2003), further restrictions are placed on chafing gear in conjunction with the small footrope requirement to reduce the use of trawls in rocky, rough-bottom seafloor areas.

<u>Bottom versus pelagic</u> - Bottom trawls and pelagic/midwater trawls have different uses and selectivities that can be used to achieve certain bycatch reduction objectives. For example, a requirement to use pelagic trawls (which must have unprotected footropes and no chafing gear) would greatly reduce the encounter with animals that live on or in the seafloor. However, the use of large midwater nets could increase the encounter rate with pelagic species that should be avoided.

<u>Bycatch reduction devices (BRDs)</u>- Bycatch reduction devices, as they apply to trawls, are mechanisms that guide or force unwanted species or sizes out of the net and reduce the likelihood they will be captured. They are gear selectivity devices. BRDs have been effective in reducing catches of halibut in certain groundfish trawl fisheries in Alaska. BRDs are also used in other regions to mitigate trawl bycatch of turtles, finfish and other animals. In particular, they are used in West Coast trawl fisheries for pink shrimp and prawns to reduce bycatch of canary and other rockfish. Often BRDs reduce catch rates of the target species, but in some cases fishers can improve gear performance with experience and practice. BRDs have not been required in the West Coast groundfish trawl fishery. However, development of effective rockfish excluder devices could result in increased catches of other species.

Hook-and-Line



West Coast commercial and recreational fishers use a variety of hook-and-line gears. This diversity of gear types is a result of the diversity of fisheries (fishing strategies) and species in the region. The specific hook-and-line gear design used is typically a result of whether the target species or species complex lives on the seafloor or higher in the water column and whether it is sedentary or mobile. Many commercial groundfish vessels are included in the federal groundfish limited licence program for stationary (fixed) longline gear. Another name for this is setline gear. Vessels typically fish this gear along the ocean floor for sablefish (blackcod) and/or Pacific halibut, but may take other groundfish and non-groundfish species also.

Other hook-and-line gears are considered "open access" which means any commercial fisher (including limited entry vessels) may use them in accordance with state or federal regulations. (Fixed longline gear may also be used by any commercial groundfish vessel, but harvest levels are restricted). Some hook-and-line gear is pulled (trolled) through the water; other longline gear extends from the surface towards the bottom and may drift with the current. Rod and reel is included in the hook-and-line category; this is the typical recreational gear type.

Potential tools for mitigating hook-and-line gear bycatch include the number of hooks, whether the gear is stationary ("fixed"), pulled (trolled) or free-drifting, the type and size of hooks, how the fixed gear is marked/labeled, maximum length of the line, and how long it may be left unattended. In addition, bycatch reduction devices (BRDs)can reduce bycatch of seabirds.

<u>Number of hooks</u> - For the recreational fishery, limits on the number of hooks been used to reduce the potential catch of overfished rockfish that must be avoided. However, it is recognized this is not a selective method to protect any particular species, but rather it reduces the potential catch of all species that might be taken. It may be used in combination with other restrictions, such as the amount of weight that may be attached to the line, and the number of fishing rods an individual may use.

Potential tools to mitigate hook-and-line gear bycatch

<u>Stationary (setline) versus mobile gear</u> - Mobile gear is being defined here as all hook-and-line gear that is not anchored at both ends, and it includes a variety of configurations. The distinction is used primarily for setting separate trip limits for limited entry and open access sectors. However, these gears often have substantially different selectivity and applicability. For example, setline gear cannot be effectively used to catch many pelagic (off-bottom) species. It can be fished throughout the water column and need not contact the seafloor, although some mobile line gear does contact the bottom (for example, “dingle bar” gear typically is bounced along the seafloor). Vertical longlines (sometimes called “Portuguese” longlines) are multi-hook lines, weighted at the bottom, that hang vertically from a vessel or a float, drifting with the current. “Fly” gear is trolled nearer the surface. Also, a variety of hook-and-line gear is used to catch nearshore (shallow water) groundfish and other species for the “live fish” market.

<u>Type and size of hooks</u> - Hook size and type can affect selectivity. For example, commercial sablefish fishers now use “circle hooks” because they tend to retain more fish and to hook the fish more in the “lip” rather than deeper in the mouth. In earlier years, the “J hook” was the primary gear. The use of small hooks can increase selectivity for small-mouth fish (such as sand-dabs, a type of flatfish) and avoid larger-mouth rockfish. Also, barbless hooks are required in some (non-groundfish fisheries) to improve survival of fish that must be released. Where the species suffer from BAROTRAUMA (pressure change), barbless hooks have little utility.

<u>Gear marking (identification) requirements</u> - Federal regulations require fixed-longline gear be clearly and visibly marked at both ends with the vessel or fisher’s identification and with a flag, radar reflector, etc. (Other line gears do not have this requirement because they are not left unattended.) Marking requirements serve both a safety and enforcement function. The safety requirement is that the gear be marked so it does not present a navigation hazard (collision or entanglement). The identification is so the owner of any lost or illegal gear can be identified. These requirements have little if any affect on bycatch other than to aid in recovery of lost gear.

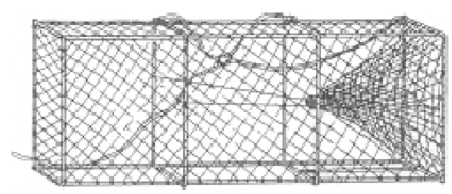
<u>Gear retrieval requirements</u> - Baited setlines continue to fish as long as any hooks remain baited. At the end of the fixed-gear sablefish season, vessels may be required to “stop fishing” at a specific time. Retrieving gear is a fishing activity, so a “stop

Potential tools to mitigate pot gear bycatch

fishing" order means any gear must be left in place. Typically, after a specified period of time, the gear may be retrieved, although it may be necessary to release any fish. Any fish that must be released are considered bycatch. To prevent excessive bycatch of this type, gear must be retrieved within a specified period of time, unless the vessel is incapable of retrieving it (for breakdown, weather or safety reasons).

Bycatch reduction devices (BRDs) - Bycatch reduction devices, as they apply to longlines, are devices that deter seabirds from chasing baited hooks as the gear is set. Thus, the BRDs reduce the likelihood seabirds will be killed. This is particularly important for listed species such as short-tailed albatross. Seabird deterrents devices have been effective in reducing seabird bycatch in Alaska groundfish longline fisheries and Pacific Ocean pelagic longline fisheries. BRDs have not been required in the West Coast groundfish longline fishery. While seabirds are technically not fish, and therefore cannot be bycatch as defined in the Magnuson-Stevens Act, there are legal and moral reasons groundfish fishers should avoid catching them.

Pot/Trap
The words "pot" and "trap" are used interchangeably to mean baited cages set on the ocean floor to catch various fish and shellfish. They can be circular, rectangular or conical and may be set out individually or fished in strings. All pots contain



entry ports that allow fish to enter. Current regulations require that all pots used for groundfish must have biodegradable escape panels or fasteners that are intended to disable the trap if it becomes lost or abandoned. This requirement is intended to prevent "ghost fishing." Individual groundfish pots must be marked at the surface; strings of pots must be marked at each terminal end with a pole and flag and a light or radar reflector.

Traditionally, groundfish pots have been used on the West Coast primarily to target sablefish. Commercial groundfish pot gear is included in the federal groundfish limited licence program for stationary (fixed) gear. Vessels typically fish this gear along the ocean floor for sablefish. Pots are also considered an "open access" gear, which means any commercial fisher (including limited entry vessels) may use them in accordance with state or federal regulations. Trap gear is also used to target live fish.

Potential tools to mitigate pot gear bycatch

Potential tools for mitigating pot bycatch include size and shape, mesh size, number of pots, how the gear is marked/ labeled, requirements to prevent "ghost fishing" if the trap is lost, and how long gear may be left unattended (retrieval time requirements).

<u>Size and shape</u> - Larger pots potentially can capture and hold larger numbers of fish, but typically would not affect the species mix. Setting a maximum pot size would thus not affect selectivity but would affect harvest capacity. There are no pot size restrictions at this time.

<u>Mesh size</u> - The mesh size of a trap is related to the size of fish the trap will retain. Mesh size can be adjusted to select for fish of different sizes. Larger mesh increases the chances for small fish to escape. Smaller trawl mesh catches more small fish along with the larger fish. There are no mesh size restrictions at this time.

<u>Number of pots</u> - A maximum number of pots an individual fisher or vessel may use can be specified. The effect of "pot limits" is to reduce individual and/or fleet capacity. This can be useful in highly overcapitalized fisheries to slow the pace of the "race for fish" and to reduce bycatch during closed seasons (for example, after the season closes). There are no pot restrictions at this time.

"<u>Escape panels</u>" - Escape panels create an opening in the pot to allow fish to escape. This is important because a pot can continue to "ghost fish" as long as it remains in the water. The size of the opening can be regulated, as can be the material that creates the opening. For West Coast groundfish, the federal regulation specifies the use of biodegradable twine that should disintegrate if the pot remains in the water too long.

<u>Gear marking (identification) requirements</u> - Federal regulations require that groundfish pots must be clearly and visibly marked at both ends with the vessel or fisher's identification and with a flag, radar reflector, etc. (Other line gears do not have this

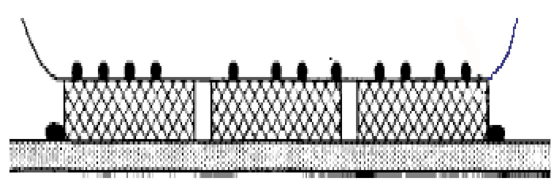
requirement because they are not left unattended.) Marking requirements serve both a safety and enforcement function. The safety requirement is that the gear be marked so it does not present a navigation hazard (collision or entanglement). The gear identification is so the owner of any lost or illegal gear can be identified. These requirements have little if any affect on bycatch other than to aid in recovery of lost gear.

Gear retrieval requirements - Baited pots continue to attract and catch fish as long as they maintain their structural integrity. At the end of the fixed-gear sablefish season, vessels may be required to "stop fishing" at a specific time. Retrieving gear is a fishing activity, so a "stop fishing" order means any gear must be left in place. Typically, after a specified period of time, the gear may be retrieved, although it may be necessary to release any fish. Any fish that must be released are considered bycatch. To prevent excessive bycatch of this type, gear must be retrieved within a specified period of time, unless the vessel is incapable of retrieving it (for breakdown, weather or safety reasons).

Unbaited pots may also attract fish because they may provide "structure." Pots left on the grounds after the end of the season will continue to ghost fish unless they are de-activated by leaving an open escape route such as an open door or escape panel. Any fish left in a closed trap eventually die and become bait for other fish. By requiring that pots be removed soon after the end the season, this can be minimized.

Setnets are not legal groundfish gear north of 38° N latitude (near San Francisco, California)

Setnet (Gill and Trammel Nets)



[The Groundfish FMP recognizes setnets as legal groundfish gear only in California south of Point Reyes (near San Francisco). Regulations controlling their configuration and use are implemented by the State of California. Drift nets are not legal gear for taking groundfish. Potential management tools are listed below but are not described.]

Setnets are flat, rectangular nets that hang vertically in the water from a buoyed cork line and weighted along the bottom with a lead line. Setnets must be anchored, and they hang fairly vertically in the water column. They tend to bulge under the effect of currents. The nets are intended to be slack rather than taught, because fish swimming into a taut section of webbing tend to bounce away rather than become entangled. Nets are made of a lightweight multi-filament nylon or monofilament strands with certain specific mesh sizes to select the catch. Mesh size of gillnets is selected so the heads of the desired fish go through the mesh, but their bodies do not. When a fish tries to escape it tends to become entangled in the net.

A **trammel net** is a net made with two or more walls joined to a common float line. The inner net is made of smaller mesh and hangs deeper than the outer webbing. Fish pass through the outer webbing, strike the inner webbing and carry through to the larger webbing on the opposite side. Fish thus become trapped in the pocket formed by the intertwined webbing.

Potential tools for mitigating setnet bycatch include mesh size, size (height and length), number of panels, how the gear is marked/labeled, how long gear may be left unattended, and where it may be used.

Time/Area Restrictions (Closures)

Time/Area Restrictions (Closures)

Closures, as a management tool, have both a spatial (area) and temporal (time) dimension. Some area closures are long term to address a long term problem or condition. Examples of this would be to protect areas with special habitat, historical significance, or scientific or other value. Marine reserves are an example of a long-term area closure where all or certain activities may be restricted, depending on the objective and designation. Short term closures may be for an entire region (such as a season) or for a more localized area (such as a spawning area to protect eggs and/or young when they are present).

In recent years, area closures based on depth contours have been used to reduce the likelihood certain overfished groundfish species might be caught. This approach may be especially effective for species (cowcod, for example) that are relatively sedentary, that move only short distances. Often, however, juveniles concentrate at different depths or habitats than adults, and in some cases may be caught in different fisheries or by different gear types. Some species migrate seasonally; a permanent area closure would have to consider the entire migratory range, while a seasonally-adjusted or moving closure might provide a similar degree of protection while allowing greater fishing opportunities for other species. Also, where multiple species are in need of protection, the individual distributions must be taken into account.

NMFS regulatory guidance on EFH suggests time/area closures as possible habitat protection measures. These measures might include, but would not be limited to: closing areas to all fishing or specific equipment types during spawning, migration, foraging, and nursery activities; and designating zones for use as marine protected areas to limit adverse effects of fishing practices on certain vulnerable or rare areas/species/life history stages. To the extent that such an identified species or assemblage is taken as bycatch in the groundfish fishery, area closures may be an effective bycatch reduction approach.

Capacity Limits

Capacity Limits

Capacity limits are used to restrict access to the fish resource. Tools to limit capacity include permits and licenses and are intended to restrict the number of participants in a fishery. (They also serve as a mechanism to monitor participation in the fishery.) "Fishing power" is also a measure of capacity that is managed with the use of gear restrictions and other tools. Permits and licenses can be used in a number of ways to limit capacity. A permit can specify the type of vessel or gear that may be used, the amount of fish that may be caught or retained, or who may do the fishing. That is, permits can apply to vessels, gear or fishers, and the number of permits can be limited. Once the number of permits has been limited, it may be necessary to further reduce the number of participants in the fishery. This can be accomplished through a "buyback" program, by the government cancelling or revoking permits, or by requiring participants to obtain multiple permits (for example, buying them from other fishers/vessels or joining into cooperatives).

A trawl buyback program is under consideration and development at this time. See the 7/18/03 *Federal Register* "Final Notice on Fishing Capacity Reduction Program for Pacific Coast Groundfish Fishery" for further information.

Vessel Restrictions

Vessel Restrictions

Restrictions on the type, size and/or power of a fishing vessel can be used as a management tool, typically to address fishing capacity. In the West Coast groundfish fishery, only vessel length is restricted. Vessel restrictions in themselves often have limited effect on capacity or "fishing power," and many potential vessel restrictions are rarely used because they are easy to circumvent. Combined with other tools, they may be an effective means of achieving a particular management goal, although the effectiveness may be difficult to predict.

Monitoring/Reporting Requirements

Monitoring/Reporting Requirements

Monitoring and reporting requirements are essential fishery management tools. Without monitoring and reporting, there is no effective measure to either ensure compliance with the tools used or to determine if the bycatch mitigation tools have been effective. Monitoring and reporting tools include permits/licenses, registration, fish tickets, logbooks, port sampling/onshore observers, on-board observers, vessel monitoring systems (VMS), onboard video recording devices, surveys, punch cards/tags, and enforcement activities. The current federal reporting requirements include permits/endorsements for the limited entry sector of the commercial fleet, reporting requirements for the at-sea whiting fleet (catcher/processor and mothership/processor vessels), an onboard observer (scientific data collection) program, and a VMS program expected to begin in 2004. Federal licenses are not required for the commercial open access sector or for the recreational sector. The current fish ticket and commercial logbook reporting requirements are conducted by the states.

Permits/licenses/endorsements - Permits and licenses confer permission to conduct specified activities. For fisheries, they may be a registration of vessel or gear, species, amounts, etc. There may or may not be a limited number of licences/permits available, and there may or may not be a cost to obtain them. In the groundfish fishery, trip limits apply to vessels rather than to permits. Endorsements are added to permits to provide specific conditions or permissions. For example, each limited entry permit includes a vessel length and gear endorsement. Also, a sablefish endorsement was created to identify those longline and pot vessels eligible to participate in the "open season" and the amount of sablefish they may harvest during the season.

Registration - Vessels may be required to report in advance their intention to fish in a certain area, fishery, time period, etc. This provides a record of intention and may confer permission. NOAA Fisheries has published (in 2003) a proposed rule to require that operators of any vessel registered to a limited entry permit and any other commercial or tribal vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to declare their intent to fish within a conservation area specific to their gear type, in a manner that is consistent with the conservation area requirements. That is, the vessel must notify a state or federal agency before it enters an area closed to fishing.

Fish tickets (commercial landings/sales receipts) - Fish tickets are a record of the amount and species of fish landed by a commercial fishing vessel. They are required by each state, and the information required may differ among states. Typically, fish tickets may also indicate gear used, area fished and other specified information. This information is keypunched into an electronic data system and transmitted to a centralized database (PacFIN, maintained by PSMFC).

Vessel logbooks - Logbooks are a vessel's record of activities and estimated amounts of fish caught and retained. The trawl logbook program is conducted by the states (with the help of PSMFC). Vessels are required to complete and submit these records as specified by state regulation. Fishing location is required, as well as amounts of fish retained in each set/haul/tow. Currently, only retained catch is recorded. Selected logbook information is keypunched into an electronic database and compared to fish ticket records. Although states require some non-trawl vessels to fill out logbooks, only trawl logbook information is entered into the data system. Electronic logbooks are used in some fisheries.

Surveys - Surveys are a series of questions, verbal or in writing, designed to collect useful information. Surveys may be conducted in person (as in a port sampling survey), by phone (as in the survey of recreational fishing), or by mail. Typically, participation in a survey is voluntary.

Punch cards/tags (recreational) - Punch cards and tags may serve as a license/permission and as a catch record. There are no federal requirements at this time for West Coast groundfish.

Port sampling/on-shore observers - When a vessel or fisher returns to port, he/she may be met by an official surveyor who collects specified fishing-related information. This may be biological information about the fish, fishing locations and methods, ocean conditions, marine animals observed, etc. Species information may be incorporated into the data system to provide more specific information than recorded by other methods. For example, a fish ticket may not record the weight of each species or even a complete list of species, but a port sampler/observer may provide that information. Port sampling is typically conducted by the states, in conjunction with PSMFC.

On-board observers - Commercial vessels fishing for groundfish are required to allow an agency-certified fishery observer aboard to collect scientific information. The current federal observer program for the West Coast groundfish fishery has resources to observe about 10% of the commercial (limited entry) groundfish fishing trips. Currently, the West Coast observer program focuses on discarded fish, recording amounts, species, and some biological information about the fish. Other information, such as time, location, and gear may also be recorded. Observers can also record observations or measurements of seabirds and marine mammals and other useful scientific information. The federal observer program is not intended or designed to be a compliance or enforcement program.

A compliance monitoring program could be established, as in conjunction with an individual fishing quota program, to help ensure vessels maintain appropriate records and comply with the fishery management program requirements. For example, a compliance monitor could record discarding activities and fishing location.

Vessel monitoring systems (VMS) – Mobile vessel monitoring system (VMS) is a tool that allows vessel activity to be monitored in relation to geographically defined management areas (PFMC 2003e). VMS transceivers automatically determine and report the vessel's position using Global Positioning System (GPS) satellites. Generally, the vessels position is determined once per hour, but the position determinations may be more or less frequent depending on the fishery. VMS transceivers are designed to be tamper resistant. In most cases, the vessel owner is not aware of exactly when the unit is transmitting and is unable to alter the signal or the time of transmission. VMS is a technological tool that can be used to improve bycatch management by providing location data that can be used in conjunction with observer data collections. (See the 5/22/03 *Federal Register* "Proposed Rule for a Vessel Monitor System" for additional information.)

Onboard video recording devices are used in some areas to monitor vessels' fishing activities. Cameras mounted on vessels can record fishing times and provide a general view of catch, as well as certain fishing-related activities. Limited bycatch (discard) and species composition information can be obtained by this method.

Enforcement activities include a variety of data collection methods and information. Traditional techniques used to monitor marine fisheries include monitoring from air and surface craft. Monitoring from aircraft provides fishing location, vessel counts, and other general information. It could provide only limited bycatch information, such as whether discarding has occurred (such as visible, floating fish).

4.1.4 General Effects of Bycatch Mitigation Tools

Catch is related to fishing effort, selectivity of the fishing gear and methods, and species abundance. Reducing unwanted catch is the highest priority in a bycatch mitigation program.

Catch is related to fishing effort, selectivity of the fishing gear and methods, and species abundance. Reducing unwanted catch is the highest priority in a bycatch mitigation program. Bycatch mitigation tools or management measures vary in their application and effect at reducing bycatch, bycatch mortality and in improving catch accountability. Few tools have only one effect, and thus it is often a case of choosing tools that effectively address a variety of goals. Likewise, it is important that the chosen tools work in harmony to achieve the objectives, rather than work in opposition to each other. In theory, an optimum management program would use a few tools that work together synergistically to achieve the desired effects. In this EIS, traditional tools and some new tools never before used in managing West Coast groundfish fisheries are evaluated.

Tools and Their Linkage to Species Associations

Tools and Their Linkage to Species Associations

The utility, effects, and effectiveness of various management measures are linked to key attributes of species we seek to manage. Some tools are more effective at reducing bycatch of rockfish than flatfish for example. Other tools designed to reduce the bycatch of one species may have different impacts on another species. In this EIS, example groundfish species have been highlighted for the analysis. These are all of the overfished groundfish species and selected emphasis groundfish species representing a sample of the 83 groundfish species managed under the Groundfish FMP. These species represent a cross section of groundfish, and have differences in stock status, behaviors, life history, and habitat associations.

Several other important non-groundfish emphasis species have also been chosen for the analysis.

Species Associations and Attributes Important to Application of Bycatch Mitigation Tools

Overfished
- **Canary rockfish**
- **Lingcod**
- **Yelloweye rockfish**
- **Bocaccio**
- **Cowcod**
- **Widow rockfish**
- **Pacific Ocean perch**

Rocky-bottom shelf habitat
- **Canary rockfish**
- **Lingcod**
- **Yelloweye rockfish**
- **Bocaccio**
- *Yellowtail rockfish*
- *Chilipepper*

Non-rocky shelf habitat
- *Dover sole*
- *English sole*
- *Petrale sole*
- *Arrowtooth flounder*

Slope
- **Darkblotched rockfish**
- **Pacific Ocean Perch**
- *Dover sole*
- *Sablefish*
- *Shortspine thornyhead*
- *Longspine thornyhead*

Pelagic or Semi-pelagic
- **Widow rockfish**
- **Pacific whiting**
- *Yellowtail rockfish*

Nearshore
- *Black rockfish*
- *cabezon*

Migratory
- **Pacific whiting**

Longevity
- Rockfishes - longest
- Flatfishes - intermediate
- **Lingcod** and *cabezon* - intermediate
- **Pacific whiting** - shortest

Productivity Index
- Rockfishes - very low
- Flatfishes - low
- **Lingcod** and *cabezon* - low
- **Pacific whiting** - low

Handling survivability
- Rockfishes, Pacific whiting - little or no survival
- Flatfishes - some survival escaping from mesh
- **Lingcod**, *cabezon*, sablefish - some survive release

Overfished species - **Bold**, Emphasis species-*italic*

Knowledge of species attributes is key to understanding if a tool can be used to reduce bycatch and how effective it will be. For example, several of the over-fished groundfish species are rockfishes that have a high degree of association with rocky-bottom shelf habitat. Some of these habitats are well defined areas on the continental shelf. Area management tools (such as MPAs or the current RCAs) may be very effective at controlling vessel encounters with concentrations of canary rockfish and cowcod. However, canary rockfish also occur outside of present RCA boundaries in lower concentrations, and thus area management alone may not minimize incidental encounter with them. A combination of area management and other tools may be more effective in minimizing incidental canary rockfish catch.

Lingcod is another overfished species which is associated with rocky-bottom shelf habitats and partially overlap canary rockfish distribution. However, lingcod are also found in non-rocky bottom and nearshore habitats. Area management tools designed to protect canary rockfish will reduce encounters with lingcod within the canary management area, but to minimize lingcod bycatch, additional measures (or area) would be necessary.

Many species have a much broader distribution across shelf and slope habitats. Generally, younger fish settle in shallow water areas and gradually move offshore as they mature. Others make small scale seasonal migrations to feed on the shelf during the summer or spawn offshore in the winter. Lingcod move inshore to spawn during the winter.

Flatfishes as a group are broadly distributed, while Pacific whiting make extensive migrations between southern and northern limits of their range. Because they are so broadly distributed, area management tools would have to be extremely broad and greatly reduce areas for fishing for other species. Gear restrictions, on the other hand, could be used to for flatfish, and seasonal restrictions on Pacific whiting to do so.

Another important attribute to be considered in designing and applying bycatch mitigation tools is a species' sensitivity to handling. Rockfishes have swim bladders that expand to the point of bursting when they are brought to the surface from seafloor depths greater than a few fathoms. Few rockfish survive this kind of trauma. Thus, regulations that require release of rockfish will likely result in near 100% bycatch mortality. Species that lack swim bladders, such as lingcod and cabezon, appear to be more durable and may be less traumatized by capture and release. Size, bag and trip limits may not contribute to high bycatch mortality rates for these species.

Effects of Bycatch Mitigation Tools

Effects of Bycatch Mitigation Tools

The primary components of bycatch that can be "managed" are through harvest levels, gear, who, when and how many (that is, which vessels, times and areas, and capacity (number of vessels and characteristics of those vessels). Other tools include monitoring/ reporting requirements. These tools have different effects on mitigating for incidental catch, bycatch, bycatch mortality, and accountability . The following is a description of the range of effects for different management tools.

Harvest Level Specifications: ABCs, OYs and Allocations

Harvest Level Specifications: ABCs, OYs and Allocations

Harvest specifications (such as ABC, TAC, MSY and OY) are the first level of conservation and management to maintain sustainable fisheries. For West Coast groundfish, harvest specifications are set to either maintain or rebuild various stocks. When stocks are not equally available (or available in the same proportions), specified harvest levels may not match the relative abundance (ratios) of all the species. OYs are the annual harvest targets for groundfish. Other management measures are designed to achieve but not exceed those targets. OYs provide the basic framework for management, but the fishery management measures to achieve them have greater direct relationship to incidental catch and bycatch.

A relatively small OY in conjunction with larger OYs may generally result in an increased probability and level of regulatory induced discard. Exceptions to this have to do with the distributional characteristics of the species and other management measures that might be applied. A widely dispersed species with a small OY is likely to have a higher encounter rate when fishers target other co-occurring species. Most of an OY would likely be used as incidental catch allowance for fisheries directed at co-occurring species.

Allocations of OY at the highest level (to major limited entry gears, open access, and recreational fishers) will also have potential impacts on bycatch due to differing selectivity of gears involved. Other tools, discussed below, may be used to mitigate for fishing impacts of small OYs.

The balance of OY and fleet size/capacity is critical to bycatch. If a stock is very abundant, and few vessels or anglers fish for it, there is unlikely to be any regulatory discard. However, any abundant stock that is underutilized is likely unmarketable. A large stock biomass in conjunction with a large (but not overcapacity) fleet can result in very low regulatory discard also. Even a small stock in conjunction with a small fleet may not have much regulatory discard. However, if that stock is mixed with abundant but unwanted species, the level of economic (non-regulatory) discard may be excessive.

And finally, a species may have a large ABC but also have harvest constraints to reduce impacts on a small OY species. The result would likely be a large regulatory discard. This is a result not of the OY directly, but rather the management measures to achieve two or more OYs that are “out of balance.” This is the case with species like yellowtail rockfish that have high OY levels but are constrained by catch co-occurring species with a lower OYs such as canary and widow rockfish.

For other species with relatively large OYs, bycatch may not necessarily decrease as there are many non-regulatory sources of bycatch that are proportional to the size of catch. Some non-regulatory sources of bycatch are related to market limits on fish size, quality, and quantity. Another different set of tools may therefore be needed to reduce non-regulatory forms of bycatch that are associated with species having high OYs.

Trip Limits, Bag Limits, and Catch Limits

Trip Limits, Bag Limits, and Catch Limits

Trip limits are retention and landing limits (by species or species complex) that apply to individual commercial fishers, vessels, permits, gear groups, or other defined groups in a given area for a given period of time. Bag limits are the equivalent for recreational fishers.

In a study of West Coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch *et al.* 1988). Restrictive limits may therefore result in a higher catch and bycatch mortality of overfished species compared to alternatives that allow larger trip limits, or alternatives that utilize a different set of management tools. Vessel trip limits for overfished species are designed to provide for non-target incidental catch, although target fishing is allowed with some gear types part of the fishing year for Pacific whiting, widow rockfish, and lingcod. Cumulative 1 or 2 month limits are used to help minimize regulatory discard.

Trip limits are often structured to preserve a ratio of catches reflective of a fishing strategy that results in a particular mixture of species. Often times the mixture contains one or more species that is either overfished or under precautionary management. Catches are constrained so that the ratio is preserved and the overfished or precautionary species OY is not exceeded. Fishers may attempt to develop strategies to maximize value of joint catches of the mixture. If actual fishing experience on the grounds and optimal values for a species mixture matched the average ratios applied when trip limits are set, regulatory bycatch should be minimized. Catches of individual species tend to be highly variable, leading to a significant tow by tow and trip by trip variation in ratios. Although rare, there are times when encounter with an isolated school of rockfish can lead to bycatch that is several times larger than the incidental catch limit. This problem can be significant for overfished rockfish with a trip limit set at a very low level.

In an analysis of Oregon Enhanced Data Collection Program (EDCP) observer data, a small percentage of the trips were found to be responsible for a large fraction of discard (Methot *et al.* 2000). Likewise, in Exhibit C.6 Attachment 2 of the Annual Specifications Data and Analysis for 2004, the author described similar variability in bycatch of darkblotched rockfish in the shoreside based whiting fishery. The rare "disaster tow" can have 2,000 times the low end of the range of variability of darkblotched bycatch (PFMC 2003d). This high degree of variability is related to the aggregating nature of some of the species in the mixture (see above discussion on species associations).

In addition, market forces stemming from price, quantity, and size may result in fishers seeking an alternative mixture of species. Catch of undersized or lower valued species can, therefore, be coupled with regulatory limits leading to discard. This problem generally increases with smaller limits. In the same analysis of EDCP observer data, predicted discard was found to be an increasing function of the amount of DTS complex landed and a decreasing function of the remaining limit available for that species (Methot *et al.* 2000).

Some fishing strategies do not take significant amounts of overfished species. The amount of overfished species varies between strategy, target species, and overfished species (See Tables D-5 through D-13 of Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2004 Pacific Coast Groundfish Fishery (PFMC 2003d)). Trip limits on some species of groundfish may not result in significant regulatory discarding, as many of the trips fall short of the cumulative limits. On the other hand, market factors such as size, quantity, quality and price limitations may also lead to discard if fishers continue to fish for other more valued species.

During three years of the EDCP study (1997-99), onboard observers attempted to record the reasons for discarding a species. "Market" was listed 66% of the time, followed by "regulations" at 24% and "quality" 10% of the time (Saelens and Creech 2003), for all species discarded. Regulations were cited as the primary reason for discarding overfished species, whereas market conditions were cited as the primary reason for discarding other emphasis species except for sablefish and shortspine thornyheads. Regulations were given as the primary reason for discard of these two species (Table 4.1.0).

Since the EDCP study, cumulative limits and depth based management have significantly altered fishing conditions. Current information on the reasons for discard are not available. We make the following simplifying assumptions with regard to trip limit effects based on the discussion and past studies cited above:

- Trip limits affect the amount of trawl discard in particular, resulting in higher discard rates as trip limits decline. Such bycatch is more likely to be regulatory discard. Overfished species tend to have more restrictive trip limits. Therefore, we assume much of the overfished species bycatch is composed of regulatory discard.

- Trip limits also regulate the catch of other groundfish in order to control the annual harvest goal or OY or to minimize impacts on overfished species. Fishers may optimize value while minimizing incidental take of a constraining species above the overfished level, or an overfished species. We assume a mixture of regulatory and market induced discard results in bycatch of these species.
- Some OYs and trip limits are liberal enough that fishers are primarily limited by market conditions. We assume that those species having liberal trip limits that can be taken without taking a high percentage of a constraining species are primarily discarded due to economic or market limiting reasons.
- Finally, trip limit management for West Coast groundfish has a 20 year history. We assume that there has been some amount of regulatory discard for any trip limit level. Some alternatives may result in increased trip limit size. While this may reduce regulatory discard, it will not eliminate it.

Bag and size limits in recreational fisheries contribute to regulatory discard. In nearshore (shallow) waters, bycatch mortality of rockfishes due to the effects of barotrauma are lessened. Some species subject to bag limits and size limits, such like lingcod and cabezon, can tolerate effects of hooking, handling, and release better than rockfish.

Catch limits are substantially different than trip or retention limits!

Catch limits (or fishing mortality limits) restrict the amount of fish that may be caught or killed, whether landed or discarded. These limits require fishers to stop fishing when a limit is reached. Catch limits have not been used in the federal groundfish management program with the exception of the tiered sablefish catch limit program for fixed gear limited entry permit holders.

At the September 2003 Council meeting, a presentation on Canada's IQ program was made. Prior to British Columbia's Individual Vessel Quota System (IVQ), harvest capacity and effort continued to increase resulting in smaller trip limits for groundfish and increasing levels of unreported discard (Larkin *et al.* 2003). As used within this EIS, the IQ takes the form of an individual vessel quota for overfished species called a restricted species quota (RSQ), or an individual vessel quota for other groundfish called an individual fishing quota (IFQ). Generally, individual quotas allow managers to do away with or minimize the use of trip limits as a management tool and to restrict fishing when quotas are reached. This has the potential to reduce regulatory induced discard, especially for overfished species. IQ programs work generally work best in conjunction with extensive monitoring to ensure accountability in catch accounting system. This may mean 100% observer coverage or some other reliable catch verification system. If effectively monitored, catch limits (or catch mortality limits) increase the incentive to keep any useable fish.

A clear distinction must be made between retention quotas and catch or mortality quotas. Retention quotas are much less effective at reducing incidental catch, bycatch and discard. This is especially apparent where the value of different sized fish is substantial; in that case, high-grading would be likely as a fisherman (as a business man) would seek to maximize his profit. Retention limits can be effectively monitored on shore through landings receipts and sampling deliveries. Catch limits, on the other hand, must be monitored at sea. The exception to this is if discarding is prohibited; in that case, an onboard video system would be relatively effective in monitoring discard activities, but would not be effective in distinguishing species.

If IQs were transferable, some consolidation of fishing strategies and perhaps fleet should be anticipated. One consequence might be a reduction in the number of vessels participating in the groundfish fishery, if fishers elected to sell their IQ shares and switch to some other fishery. Fewer vessels with more IQ shares would have access to more resource. The impacts of this scenario are less easily resolved. Acquiring more IQ shares of overfished species should allow fishers more access to other groundfish.

Gear Restrictions

Gear Restrictions

Gear regulations are often intended to reduce the efficiency of the various gear types. Gear regulations can also be used to change the gear's selectivity. Gear selectivity is related to catch and bycatch, and thus selectivity can be adjusted to mitigate for the effects of fishing and reduce bycatch. Unobserved bycatch mortality may still occur even though bycatch as measured through observer programs is reduced. Gears can be modified to reduce the take of undersized fish, change the species composition, reduce the take of prohibited species, decrease overall efficiency, or force the gear to be used in particular habitats. Through the EFP process, fishers, agencies, and gear manufacturers are actively experimenting with modified gears designed reduce the take of overfished species.

Trawl

West Coast commercial fishers use a variety of otter trawl types. Bottom trawls are used to fish for rockfish, flatfish, and sablefish. Gear restrictions on bottom trawl gear have had a significant impact on bycatch rates and amounts of overfished and other groundfish species. The minimum mesh size for trawl gear was increased from 4 inches to 4 ½ inches in 1995, based in large part on a mesh size study conducted in the late 1980s. The study demonstrated reduced retention of small, unmarketable groundfish. Larger mesh size reduces the catch of undersized fish that would otherwise be sorted and discarded at sea. Changes in the type and use of chafing gear is also believed to have increased escapement of juvenile rockfish, flatfish and sablefish. Bycatch mortality of fish escaping through the meshes may be occurring, however (Davis and Ryer 2003).

Large diameter roller gear permitted bottom trawls to be used in hard bottom areas preferred by shelf rockfish species. Restricting the use of rollers larger than 8 inches effectively reduced directed rockfish fishing on these rocky-bottom shelf areas. A study by Hannah (2003) showed that trawlers avoided rocky reef areas on the shelf as a result of the regulation, and that encounter rates of overfished species were reduced.

EFPs are currently be used to test the selectivity of special flatfish trawls designed to reduce rockfish catches. These nets have large, cut-back sections of net in the upper panel of the trawl and reduced trawl height compared to conventional trawls. Preliminary results from an ODFW study using this experimental trawl in 50-180 fm indicated a 61% reduction in canary rockfish catch while increasing catches of flatfish (Parker 2003).

Other regulations could be used to change selectivity and efficiency of the gear. Smaller trawls could reduce bycatch by reducing area swept by the trawl, which in turn would reduce bottom disturbance and catch. If navigation methods were sufficiently accurate, smaller trawls may be able to reduce contact with sensitive habitat species. Reduced trawl height would reduce the capture of rockfish distributed in the water column above the bottom.

Most rockfish species do not survive after being brought to the surface after capture with trawl gears. Sablefish, cabezon, lingcod, and flatfishes (including halibut) lack swim bladders and have a better chance at survival. Thornyheads also do not have a swim bladder but are usually descaled badly due to contact with other fish and trawl webbing.

In addition to catching other non-groundfish marine finfish, all bottom trawls have some contact with the sea floor that results in the bycatch of benthic epifauna and shellfish. Marine plants, corals, sponges, sea urchins, and sea stars are taken as bycatch, some of which is unobserved. Bottom trawl doors, bridles and footropes also disturb rocks and sediments. Indirect impacts of this type of disturbance are poorly understood but are thought to reduce or modify fish habitats.

Midwater (pelagic) nets are used to target Pacific whiting and can be used to target semi-pelagic species such as widow and yellowtail rockfish. Pelagic trawls typically have lower bycatch rates of benthic organisms than bottom trawl gear.

Bycatch reduction devices (BRDs) are typically not used in West Coast groundfish trawls but are used by groundfish trawlers in Alaska (to reduce bycatch of Pacific halibut) and by West Coast shrimp and prawn trawlers (to reduce groundfish bycatch). Studies by the ODFW show a significant reduction in the bycatch of finfish species when fish excluders are used in shrimp trawls (Hannah *et al.* 1996). States currently manage the shrimp fishery and require the use of excluder devices to help reduce the take of canary rockfish.

Hook-and-Line

Fish harvested with hook-and-line gear typically have minimal physical damage from the gear itself. Puncture wounds from hooks are often limited to the mouth and may result in relatively low mortality rates in released/discarded fish. Swallowed hooks result in higher mortality rates. De-scaling is a less typical effect, compared to trawl capture. Hook size and shape also affect the degree of injury. However, physical strain resulting from rapid decompression, temperature change, exposure to air and physical handling result in some level of mortality.

West Coast commercial and recreational fishers use a variety of hook-and-line gears. Most West Coast groundfish longline gear is used to target sablefish and coincidental catch rates of other groundfish are thought to be low in this fishery. Levels of discard or sablefish are currently being evaluated by the NMFS observer program. Sablefish is a relatively hardy species, but some hooking mortality occurs in released fish. Small fish or fish damaged by sand fleas or bites from predators typically make up the discard. A study of the Alaskan sablefish fishery indicated that sablefish bycatch as discard including bycatch mortality was less than 12% of the total allowable catch (TAC) (Richardson and O'Connell 2002). In a comparison of sablefish pot and longline gear survey methods, Pacific rattail made up more than half of the total catch of all species in gear placed in deep water (600 fm) (Matteson *et al.* 2001). Most longline gear is fished shallower than this, and low bycatch rates were observed in this same.

Open access and recreational hook-and-line gears are diverse, and each gear type has different selectivity characteristics. This results in different species mixtures. Small fish or those with limits are discarded. Hook-and-line gear bycatch, when released, has some chance of survival depending on the species and depths fished. Due to barotrauma, mortality rates for rockfish released from hook-and-line gear are likely to be high especially if they are taken in deeper water. A study of different handling methods showed no significant difference in survival rates between quillback rockfish vented with a hyper-dermic needle or brought more slowly to the surface compared to un-vented fish or those brought more rapidly to the surface. Survival was significantly improved in fish rapidly returned to depth (Berry 2001). Similar findings for black rockfish were noted by ODFW researchers (Rankin 2003). Impacts to lingcod, cabezon, and sablefish should be less as they do not have swim bladders. Ultimate survival of all of these species handled in such a manner is poorly understood, however.

BRDs have not been required in the West Coast groundfish longline fishery and little information is available on encounter rates with marine bird species. Observer programs may provide better information on encounter rates. BRDs have been successfully used in longline fisheries in Alaska and elsewhere.

Pot/Trap
Pot gear causes minimal physical damage to fish. However, some level of predation (including cannibalism) occurs withing

the traps. In addition, physical strain resulting from rapid decompression, temperature change, exposure to air and physical handling result in some level of mortality.

Pot or trap gear is principally used to target sablefish in the West Coast limited entry fixed gear groundfish fishery. It is highly selective for sablefish. Bycatch in the commercial fishery is made up of undersized fish. A pilot survey study conducted by the ODFW comparing pot and longline gears indicated that sablefish made up more than 99% of the pot gear catch over a broad range of depths (Matteson *et al.* 2001). West Coast traps are typically equipped with 3 ½ inch mesh allowing escapement of some small fish.

Little is known about the mortality of released sablefish. Some studies indicate that bringing sablefish through an abrupt temperature change, such as the thermocline present offshore during the summer, can lead to stress and mortality (Davis and Ryer 2003).

Pot gear is also used by open access and limited entry participants in nearshore live fish fisheries. These small pots facilitate handling of fish and reduce injury so that fish will have a higher rate of survival when transported and held in the market place.

There is no maximum on pots used in the limited entry fixed gear fishery. However, the State of Oregon limits the number of pots used by the only nearshore fisher holding a developmental fisheries pot permit for nearshore species.

Some ghost fishing can occur with lost pots and traps. To minimize losses gear is marked so it can be found and biodegradable lacing is required to disable any lost pot by creating a large hole as the lacing "dissolves." Mortality due to lost gear is not well understood or documented.

Setnet (Gill and Trammel Nets)
Mitigation tools used by the State of California for managing setnets are similar to those used for other nets. California placed observers onboard many vessels using setnets during the 1980s. Based on those observations, the State uses area restriction as a primary bycatch mitigation tool. Setnets are prohibited in areas where bycatch of marine mammals and seabirds was observed, especially in nearshore areas and feeding grounds. In addition, mesh size restrictions are used to

reduce bycatch of small fish. Tools for managing setnets are not discussed here because this gear is managed by the State of California.

Time/Area Restrictions (Closures)

Time/Area Restrictions (Closures)

Time/area closures reduce bycatch by reducing fishing in areas where "restricted" species are most abundant. If the designated time/area restriction coincides with the majority of the species' population, capture of that species can be greatly reduced. This tool can be especial effective for localized population of sedentary species. Time/area restrictions are less effective for mobile or migratory species and for species that are broadly distributed over large geographic areas.

Large scale, depth-based closures, designed to protect several overfished species, are now in effect (Rockfish Conservation Areas or RCAs). While these closures and restrictions have not been designated as "permanent," they are likely to remain in effect for several years as integral tools in strategies to rebuild overfished shelf rockfish. Only a very small percentage of the available habitat is set aside in long-term (permanent) marine protected areas or research reserves. Fishing activities in the RCAs, in particular on-bottom fishing, are restricted; fishing with certain gear types is still allowed.

Protected areas are best used when the migratory range of species is limited and species have strong site affinity for specific habitat types that can be identified and isolated through regulatory means. Protected areas have significantly reduced the bycatch of overfished canary rockfish, bocaccio, and cowcod. Seasonal restrictions can afford similar protection to species that aggregate during spawning migrations. Winter closures have been effective at reducing the catch of lingcod in nearshore spawning areas for example.

Use of RCAs and MPAs will have some impacts on other species both inside and outside of the boundaries. Catch of co-occurring species within the area is eliminated if the area is closed to all fishing activities. If some fishing is allowed, the amount of catch will be proportional to the effort and gear selectivity and abundance of the various species. Outside an area that encompasses the majority of a species population, only a small number of fish would be present. Thus, even if effort increases substantially the catch will remain very small for that species. However, increased effort would result in increased catch of other species, again depending on selectivity and abundance.

Capacity Limits

Capacity Limits
Capacity limits are used to restrict access to the fish resource. Reducing capacity is a goal of the Council's *Strategic Plan for Groundfish*. Generally, capacity reduction in most forms reduces the need for other controls that may lead to regulatory induced bycatch in particular. Non-regulatory bycatch may also be reduced if there are fewer boats to supply market demands.

IQ programs typically have a direct effect of reducing capacity if fishers sell their shares and leave the fishery. Impacts would be similar to other capacity reduction methods that consolidated vessel permits into a smaller fleet.

Vessel Restrictions
The links between vessel size and fishing efficiency and capacity are very indirect, and thus size restrictions are not an effective tool for mitigating either bycatch or bycatch mortality. Likewise, horsepower and other vessel restrictions are similarly ineffective.

Monitoring/Reporting Requirements

Monitoring/Reporting Requirements
Monitoring and reporting requirements are essential fishery management tools. Accountability and accuracy of these programs is proportional to the amount of observer coverage and catch verification that can be accomplished. Higher levels of monitoring will yield more complete, accurate, and timely estimates of total catch including bycatch. Direct benefits would include in-season adjustments based on current season data and higher compliance rates. Indirect benefits would include improved stock assessments and tracking of rebuilding plans.

4.2 Impacts to Ecosystem and Biodiversity

Impacts to Ecosystem and Biodiversity

Natural and human factors and events affect the coastal marine environment (ecosystem) in a variety of ways. Large and small scale climatic factors sometimes cause dramatic changes in biological productivity, species abundance and biodiversity.

From an ecosystem perspective, human fishing activities might be viewed as large-scale predation that consumes species at a variety of trophic levels and may also affect other tropic levels directly or indirectly. Effects of fishing on species abundance, species diversity, community structure and physical environment have been described in numerous studies. For example, top predators may be removed, resulting in increases of species lower in the food web. At the other trophic extreme, removal of large amounts of krill or other zooplankton can result in reduced productivity and mortality of higher trophic animals. Fishing practices can also affect habitats, community structure and biodiversity. The cumulative effects of 100 years of West Coast groundfish fishing (and fishing for other species) have helped shape present day ecosystem structure. Forage species (including groundfish and non-groundfish) captured in the course of groundfish fishing may be removed from the environment. Top level predator species may also be removed, resulting in increases of their prey species. Or, their competitors may increase, making it difficult to regain their previous position in the hierarchy. In either case, fishing increases the mortality rate of "unfished" populations. These and other changes could alter trophic dynamics, abundance and biodiversity of the ecosystem. It is difficult, however, to separate many of these fisheries related changes from environmental ones.

Mitigation tools available to the Council and NMFS are divided into three major categories: those that mitigate (reduce) unintended catch, those that may reduce mortality of unintended catch, and those that reduce waste of unintended catch. A fourth category could also be considered (reduce unobserved fishing-related mortalities) but very little information is available to address that category except to speculate. Even for the first three categories, the magnitude of effects is difficult to predict, and even the direction of effect may not be apparent or predictable.

Tools to mitigate unintended catch are likely to affect species abundance and ecosystem structure. Some of these tools have more selective effects and may affect relatively few species of similar size and shape. Others have broad effects on a variety of species and sizes. These effects are analyzed for a set of species that represent various trophic levels and geographic areas within the affected environment.

4.3 Impacts of the Alternatives on Groundfish Resources

Impacts of the Alternatives on Groundfish Resources

Impacts of the six alternatives on groundfish resources are summarized below. Detailed effects of alternatives on groundfish are contained in Appendix B.

Outside of environmental influences, fishing mortality accounts for the primary impact on groundfish resources. The Council controls fishing mortality through harvest management in order to attain the OY for each species. This is complicated by the fact that groundfish are caught in a suite of mixed species fisheries that correspond to ecological species groupings and reflect fishing strategies as well as stock condition of individual species components. The amount of groundfish taken results from the interplay between the OY specifications, management measures established for rebuilding some species, allocation among competing uses, and facilitating access to healthy stocks of groundfish.

Overfished species play a central role in consideration of alternatives. Current stock levels reflect a combination of recent and poor environmental conditions leading to lower levels of recruitment and productivity, effects of management of groundfish in the absence of sufficient stock assessment information, increases in fishing efficiency and effort, and unknown impacts of multi-species fishery where discard contributed to un-accounted for fishing mortality. Abundance of several groundfish species declined below the overfishing threshold. Some species, such as canary rockfish and bocaccio are at very low stock levels and co-exist with a wide variety of groundfish species across a broad latitudinal and bathymetric ranges. Rebuilding these species requires major constraint on harvests of other healthier stocks of groundfish - reducing overall OY significantly.

We have chosen a select group of groundfish species and non-groundfish species that represent a range of biological resources having significant and different bycatch issues. The application of different management tools can be tailored to address these issues. In our analysis, we attempt to look at how these tools address regulatory and non-regulatory bycatch for OVERFISHED SPECIES and select EMPHASIS SPECIES (Table 4.3.0a) Characteristics of these two groups follow:

- **Overfished species** are the 9 groundfish species that have fallen below 25% of spawning biomass levels and have or soon will have rebuilding plans. Most of these species are long-lived rockfish that prefer rocky habitats and have behaviors that may concentrate them in time and space. In addition, rockfish have generally high market acceptance and in many cases high value. These characteristics have made them vulnerable to target fishing, contributing to their present overfished state. Rockfishes are subject to barotrauma and typically do not survive capture. Much of the recent discard of rockfish has been regulatory due to fishers reaching trip limits (See Table 4.3.0a). Dispersion of these species can be fairly broad and in lower concentrations than preferred habitats, making them vulnerable to capture as incidental catch in fisheries targeting other species. Tools that require retention of overfished species, increase trip limit size, or provide refuge areas tend to reduce bycatch of overfished species.

- **Emphasis species** include 11 species of groundfish from a broad range of habitats described in Chapter 3 (Table 4.3.0b). While not overfished, some species are under precautionary management. Others are healthy but their catches are constrained by measures to limit the take of overfished or other species. Flatfishes as a group are also represented. They have a broad dispersion and several do not have significant regulatory bycatch issues. Bycatch in the form of economic discard for this group is often related to size and other market related restrictions. Tools that increase trip limit size for emphasis species constrained by trip limits, require retention, or eliminate the take of undersized fish tend to reduce bycatch of emphasis species.

The analytical methods are intended to reveal the effect of each tool in isolation from other tools, and in combination with other tools grouped together to form a distinct alternative.

Impacts of alternatives on groundfish resources are evaluated in a building block fashion with a special focus on overfished species as these tend to constrain healthier stocks of groundfish. Species under precautionary management, and those above target biomass levels will also be addressed in context with each environmental division and relationship to overfished species.

This EIS addresses the following interactions:

- Catch and bycatch - (direct effects)
- Predatory/prey interactions (indirect effects)
- Fishing strategy interactions (indirect effects)

The analysis of six alternatives is done within an ecological and biogeographical framework as opposed to an individual species by species analysis of impacts. Direct and indirect effects of alternatives will reference keystone species, such as those under a rebuilding plan, other emphasis species of groundfish at or above MSY, and for other non-groundfish species. For purposes of this analysis we have identified the following ecological and biological groupings:

- **Northern Shelf Environment**
- **Southern Shelf Environment**
- **Slope Environment**
- **Pelagic Environment**
- **Nearshore Environment**

Analysis of overfished and emphasis species also reflects important latitudinal differences associated with species distributions along the coast (e.g. north and south of 40° 10' N. Lat.).

Impacts to groundfish are ranked by alternative and summarized in Tables 4.3.1 through 4.3.6.

4.3.1 Impacts of Alternative 1 (No Action)

Summary of Alternative 1 The policy goal of alternative 1 is to continue current fishery management provided by the FMP in a manner consistent with Council objectives of maintaining a year-round groundfish fishery, preventing overfishing, and rebuilding overfished stocks at current levels of effort. In this alternative, bycatch and bycatch mortality are controlled in part through modifying effort and gear efficiency. Trip limits are used to discourage fishing in certain areas based on encounter rates of overfished species. Gear restrictions are used where possible to reduce expected bycatch rates. Area closures are also used to reduce or prohibit fishing within Rockfish Conservation Areas (RCAs) on the continental shelf. Management relies on monitoring and reporting through logbooks, port sampling, and partial observer coverage of the groundfish fleet.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 1:

- **Harvest Levels** Ratios of overfished species to other groundfish are used to set total catch caps for the overfished species. Unlike some of the alternatives, these are 'soft' caps allocated to various fishery sectors. Other groundfish harvest is constrained to maintain expected catch ratios, thus lowering overall OY and reducing harvest opportunities on healthy stocks. The GMT's quota system monitoring (QSM) program is used to track soft caps and the Council recommends appropriate in-season adjustments to ensure overall catch remains at or below recommended OY. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.1).
- **Vessel trip limits** Trip limits are the most restrictive with this alternative due to the need to keep catch and bycatch of overfished species within OY at current levels of effort, and to maintain a year-round season. This tool is ranked 4th out of a range of 1-4 scored for the alternatives (Table 4.3.1).
- **Vessel catch limits** Vessel catch limits not explicitly used as a tool in this alternative. This tool ranks last or 4th out of a range of 1-4 scored for the alternatives (Table 4.3.1).
- **Gear regulations** Gear restrictions are used to minimize take of undersized fish and overfished species, reduce bycatch and bycatch mortality. Survival rates of bycatch escaping gear is unknown. Experimental Fishing Permits (EFPs) are used to allow participating fishers the opportunity to experiment with various gear modifications to reduce bycatch and bycatch mortality of overfished species in particular. This tool is ranked 2nd out of a range of 1-3 scored for the alternatives (Table 4.3.1).
- **Time/area closures** Extensive use of Rockfish Conservation Areas (RCAs) is intended to reduce encounter rates of overfished species, thus reducing bycatch and bycatch mortality. Large areas of the shelf are closed to directed groundfish fishing. Some open access and recreational fishing still occurs within RCAs. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.1).

- **Capacity reduction** Capacity reduction is not explicitly considered under this alternative. ***(If the ongoing trawl buyback program is successful, Alternative 1 would be more similar to Alternative 2.)***
- **Data reporting, record-keeping, and monitoring** Under Alternative 1 management, 100% of the at-sea whiting fleet and approximately 10% of the remaining commercial groundfish fleet are monitored with on-board observers. Data are used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish. Under status quo management, these data are updated annually and used to change forecast of OY and trip limit impacts by fishery sector for the annual specifications process. This tool is ranked 5th out of a range of 1-5 scored for the alternatives (Table 4.3.1).

Impacts on Groundfish

Ranking of effects of Alternative 1 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are summarized in Table 4.3.1. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

<u>Overfished groundfish</u>

A major source of impacts to groundfish resources is regulatory discard of groundfish due to tight trip. Primary affected groundfish species include overfished groundfish and highly valued groundfish with catches constrained by co-occurring overfished species limits. While current management protects rebuilding strategies, a significant fraction of the overall groundfish OY is discarded or not harvested due to constraints on overfished species. Gear restrictions and RCAs have the added benefit of restricting most fishing activities along with associated bycatch impacts from large areas of the continental shelf off Washington, Oregon, and California. (Bycatch reductions within these areas also reduce the bycatch of halibut and benthic organisms.) Pelagic trawling still occurs within the boundaries of RCAs and there is measurable bycatch of Pacific whiting, widow rockfish, and yellowtail rockfish.

Experimentation with gear designs and configurations may result in reduced observed bycatch of overfished species. The fate of fish excluded from fishing gears is largely unknown and excluded fish are likely to contribute to bycatch mortality to some degree.

Emphasis species

Alternative 1 provides fishing opportunities outside the RCAs while conserving overfished groundfish. Cumulative trip limits are set to reflect ratios that protect vulnerable species while allowing harvest of healthier stocks. Ratio management under Alternative 1 tends to leave un-attained OY for some species and possibly increased rate of discard for others, although overall catches are thought to be biologically conservative. The Dover sole, thornyhead, and sablefish complex reflects this dilemma (see Appendix B). The complex is managed to protect shortspine thornyhead. Under current limits, Dover sole, sablefish, and shortspine thornyhead bycatch rates are high. Catches of longspine thornyhead (and sometimes sablefish) may be below OY.

Pelagic fisheries still provide some opportunity within RCA boundaries for the shelf dwelling yellowtail rockfish.

Seaward and shoreward of the RCA boundaries, current management measures do not significantly affect economic discard/bycatch resulting from discard of undersized fish or fish having low or no present market value.

4.3.2 Impacts of Alternative 2 *(Larger trip limits - fleet reduction)*

Summary of Alternative 2 The policy goal of this alternative is to reduce bycatch by reducing harvest capacity and increasing trip limit size without reducing the length of the season. In this alternative, bycatch and bycatch mortality are controlled in part by modifying effort and gear efficiency.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 2:

- **Harvest Levels** (harvest policy, rebuilding) ABCs and OYs are assumed to be the same as under Alternative 1. However, proportionately more catch would be available to each individual vessel remaining in the fleet compared to Alternative 1. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (See performance standards and OY reserves in Table 4.3.2).
- **Vessel trip limits** Vessel trip limits are used and would increase under this alternative due to a 50% reduction in

effort through capacity reduction. Regulatory discard is inversely proportional to trip limit size; the direct impacts of this alternative would be to reduce bycatch and associated mortality. This tool ranks between 2nd to 4th out of a range of 1-4 scored for the alternatives (Table 4.3.2).

- **Vessel catch limits** Vessel catch limits are not explicitly used as a tool in this alternative. This tool ranks last or 4th out of a range of 1-4 scored for the alternatives (Table 4.3.2).
- **Gear regulations** Gear regulations under this alternative would be the same or similar to those in Alternative 1. It is not anticipated that a 50% reduction in fleet capacity would permit the use of large footrope gear within current RCA boundaries. This tool is ranked 2nd out of a range of 1-3 scored for the alternatives (Table 4.3.2).
- **Time/area closures** The application of RCAs would be the same as Alternative 1. A 50% reduction in fishing effort might allow redefinition of the timing and application of closed areas to provide more opportunities to access other groundfish resources within current RCA boundaries. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.2).
- **Capacity reduction** Catch is related to effort, selectivity and species abundance. Effort must be viewed in terms of "effective effort," or effort that produces an average catch of groundfish per (trawl) hour fished. Trawl fleet reduction that reduces effective effort would increase catch per vessel for the remaining fleet and increase the efficiency of other bycatch mitigation tools. However, *effective* effort is the causative agent, and the magnitude of net decrease in catch depends on the net decrease in effective effort. Alternative 2 would still have a net benefit compared to Alternative 1. This tool ranks 1st out of a range of 1-3 scored for the alternatives (Table 4.3.2).
- **Data reporting, record-keeping, and monitoring.** Catch reporting, record-keeping, and monitoring through use of observers may improve over Alternative 1. Assuming the number of observer days remains the same, a higher proportion of total trips and catch would be observed due to the reduced fleet size, larger trip limits, and reduced total number of trips. If effort increases, trip limits may have to be reduced, and observer coverage would become more like

Alternative 1. This tool is ranked 4th out of a range of 1-5 scored for the alternatives (Table 4.3.2).

Impacts on Groundfish

The Alternative 2 ranking of effects on reducing groundfish bycatch, bycatch mortality, and increasing accountability are summarized in Table 4.3.2. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Overfished groundfish
This alternative is similar to Alternative 1 in that trip limits, gear restrictions, RCAs, and an economical sampling program is used to manage the fishery. It differs significantly in that trawl effort is reduced 50% compared to Alternative 1. Reducing effort would tend to make other bycatch reduction tools work more efficiently. The primary effect of effort reduction is that trip limit size could be increased. Studies have shown that bycatch is inversely proportional to trip limit sized. This was found to be true for especially for West Coast groundfish species of concern. The primary benefit of increasing trip limit size in contemporary management of overfished species is to reduce regulatory induced bycatch. Bycatch reduction of highly valued but constrained species of other groundfish would also occur due to the larger trip limits. For example, regulatory related bycatch of Dover sole, shortspine thornyhead and sablefish may be reduced as capacity is reduced and cumulative limits are increased. Other impacts would remain largely the same as Alternative 1.

Emphasis species
Impacts of this alternative on other groundfish vary somewhat compared to overfished species. Capacity reduction and potentially increased trip limits should not have as much impact on reducing bycatch and bycatch mortality of groundfish limited by market conditions such as many of the flatfishes and chilipepper rockfish. Capacity reduction will largely affect shelf and slope fisheries but should have less impact on nearshore groundfish like black rockfish and cabezon, which are caught principally by the recreational and open access fisheries.

4.3.3 Impacts of Alternative 3 *(Larger trip limits - shorten season)*

Summary of Alternative 3 The policy goal of this alternative is to reduce bycatch by shortening the fishing season by 50%. In this alternative, bycatch and bycatch mortality is controlled in part by modifying effort and gear efficiency. It attempts to accomplish effort reduction sought in alternative 2 without reducing fleet size. This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks while maintaining an economical monitoring program. It may be contrary to the current goal of maintaining a year-round groundfish fishery, although platooning could be used to accomplish this objective.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 3:

- Harvest Levels (harvest policy, rebuilding) Harvest Levels are assumed to be the same as under Alternative 1.
- **Vessel trip limits** This alternative assumes the season would be shortened for fishing vessels and that some form of platooning would be used to maintain fishing throughout the year. Vessel trip limits under this alternative would be the same as under alternative 2. Season length for the platooned fleet would be modeled by the GMT to maintain trip limits. Trip limits equivalent to those in Alternative 2 would reduce bycatch and bycatch mortality in a fashion similar to alternative 2. This tool ranks 3rd out of a range of 1-4 scored for the alternatives.
- **Vessel catch limits** Vessel catch limits not explicitly used as a tool in this alternative. This tool ranks last or 4th out of a range of 1-4 scored for the alternatives (Table 4.3.3).
- **Gear Regulations** under this alternative would be similar to Alternative 1 and be structured to keep catches within the OY limits for overfished species. It is not anticipated that a 50% reduction in fishing season would permit the use of large footrope gear within current RCA boundaries, however small footrope gear may be re-introduced into RCAs. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.3).
- **Time/area closures** In addition to the RCAs used in Alternative 1, this alternative compresses the fishery through seasonal closures for a platooned fleet. For instance, each half of the fleet would have a fishing

season of only 6 months. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.3).

- **Capacity reduction** No capacity reduction is considered under this alternative. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.2.3).
- **Data reporting, record-keeping, and monitoring** Catch reporting, record-keeping, and monitoring with the same number of observer days as under Alternative 1 is assumed. A compressed season would mean that the percentage of total trips covered by observers would increase over Alternative 1. This tool is ranked 3rd out of a range of 1-5 scored for the alternatives (Table 4.3.3).

Impacts on Groundfish

Effects of tools used in alternative 3 to reduce groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.3. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Overfished groundfish
Under this alternative, trip limit size would be increased to reduce bycatch and season would be shortened so that larger trip limits could be maintained. By careful platooning of the fleet, it is hoped that a year-round season would still be possible. Fleet response to this approach is hard to predict. The shortened season may result in some fishers choosing alternative non-groundfish fisheries, or electing to fish at a particular time of the year. Fishing could occur at a time of year when encounter rates of overfished species is higher. If too many fishers elected to fish during a certain period of the year, product flow could be interrupted. Aside from these concerns, the impacts of a reduced season and larger trip limit size should be similar to alternative 2, without the cost of a buyback program.

Emphasis species
As was described above under the Alternative 1, bycatch of species within the DTS may be the result of several factors, including size, attainment of regulatory limit, and high grading related price structure of different sizes of sablefish. A 50% reduction in fishing season and increased trip limits for components of the complex would tend to reduce regulatory induced discard. Within the DTS complex, bycatch of shortspine thornyhead may be reduced if a larger trip limit for

this species is allowed. High grading of sablefish may still occur, however.

The potential increase in trip limit size not likely a significant factor for some species of groundfish like those in the other flatfish category. Landing limits under Alternative 1 are quite liberal compared to current catches and attainment of the cumulative limit under alternative 3 is not likely. Bycatch and bycatch mortality is related to market limitations related to undersized fish, price, and constraints on quantity. If fleet response to the shortened season is to seek some alternative fishery rather than increase effort during season openings, bycatch and bycatch mortality may be reduced due to a reduction in overall harvest levels.

As was the case with Alternative 2, increasing trip limit size may have less of an impact on nearshore fisheries unless season are shortened for recreational and open access fisheries as well.

4.3.4 Impacts of Alternative 4 *(Fleet sector catch limits)*

Summary of Alternative 4 The policy goal of this alternative is to reduce bycatch by setting catch limits for the various fleet sectors and establishing an in-season catch monitoring or verification program to ensure catch caps are not exceeded. In this alternative control of bycatch and bycatch mortality is effected by controlling overall catch and gear efficiency. This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is increased over Alternative 1 at an increased cost.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 4:

- Harvest Levels (harvest policy, rebuilding) Objectives for optimum yield and rebuilding would remain the same as in s*tatus quo*. Harvest policy would be modified from Alternative 1 in that OY would be broken down into caps for each fishing sector with in-season monitoring of caps. Fishery sectors for groundfish would be broad consisting of separate fleet caps for limited entry midwater trawl, limited entry bottom trawl, limited entry fixed gear, open access, and recreational fleets. Overfished species constrain harvest of other groundfish and are distributed unevenly along the coast. Thus, this alternative assumes a partitioning of the caps north and south of Cape Mendocino at 40° 10' N. Lat. for most species. When OY is reached, further fishing would be prohibited or severely curtailed. A portion of other groundfish OY would be set aside in reserve for the fishery sector with the lowest bycatch to provide an incentive to lower catch rates of overfished species. The primary direct effect of this Alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. This tool is ranked 2nd out of a range of 1-3 scored for the alternatives (See performance standards and OY reserves in Table 4.3.4).

- **Vessel trip limits** Vessel trip limits would initially be the same as Alternative 1 and based on previously observed joint catch ratios of overfished and co-occurring groundfish species. Vessel trip limits may be altered compared to the Alternative 1. More careful monitoring of catch coupled with fleet sector incentives would reduce catch and bycatch of overfished species. To the degree that limits were liberalized, bycatch and bycatch mortality of overfished species may be reduced.. This tool ranks between 2nd and 3rd out of a range of 1-4 scored for the alternatives (Table 4.3.4).
- **Catch Limits** Sector allocation would be used to partition available OY into sector caps by fishery. Increased monitoring and sector management measures would provide fishers with incentives to keep within sector caps reducing bycatch and bycatch mortality compared to the first 3 alternatives. This tool ranks 3rd out of a range of 1-4 scored for the alternatives (Table 4.3.4)
- **Gear Regulations** Gear regulations under this alternative would be the same or similar to Alternative 1, and would be structured to keep catches within the OY limits for overfished species. Incentives would be stronger to modify gear in order to reduce bycatch and bycatch mortality, due to strict caps and robust monitoring system of this alternative. Gear modifications that reduced the take of overfished rockfish outside of RCAs would have a direct positive impact on bycatch and bycatch mortality, compared to the first three alternatives. The fate of excluded fish is unknown. Fish interacting with and escaping fishing gear may succumb to delayed mortality even though

bycatch in the form of discards is reduced. This tool is ranked 2nd out of a range of 1-3 scored for the alternatives (Table 4.3.4).

- **Time/Area Closures** Initially time and area closures (RCAs) would be similar to those under Alternative 1, and would be based on the previously observed catch ratios of various groundfish species. Some additional flexibility might be possible due to increased monitoring and updating of catch ratios and performance of the fishing sectors. This alternative may allow changes in time or depth of RCAs based on OY cap tracking of overfished species. Closures, when and where they occur, may directly reduce bycatch and bycatch mortality of overfished within the closed area. Due to the general lack of incentives to discard overfished species under this alternative, most of the effect of bycatch reduction would likely be accomplished through higher rates of retention. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.4).
- **Capacity Reduction** Capacity reduction is not considered under this alternative. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.4).
- **Data Reporting, Record-keeping, and Monitoring** Catch reporting, record keeping, and monitoring uses a more robust program than Alternative 1. 100% logbook coverage would be required to aid in improving accuracy of estimated catch by commercial and charter boat. Observer coverage of commercial fleets would be increased and with coverage placed on a subsets of each sector. Observed catch rates would be extrapolated (expanded) to the entire sector. Recreational sampling would be also be increased. The net effect would be to estimate total catch to within $\pm$ 25%. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the first three alternatives as fishers are more likely to retain catches of overfished species . Bycatch mortality of overfished species caught and released in the recreational fishery is unknown. This tool is ranked 2nd out of a range of 1-5 scored for the alternatives (Table 4.3.4).

Impacts on Groundfish

Effects of tools used in alternative 4 to reduce groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.4. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

<u>Overfished species</u>
Under this alternative, overfished species OY would be broken down into caps for each fishing sector with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A portion of other groundfish OY would be set aside in reserve for each fishery sector to provide an incentive to lower catch rates of overfished species. If successful, the primary direct effect of this alternative would be reductions in bycatch of overfished species due to strict caps and monitoring of these species. It is highly likely that the shelf dwelling canary rockfish and bocaccio will present the biggest challenge to sectors. Current harvest levels under Alternative 1 conditions are very close to OY. Catch of other overfished species are below OY largely due to fishing constraints caused by these two species.

There is some question as to whether incentives work on a fishery sector basis. Huppert *et al.* (1992) suggested that sector based incentive systems tend to penalize those participants who adopted methods of reducing bycatch of prohibited species as fewer target species are likely to be caught. Sector based incentive programs work best for relatively small and discreet fishing units like fishing co-operatives. The Pacific whiting fishery sector utilizes a similar program to limit harvest of salmon incidental catch.

The limited entry fixed gear fleet would likely be successful limiting bycatch of non-target species of concern (halibut, lingcod, and overfished rockfish), as the fleet size and catch of overfished species is small. In contrast, the recreational sector may have a difficult time controlling catch of overfished species through an incentive program as there are many and diverse participants. Thus, other means of controlling this sectors OY cap would likely be more effective.

Cumulative trip limits might be relaxed or increased in size to the extent fleet sectors were able to minimize bycatch of overfished species. Gear modifications would be encouraged to reduce the take of overfished species.

<u>Emphasis Species</u>
Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch reducing fishing tactics. A reduction in effort could result from early attainment of overfished species sector caps. The direct impact of OY caps may result in less harvest of other groundfish, thus reducing bycatch and bycatch mortality at the expense of lost economic opportunity. On the other hand, incentives, in the form of additional OY for the fishing sector may change enough of the sectors fishing practices to reduce bycatch of overfished species and increase catch of other groundfish. If bycatch is proportional to catch, bycatch and bycatch mortality may increase for other groundfish.

Increased cumulative limits might result if bycatch of overfished species was well controlled using sector caps, incentives and gear modifications. Access to other groundfish with higher market value or demand may increase as a result. Bycatch may be reduced for some species like Dover sole, shortspine thornyhead, sablefish, and yellowtail rockfish. Increased cumulative limits would have less of an impact on species constrained by market limits (some flatfishes and chilipepper rockfish, for example).

4.3.5 Impacts of Alternative 5: Vessel catch limits

Summary of Alternative 5 The policy goal of this alternative is to significantly reduce bycatch by limiting catch of each vessel through the use of transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (IFQs). Direct control of catch and individual vessel accountability sets this alternative apart from the previous alternatives. A robust monitoring or catch verification program would be implemented to ensure catch caps are not exceeded. Discarding of overfished species would be prohibited. Gear regulations would be flexible, allowing fishers the ability to modify gear and operations to avoid catch of overfished species and reduce unwanted bycatch of all species. A system of rewards in the form of reserved OY would be used to create vessel incentives to reduce bycatch of overfished species.

This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is increased over Alternative 1 at an increased cost.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 5:

- **Harvest Levels** Optimum yield would remain the same as in Alternative 1, however distributions of available OY would be broken down into caps for each fishing vessel with in-season monitoring of caps. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. The primary direct effect of this alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. Thus, bycatch (discarded catch) of overfished species should be reduced with this alternative as there would be little incentive to discard. This tool ranks 1st out of a range of 1-2 scored for alternatives (See Performance standard and OY reserves in Table 4.3.5).
- **Vessel trip limits** Vessel trip limits would be relaxed or absent, as each vessel would have an individual caps on overfished and other groundfish species. Direct effects expected under this alternative compared to Alternative 1 would be a reduction in regulatory induced discard of overfished species due to the absence of trip limits. This tool ranks 1st out of a range of 1-4 scored for the alternatives (Table 4.3.5).
- **Vessel Catch Limits** Individual vessel caps in the form of transferable restricted species catch quotas (RSQ) for overfished stocks and individual transferable fishing quotas (IFQ) for other groundfish species would be established with this alternative. Bycatch could be avoided due to relaxed trip limits. Catch limits should work positively to minimize discard of overfished species as there would exist no incentive to discard fish. In addition, RSQ or IFQ shares could be purchased if a fisher needed more share of groundfish to continue fishing. When vessels attain limits and cease fishing, bycatch and bycatch mortality would also be reduced to

the degree overall effort is reduced when a vessel reaches a cap. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of all species with RSQs. This tool ranks 1st or 2nd out of a range of 1-4 for the alternatives, depending on the species (Table 4.3.5).

- **Gear Regulations** Gear regulation would be more flexible than under Alternative 1. Gear modification would be facilitated allowing fishers to experiment with different methods to reduce bycatch of overfished species. Strict caps and a robust catch monitoring system would allow fishers to chose modified gear in order to keep within a cap or seek other alternatives such as purchasing more quota shares or fish using a different strategy. This tool ranks 3rd out of a range of 1-3 for the alternatives (Table 4.3.5).
- **Time/Area Closures** would be applied in a manner similar to the first four alternatives. However, under an RSQ/IFQ program, RCAs as they are currently used may be unnecessary. Once an individual vessel's RSQ/IFQ is attained, the vessel must cease to fish anywhere, until the fisher can obtain more quota. There may some limited circumstances where continued fishing might be allowed where the likelihood of encountering the particular species would be highly unlikely. Under an individual vessel catch limit/quota program, fishers would have greater incentive to improve the selectivity of their fishing gear and techniques, avoiding "troublesome" areas in the process and fishing more in areas where they can maximize their profit.
  Other types of time/area closures, such as habitat areas of particular concern, research reserves, etc., would apply to all types of fishing activities specified for those areas. This tool ranks 1st for most species, out of a range of 1-3 for the alternatives (Table 4.3.5).
- **Capacity Reduction** No direct reduction in capacity is considered under this alternative. See discussion under Alternative 1. Some capacity reduction may occur if vessel owners sell RSQ or IFQ shares and elect to fish in a non-groundfish fishery. Capacity reduction accomplished through RSQ/ IFQ sales could have a positive direct effect on the overfished species, if a species cap for a vessel is not used by the vessel. Excess cap could be re-distributed to active fishers or left in reserve. This tool ranks 2nd out of a range of 1-3 for the alternatives (Table 4.3.5).

- **Data Reporting, Record-keeping, and Monitoring** Increased observer coverage would be required. VMS would be used to ensure vessels did not fish within RCAs or other closed areas (PFMC 2003e). Recreational sampling would also be increased under this alternative. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the first three alternatives as fishers are likely to retain catches. Bycatch mortality of groundfish caught and released in the recreational fishery is unknown This tool ranks 1st or 2nd out of a range of 1-5 scored for the alternatives depending on the species (Table 4.3.5).

Impacts on Groundfish

Effects of tools used in alternative 5 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.5. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect. Higher accountability is the hallmark of this alternative. Gear restrictions would be flexible with the exception of RCAs prohibiting use of bottom fishing gears. Performance standards should provide strong incentives to modify gear as needed to reduce bycatch, without the need for regulatory intervention. RSQ and IFQ sales could also lead to capacity reduction within the groundfish fishery if some fishers elect to sell all of their shares and move out of the fishery.

<u>Overfished groundfish</u>
OY for overfished species would be broken down into RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused or reserve OY for other groundfish would be made available to those vessels that had not taken their overfished species OY share.

Canary rockfish and bocaccio catches are currently very close to OY, and constrain catches of other co-occurring groundfish. Under this alternative, incentives would be strong to develop specific gear modifications and adopt new fishing strategies to avoid taking these species. Without transferability, it might be impossible to conduct a fishery where encounter rates of these two species is high. OY shares under this alternative will be very small on a per vessel basis. One indirect effect will be a partitioning of the fleet into different fishing strategies, as vessel owners buy and sell RSQ and IFQ shares to make fishing practical and profitable for a particular strategy.

The primary direct effect of this alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. Thus, overfished species bycatch (discarded catch) should be reduced or eliminated with this alternative as there would be less incentive to do so. Discarded fish counts against the IFQ and observer coverage under this alternative is 100% of the commercial fleet. Some discarding could continue in minor nearshore and recreational fisheries.

Trip limits should not be needed as much, if at all, to manage catch. High levels of accountability would be expected due to performance standards and complete observer coverage. Gear restrictions would be flexible and the performance standards should provide strong incentives for fishers to voluntarily modify gear in order to keep catch of overfished species within specified limits. RCAs would prohibit use of bottom gear having a direct impact on reducing the unwanted catch of overfished species.

Emphasis Species

OY for other groundfish would be broken down into IFQs for each fishing vessel with in-season monitoring of caps. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. When OY is reached, further fishing would be prohibited or severely curtailed, unless additional IFQ share was purchased.

As was pointed out above, there may be strong incentives to buy and sell RSQ and IFQ shares in order to more selectively fish using different strategies. Fishers are not currently able to access other groundfish at or near MSY levels. As an example, some fishers may successfully modify gear and/or purchase enough canary rockfish RSQ to take advantage of yellowtail rockfish IFQ.

If enough fishers are successful at acquiring RSQ shares and/or are able to make appropriate gear modifications to catch more OY of other groundfish then catches of more species may move toward OY levels. Bycatch of Dover sole, shortspine thornyhead, and sablefish should be reduced significantly as a consequence. Under alternative 5, other groundfish that are not overfished are not required to be retained. The result may be an increase in bycatch and bycatch mortality of other groundfish due to higher catch attainment.

Some bycatch and discard mortality could still occur if a vessel approaches attainment of the IFQ. There may be some incentive to finish out the season by spreading out the remaining IFQ in order to maintain the supply of groundfish to the market. In addition, some bycatch and bycatch mortality could occur on the last trip when the IFQ is reached.

Market limits may still have an impact on bycatch and bycatch mortality, as they would continue to exist in the absence of regulatory limits. Bycatch of some species should be reduced due to prohibition of bottom gears in some areas.

4.3.6 Impacts of Alternative 6 *(MPAs, Individual Catch Caps, and Full Retention)*

Summary of Alternative 6: The policy goal of this alternative is to reduce bycatch to near zero by establishing large MPAs in areas where overfished groundfish are most likely to be encountered, prohibiting discard of groundfish, and accurately accounting for catch. This alternative controls bycatch and bycatch mortality by direct controls on both catch, effort, and gear efficiency.

This alternative supports Council objectives for protecting and rebuilding depleted groundfish stocks at a higher cost for monitoring than status quo.

Discussion of Tools Used: The following mix of management measures are applied to create Alternative 6:

- **Harvest Levels** Harvest OY would remain the same as in Alternative 1, however distributions of available OY would be broken down into caps for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed.

A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. The primary direct effect of this Alternative would be a reductions in bycatch of groundfish to near 0 due to strict caps, 100% retention of all groundfish, and 100% observer coverage of the commercial fleet. Unobserved recreational trips would be the primary source bycatch. This tool ranks 1st out of a range of 1-2 scored for alternatives (See Performance standard and OY reserves in Table 4.3.6).

- **Vessel trip limits** Vessel trip limits would be relaxed or absent, as each vessel would have an individual cap on overfished species. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard due to relaxed trip limits and 100% retention requirement. This tool ranks 1st out of a range of 1-4 scored for the alternatives (Table 4.3.6).
- **Vessel Catch Limits** Individual vessel caps in the form of RSQs for overfished stocks and IFQs for other groundfish would be established. 100% of all groundfish would be retained. Thus, bycatch would be near 0. This tool ranks 1st or 2nd out of a range of 1-4 for the alternatives, depending on the species (Table 4.3.6).
- **Gear Regulations** Gear regulation would be actively used to reduce bycatch and bycatch mortality. Through an incentive program, fishers would be encouraged to experiment with gear modifications, use different gear types, or adopt different fishing strategies to stay within bycatch caps. 100% observer coverage of the commercial fleet would allow relaxation of the EFP process normally required for modified gear. Gear modifications may result in exclusion of undersized and overfished groundfish. Bycatch could take the form fish caught but excluded by the gear. The bycatch mortality of escaping fish is unknown. This tool ranks 1st out of a range of 1-3 scored for the alternatives (Table 4.3.6).
- **Time/Area Closures** would take the form of large permanent or semi-permanent MPAs. The placement and size may differ significantly from all of the other alternatives. For purposes of this analysis, we assume MPAs would be patterned after option 3a of the Council's Phase I Technical Analysis of marine reserves (PFMC 2001). This type of reserve would be tailored to

protect overfished species and would set aside 20% of the habitat or biomass with a similar reduction in harvest of the species. MPAs should directly reduce bycatch and bycatch mortality of fish within the closed area. The amount of reduction in bycatch and bycatch mortality due to an MPA would be in proportion to the amount of habitat set aside compared to the total amount of habitat vulnerable to fishing. This would vary depending on the species protected and design of the MPA. The 100% retention requirement would still be the primary means of reducing bycatch outside of MPAs. Some indirect benefits to the groundfish resource would likely occur due to reduce disturbance of habitat afforded by an MPA. This tool ranks 1st out of a range of 1-3 scored for the alternatives (Table 4.3.6).

- **Capacity Reduction** No direct reduction in capacity is considered under this alternative. Tradable IQs may result in consolidation of the fleet though sales of RSQ and IFQ shares (See alternative 5 discussion on capacity reduction). This tool ranks 2nd out of a range of 3 for the alternatives (Table 4.3.6).
- **Data Reporting,** Record-keeping, and Monitoring 100% observer coverage and 100% retention of all groundfish would be required for all commercial fishing sectors. Recreational sampling would also be increased under this alternative. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch compared to other alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the other alternatives, as fishers will be required to retain catches. Bycatch mortality of fish caught and released in the recreational fishery is unknown. This tool ranks 1st out of a range of 1-5 scored for the alternatives (Table 4.3.6).

Impacts on Groundfish

Effects of tools used in alternative 6 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.6. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

<u>Overfished groundfish</u>

OY for overfished species would then be broken down into caps or RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment.

The impacts of application of this tool within alternative 6 is similar to the impacts described under Alternative 5. Small individual shares of RSQ for some species like canary rockfish and bocaccio would have to be purchased and sold to consolidate enough share to fish under certain strategies. The primary direct effect of this alternative would be reductions in bycatch due to strict caps and 100% retention of all groundfish. Thus, overfished species bycatch (discarded catch) should be near 0 with this alternative due to 100% retention requirement.

Gear restrictions would be utilized to keep catch of overfished species within caps. Permanent closures would eliminate all fishing for groundfish reducing bycatch of overfished species and minimizing impact to overfished species habitats.

Unobserved recreational trips would be the primary source overfished species bycatch.

<u>Emphasis Species</u>
Objectives for optimum yield would remain the same as in Alternative 1. OY for overfished species only would then be broken down into caps for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. Tradable IFQ shares would have impacts similar to alternative 5 in that shares are likely to be bought and sold to consolidate fishing strategies. This alternative differs from alternative 5 in that all groundfish must be retained. The primary direct effect of this Alternative would be reductions in bycatch due to strict caps and 100% retention of all groundfish

Gear restrictions would be utilized to keep catch of other groundfish species within caps. Permanent closures designed to protect overfished species would also eliminate all fishing for groundfish thus eliminating bycatch of other groundfish species within these areas.

4.4 Impacts of Alternatives on Non-groundfish Biological Resources

4.4.1 Impacts on Other Relevant Fish, Shellfish, and Squid

<u>Bycatch of Pacific Halibut</u>
Pacific halibut is a highly prized fish targeted by commercial, recreational and tribal fisheries along the West Coast. Directed halibut fishing is managed through a combination of gear, season, area and size restrictions. Only specified hook-and-line gear (see below) may be used to fish for halibut, and only halibut taken with hook-and-line gear may be retained. (The only exception is for tagged halibut, which may be retained regardless of gear, size or area. However, if a tagged halibut is retained, the tag must be returned to the IPHC.) A minimum size limit also applies throughout the range of the species; only halibut over 82 cm (32 in) may be retained in any fishery. Again, the exception is tagged halibut of any size may be retained.

During specific annual seasons/areas, legal-sized halibut may be retained and landed in recreational, commercial setline, and tribal setline fisheries. An allowance is also made for commercial salmon trollers, who are authorized to retain limited amounts of halibut caught while fishing for salmon. Any halibut taken with other gear, outside those seasons/areas, or under legal size, must be returned to the sea and are bycatch. These regulations are established to attain but not exceed the estimated total allowable harvest for the year established by IPHC. Pacific halibut (unless tagged) may not be legally retained by trawl gear at any time and all that are caught are bycatch. Depending on the method of capture and fishing operations, many halibut may survive if handled gently and returned to the sea quickly.

The bycatch of Pacific halibut off the West Coast has relatively little impact on the overall status of the population, but it does affect the total allowable harvest for directed West Coast halibut fisheries, including groundfish fisheries authorized to retain halibut. Pacific halibut are migrants from northern waters off Canada and Alaska, where the bulk of the population resides.

Little, if any, spawning occurs off the West Coast. Each year, the bycatch of legal-sized fish off the West Coast is subtracted from the estimated yield, based on IPHC's stock assessment, to determine the allowable harvest for target fisheries. Consequently, the amount of bycatch has a direct impact on the recreational and setline fisheries for halibut.

The amount of bycatch in groundfish fisheries can be substantial, based on observations of the bottom trawl fishery. Pacific halibut are most frequently caught by bottom trawls operating in the 100-300 fathom depth range off Washington and Oregon, but also are taken at shallower depths on the shelf and off northern California. Few halibut are taken by groundfish gears fishing in midwater.

Bycatch is estimated as a function of halibut catch rate and effort fished for a particular time, area, depth, and target species category. Some of these categories have much higher catch rates than others and could be termed "halibut hot spots." Much of the distribution of Pacific halibut falls within the RCAs recently established for groundfish. Therefore bycatch may already have been reduced from previous years because bottom trawl effort was curtailed in these areas.

Impacts of the Alternatives Compared to Alternative 1 (no action), bycatch of Pacific halibut would not likely change much under Alternatives 2, 3 and 4. The recent reductions in halibut bycatch would be maintained, to the extent that depth restrictions (RCAs) for fishing on the bottom for groundfish is not expanded under these alternatives. However, this reduction could be partially offset if effort were concentrated in an area or time when halibut were also concentrated. For example, observations of catch rates by bottom trawl fisheries during the late 1990s were higher during the January through August period than during September through December. Therefore, if the fishing season (and effort) under Alternative 3 were concentrated during January through August, then more bycatch may be taken.

Under Alternatives 5 and 6, halibut bycatch would tend to be reduced from the status quo. Bycatch may be reduced indirectly by slowing the "race for fish" provided by the increased flexibility of individual fishing operations under these alternatives. These alternatives may provide greater awareness and opportunity to conduct fishing operations in a manner that could lead to reduced bycatch and bycatch mortality of halibut.

The desire to avoid halibut bycatch is likely comparable to the desire to avoid bycatch of overfished species so halibut bycatch would tend to be reduced, at least in the same direction if not magnitude, as bycatch for overfished species. In addition, halibut bycatch under Alternative 6 would likely be reduced to the extent that closed areas are placed in areas where halibut are concentrated, such as the "hot spots." However, bycatch would be increased to the extent that greater fishing effort on bottom occurred in these hot spots through placement of closed areas elsewhere. Incentives for gear modifications and changes to fishing practices to remain within groundfish bycatch caps under these alternatives could increase or decrease halibut bycatch, depending on the modifications implemented.

Although not expressly included in the alternatives, Pacific halibut could be treated like a groundfish for purposes of applying a prohibited species cap (Alternatives 5 and 6) or allowing access to a reserve pool if halibut bycatch were reduced (Alternative 5). If a cap were applied, then halibut bycatch would be reduced accordingly. If full retention were required for halibut like for groundfish in Alternative 6, then bycatch would be eliminated.

Summary Currently, bycatch and bycatch mortality of Pacific halibut off the West Coast are primarily a function of the amount of bottom fishing effort in times and areas where halibut occur. Reducing effort in these areas reduces bycatch, and increasing effort increases bycatch. To the extent that fishing effort patterns change with respect to halibut distribution and abundance, the impact of the alternatives will increase or decrease halibut bycatch. Perhaps as important, many of the alternatives depend upon increased monitoring and reporting, and the resultant improved understanding of halibut bycatch should contribute to reducing it.

Halibut bycatch may be more effectively reduced through the application of certain fisheries management tools than through the proposed alternatives. For example, allowing retention of Pacific halibut by the trawl fishery and by other fisheries outside of currently allowed seasons or areas could substantially reduce bycatch. Similarly, gear modification through the use of halibut bycatch reduction devices, which have been used in trawl fisheries off Alaska, may be beneficial, although potentially costly, for reducing bycatch off the West Coast. Such regulatory changes would primarily be based on social and economic considerations not explicitly addressed in the alternatives, but they could be considered in any of the alternatives.

4.4.2 Impacts on Protected Species

4.4.2.1 Bycatch of Pacific Salmon

Pacific salmon are among the most highly prized species targeted by commercial, recreational and tribal fisheries on the West Coast. Directed salmon fishing is managed through a combination of catch limit, gear, season, area, size and fin-clip restrictions. Pacific coast fisheries in Council-managed waters (3-200 nm offshore) are directed toward and harvest primarily chinook (king) salmon and coho (silver) salmon. Small numbers of pink salmon are also harvested, especially in odd-numbered years. There are no directed fisheries for other Pacific salmon species, and they occur rarely (sockeye) or in very limited numbers (steelhead and chum) in Council-managed harvests.

Several salmon stocks on the West Coast are listed as threatened or endangered under the ESA. Salmon caught in trawl nets are classified as prohibited species, and therefore, salmon captured by groundfish trawl fisheries and brought aboard must be returned to the sea as soon as practicable and with minimal injury (after allowing for sampling by an observer).

Relatively low numbers of salmon are incidentally taken during commercial fishing operations for groundfish. As a result of the spatial/temporal overlap between chinook salmon distribution and the midwater trawl fishery for whiting, most salmon bycatch is taken when fishing for Pacific whiting. Salmon are most often present in the water column, rather than near the sea floor, and midwater trawl gear is primarily used to capture whiting. At present, the whiting fishery consists of at-sea and shore-based components. In the at-sea fishery, the trawl nets are emptied on the deck, and salmon can be removed from the catch and returned to the sea quickly. In the shore-based fishery, the catch is stored, usually in refrigerated seawater, for up to several hours as the catcher vessels transit from the fishing grounds to shore-based plants where the fish are processed. In this fishery, salmon (and other prohibited species) are precluded from being released immediately upon capture.

The 1992 BIOLOGICAL OPINION (BO) analyzing the effects of the Pacific Coast groundfish fishery on salmon stocks listed under the ESA established limits to bycatch of chinook salmon. Currently the limit is set at 0.05 chinook salmon per metric ton of Pacific whiting, with an associated total catch of 11,000 chinook for the coastwide Pacific whiting fishery.

The 1992 BO also requires PFMC to provide for monitoring of salmon bycatch in the midwater trawl fishery for whiting but not in the bottom trawl fishery for groundfish. Currently, this monitoring requirement is based on not jeopardizing the existence of listed salmon species, including the Snake River fall chinook, lower Columbia River chinook, upper Willamette River chinook, and Puget Sound chinook. At present, the at-sea whiting fishery has 100% observer coverage. For the shoreside fishery, 30% of Pacific whiting landings were observed in 2003. In recent years, a cooperative effort between the fishing industry and management agencies has been voluntarily implemented to facilitate observer coverage and collect information on directed whiting landings at shoreside processing plants. Participating vessels are issued EXEMPTED FISHING PERMITS (EFPs) which require vessels to land unsorted catch at designated processing plants. Permitted vessels are not penalized for landing prohibited species, including Pacific salmon, nor are they held liable for overages of groundfish trip limits. In 2003, 99% of the whiting catch by the shoreside fishery was landed under an EFP.

Impacts of the Alternatives In general, the impacts of the alternatives on salmon bycatch is relatively minor. Compared to Alternative 1, bycatch of Pacific salmon in the whiting fisheries would not likely change much under Alternatives 2, 3, and 4. Under Alternatives 5 and 6, the increase in observer coverage to 100% would provide a more comprehensive understanding of salmon bycatch, possibly leading to some improvements. Comprehensive observer information could identify if a salmon bycatch problem occurred in any groundfish fishery, and thereby provide an opportunity to address the problem. However, given the voluntary efforts to avoid salmon bycatch in the whiting fisheries, little reduction would likely occur in these fisheries as long as voluntary measures remain in effect.

4.4.3 Impacts on Seabirds

Interactions between seabirds and fishing operations are wide-spread and have led to conservation concerns in many fisheries throughout the world. Abundant food in the form of offal (discarded fish and fish processing waste) and bait attract birds to fishing vessels. Of the gear used in the groundfish fisheries in the north Pacific, seabirds are occasionally taken incidentally by trawl and pot gear, but they are most often taken by longline gear. Around longline vessels, seabirds forage for offal and bait that has fallen off hooks at or near the water's surface, and are attracted to baited hooks near the water's surface, during the setting of gear. If a bird becomes hooked while feeding on bait or offal, it can be dragged underwater and drowned.

Besides entanglement in fishing gear, seabirds may be indirectly affected by commercial fisheries in various ways. Change in prey availability may be linked to directed fishing and the discarding of fish and offal. Vessel traffic may affect seabirds when it occurs in and around important foraging and breeding habitat and increases the likelihood of bird strikes. In addition, seabirds may be exposed to at-sea garbage dumping and the diesel and other oil discharged into the water associated with commercial fisheries.

In the Pacific Coast Groundfish Fisheries, groundfish observers collect information on interactions between seabirds and groundfish fisheries. Observer coverage varies between different components of the Pacific Coast groundfish fisheries. The at-sea component of the Pacific Coast whiting fishery, which consists of catcher-processors, motherships, and the catcher-vessels delivering to the motherships, has had observer coverage since the mid-1970s. Currently, there is 100% observer coverage of the catcher-processor and mothership vessels. The non-whiting portion of the Pacific Coast groundfish fishery has had observer coverage only since the fall of 2001. Between September 2001 and October 2002, approximately 10% of the coastwide limited entry trawl landed weight and 30% of the limited entry fixed gear landed weight was observed.

The incidental take of seabirds by the at-sea Pacific whiting fleet is rare and infrequent. The species that have been taken by the at-sea whiting fleet include black-footed albatross, northern fulmar, and unidentified puffin. In the limited entry groundfish fisheries, few interactions with seabirds have been observed (Table 4.4.3).

Table 4.4.3. Interactions between seabirds and the Pacific Coast groundfish fisheries documented by West Coast Groundfish Observers between September 2001 and October 2002.

Species	Gear Type	Type of Interaction
Unidentified Gull (*Larus species)*	Trawl	1 Individual Taken
Unidentified Seabird	Trawl	4 Individuals Taken
Short-tailed Albatross (*Phoebastria albatrus*)	Longline and Trawl	Feeding on Discard
California Brown Pelican (*Pelecanus occidentalis californicus*)	Rod and Reel	Feeding on Discard
Marbled Murrelet (*Brachyramphus marmoratus*)	Trawl	Landed on Deck
Black-footed Albatross (*Phoebastria nigripes*)	Trawl, Longline, and Pot	Feeding on Discard
Leach's storm-petrel *(Oceanodroma leucorhoa*)	Trawl	Landed on Deck
Cassin's auklet *(Ptychoramphus aleuticus)*	Trawl	Landed on Deck
Pigeon guillemots *(Cepphus columba*)	Pot	Feeding on Discard
Laysan albatross *(Phoebastria immutabilis)*	Pot	Feeding on Discard
Unidentified Cormorant (*Phalacrocorax species)*	Rod and Reel	Feeding on Discard
Unidentified Storm Petrel (*Oceanodroma species*)	Longline	Landed on Deck
Unidentified Shearwater (*Puffinus species*)	Pot	Feeding on Deck

In response to increased national concern about the incidental take of seabirds, NMFS, USFWS, and the Department of State (DOS) collaborated in 2001 to develop the U.S. *National Plan of Action for Reducing the Incidental Catch of Seabirds in*

Longline Fisheries. The purpose of this plan is to provide national-level policy guidance on reducing the incidental take of seabirds in U.S. longline fisheries and to require NMFS, in cooperation with USFWS, to conduct an assessment of all U.S. longline fisheries to determine whether an incidental take problem exists. Using the West Coast Groundfish Observer Program's first year of data, NMFS drafted a preliminary assessment of seabird interactions with the groundfish longline fleet in 2003. There were no incidental takes of seabirds by longline vessels documented by Groundfish Observers during September 2001 to October 2002; however, a number of interactions between seabirds and longline vessels were observed (see Table 4.4.3). Additionally, this National Plan of Action further requires NMFS, in cooperation with USFWS, to work through the regional fishery management council process in partnership with longline fishery representatives to develop and implement mitigation measures in those fisheries where the incidental take of seabirds is a problem. Therefore, NMFS will continue to work with the USFWS to better understand the interactions between seabirds and the Pacific Coast groundfish fisheries and evaluate the need for seabird incidental take mitigation and management measures.

In order to predict the effects of the bycatch reduction alternatives on Pacific Coast seabird populations, it is important to have knowledge of the distribution, intensity, and duration of fishing effort associated with the groundfish fisheries. This information is currently unavailable for the groundfish fleet, but additional sources information should soon become available.

Regulations have been proposed to establish a Vessel Monitoring System (VMS) for the groundfish fishery and VMS equipment identifies precise vessel location information. Under the proposed rule, which is expected to take effect early in 2004, all vessels will be required to carry VMS equipment while fishing for groundfish. Additionally, information on the distribution of fishing effort is being developed as part of an Essential Fish Habitat Risk Assessment scheduled to be available in the spring of 2004. Because of the temporal and spatial overlap between seabird populations and groundfish fishing effort, projected harvest levels and proposed area closures will be used as a proxy for predicting the bycatch reduction alternatives on seabird populations.

As required by CEQ's NEPA implementing regulations, anytime there is incomplete or unavailable information the federal agency must not only identify that such information is unavailable, but also make an assessment of the importance of that information and what would be the agency's evaluation of the predicted environmental impacts (i.e., best professional judgement) (40 CFR Part 1502.22). Accordingly, NMFS acknowledges that information on the distribution, intensity, and duration of fishing effort is incomplete with no current means of accurately tracking this information. This information is important in order to quantify fishing effort and predict the potential risks of interactions with seabirds. Thus, the following paragraphs shall present a best professional judgement (i.e., qualitative assessment) of the predicted environmental impacts of the alternatives on seabirds.

Under Alternative 1, it is predicted that interactions between the Pacific Coast groundfish fishery and seabirds would be similar to the seabird/fishery interactions during the 2002/2003 groundfish fishery. Based on West Coast Groundfish Observer data, the combined use of trip limits, gear restrictions, and area closures has resulted in few interactions between the groundfish fleet and seabirds (Table 4.4.3). Seabirds may benefit from the temporal and/or spatial distribution of fishing effort associated with trip limit management and area closures, provided that these management measures do not concentrate fishing effort in areas important to seabird foraging and/or breeding. As more information is gathered on seabird interactions with the groundfish fleet, gear restrictions and area closures may be modified to reduce interactions with seabirds.

Under Alternative 2, the number of commercial groundfish trawl vessels would be a reduced by 50%. This reduction in fleet size, paired with gear restrictions and area closures, would likely reduce the trawl fleet's interactions with seabirds. Additionally, by increasing the trip limits for various groundfish species, the "race for fish" should be reduced, potentially allowing fishing behavior to be modified to avoid interactions with seabirds.

Alternative 3 would implement a shorter fishing season, as opposed to the current year-round groundfish fishery, as well as gear restrictions and trip limits designed to discourage fishing in certain areas. Under this alternative, the number of vessels would not be reduced, but fishing would be concentrated in shorter seasons. If fishing activities were concentrated into seasons were there was limited seabird activity along the Pacific Coast, the number of interactions may be reduced under

Alternative 3. However, if fishing were to be concentrated into seasons important for seabird foraging and/or breeding, interactions with seabirds may increase under Alternative 3. During closed periods, all interactions with seabirds would be greatly reduced. The overall effect of Alternative 3 is difficult to predict but it likely depends on the seasonality of the concentrated Pacific Coast groundfish fishery.

Alternative 4 would continue the use of trip limits but with additional restrictions on the amount of groundfish catch that can occur. The objective of Alternative 4 is to provide extended groundfish fishing opportunities for vessels with low rates or low amounts of groundfish bycatch. The effects on seabird/fishery interactions due to additional catch restrictions are difficult to predict, however, it is likely that they would be similar to those under Alternative 3.

Alternative 5 would establish individual vessel groundfish catch quotas (IQs) as a means to mitigate groundfish bycatch and would relax some gear restrictions to encourage fishers to develop individual groundfish bycatch avoidance techniques. While establishment of groundfish IQs may be an effective way to limit bycatch of groundfish species, it is predicted that IQs alone would not directly reduce interactions between seabirds and the Pacific Coast groundfish fleet. However, it is likely that the establishment of individual groundfish catch quotas would result in reduction in the number of trawl vessels. IQs are also predicted to eliminate the "race for fish" and provide a much greater opportunity for vessels to choose when and where they will fish. Additionally, an IQ program may require 100% observer coverage to ensure effectiveness, therefore, the level of information on seabird interactions (as well as seabird distribution) would likely increase substantially. As more is understood about the interactions between groundfish vessels and seabirds along the Pacific Coast and as this information is passed along to fishers, Alternative 5 has the potential to reduce interactions with seabirds.

Under Alternative 6, MPAs and vessel caps would be used to mitigate bycatch by groundfish vessels. MPAs would likely be designed to reduce or prevent incidental take of overfished groundfish species, although they could also be designed to reduce bycatch of other species. Should these areas of reduced fishing coincide with areas important for foraging and breeding seabirds, then Alternative 6 may be useful in reducing the potential for seabird/fishery interactions. Conversely, if these restricted areas cause fishing effort to be concentrated in areas used by seabirds, then Alternative 6 may increase the potential for seabird/fishery interactions. However, the added implementation of groundfish IQs would likely result in a smaller fleet and more cautious fishing strategies. Therefore, Alternative 6 is predicted to result in reduced seabird/fishery interactions compared to Alternatives 1, 2, and 3 and similar to Alternative 5. As more information is gathered on seabird interactions with the groundfish fleet, marine protected areas may be modified to reduce interactions with seabirds.

As more information about the spatial and temporal overlap of groundfish fisheries and seabird populations along the Pacific Coast is gathered, a more comprehensive understanding of seabird/fishery interactions is possible. If it is found that mitigating the effects of the Pacific Coast groundfish fishery on seabirds is necessary, additional management measures, such as seabird deterrents (i.e., streamer lines), discharging offal opposite the hauling station, and reducing fishing activity in areas and/or during seasons important for seabird breeding/foraging, may be required under any of the alternatives.

4.5 Summary of Impacts of Alternative Monitoring Programs

Data Reporting, Record-keeping, and Monitoring are summarized in Table 4.5.1 and briefly described below:

- **Alternative 1** 10% coverage of commercial fleet, 100% coverage of at-sea whiting catcher/processor fleet.
- **Alternative 2** Same as Alternative 1, except some marginal increase in coverage due to fewer trips.
- **Alternative 3** Same as Alternative 1, except some marginal increase in coverage due to fewer trips.
- **Alternative 4** Significant increase in observer coverage with allocation to fleet sectors, mandatory logbooks, increased recreational sampling
- **Alternative 5** 100% observer coverage of commercial fleet and charter boats.
- **Alternative 6** 100% observer coverage of commercial fleet and charter boats.

Effectiveness of tools to improve accountability are ranked by alternative in Tables 4.5.1 and 4.5.2

Overfished Groundfish

Under the Alternative 1 sampling program, total catch estimates of overfished species are highly variable for several reasons. Most of the species are highly aggregating rockfish and population abundance is low, thus tow by tow variability is quite high. The sampling program was initiated in the fall of 2001 and depends on accumulation of observed tows to stabilize variability (NMFS 2003). A complete estimate cannot be made until after logbook and fish ticket data are acquired, some months after the fishing season is over. Status quo monitoring improves previous estimates of bycatch that are based on dated studies. In spite of sampling limitations, these estimates better reflect current population levels, management, and fishing strategies.

Amendment16-2 (PFMC 2003c) discusses status quo bycatch monitoring of overfished species (see section 4.3.1.2). One of the primary concerns with bycatch monitoring is that rebuilding of overfished species is sensitive to actual bycatch rates. Total catch must be accounted for accurately for rebuilding to be successful. Under status quo, observer coverage is available for about 10% of the commercial fleet (100% of at-sea Pacific whiting catcher processors have observer coverage). As was pointed out in the Amendment 16-2 EIS, if bycatch estimates are underestimated, rebuilding progress will be compromised (PFMC 2003c). On the other hand, if they are overestimated, trip limits and available harvest of overfished and healthy stocks of groundfish will be lower, bycatch and bycatch mortality will be higher, and there will be indirect negative socioeconomic impacts. Low OYs for some species make in imperative to improve accounting of catch and bycatch.

Alternatives 2 and 3 assume the same number of observer days would be applied to fewer trips due to either a reduced fleet size (alternative 2) or reduced season (alternative 3). This would have the effect of increasing the proportion of total trips having observer coverage. Some marginal improvements should occur in tracking of overfished species.

In alternative 4, observer coverage would be significantly increased along with cost compared to alternatives 1-3. Observers would be placed on a subset of each sector, and observed catch rates extrapolated (expanded) to the entire sector. Recreational sampling would also be increased under this alternative. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Bycatch mortality of overfished species may also be reduced in the commercial fishery compared to the first three alternatives as fishers are likely to retain catches.

Alternative 5 and 6 provide 100% coverage of the commercial fleet, increased monitoring of the recreational charter boat fleet. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given fishing vessel. These controls would have a direct effect of reducing bycatch of overfished species compared to the first four alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the first four alternatives as fishers are more likely to retain catches.

Although coverage of the charter boat fleet is increased, some bycatch mortality of rockfish caught and released in the recreational fishery would occur. Bycatch mortality of lingcod is thought to be less than for rockfish as lingcod do not possess a swim bladder.

Costs for alternatives 5 and 6 are significantly higher than alternatives 1-3 and somewhat higher than alternative 4.

<u>Emphasis Species</u>
Several species of groundfish co-occurring with overfished species or species under precautionary management are constrained in an effort to control harvest of species of concern. Ratio management seeks to predict catch of overfished species and those under precautionary management relative to target species in order to scale and proportion trip limits. Under Alternative 1, if observer coverage and monitoring efforts result in over estimation of the bycatch of overfished species or species under precautionary management, trip limits for healthy stocks such as shelf rockfish, Petrale sole, Dover sole, sablefish, and longspine thornyhead could be constrained more than they need to be (see discussion above under <u>Overfished species</u>) resulting in an increase in bycatch and bycatch mortality as well as negative socioeconomic impacts. Nevertheless, it is critical to improve estimates of catch and bycatch in order to provide accurate catch ratios and set trip limits that reflect these ratios. Currently, there is evidence that catch ratios may not reflect reality. For example, Dover sole discard rates are estimated to be only 5%, and most of the OY is taken by the trawl fishery for DTS complex. On the other hand, sablefish and longspine

thornyhead harvest is lower than OY. Discard rates are comparatively high for shortspine thornyhead, to the point that OY may be exceeded. All of these observations suggest that the ratios do not reflect reality, and that better information is needed (see discussion above under **Trip limits**).

As was described above under overfished species, Alternatives 2 and 3 should have a positive impact on catch reporting of other groundfish compared to alternative 1. Discard information on other healthier stocks of groundfish may be improved. Currently observers do not collect data on the reasons for discarding fish. Managers may want to consider allocating some of time spent accounting for overfished species and other groundfish (ratio estimation) towards gathering additional important data on the reasons for discard.

Alternative 4 would improve reporting of catch over the previous three alternatives and should produce more precise information about regulatory, size, and market induced discard of other groundfish. The improved information should have a positive indirect impact on stock assessments of other groundfish.

Discarding of other groundfish would still be legal under alternative 5 but not alternative 6.. 100% observer coverage of the commercial fleet and increased coverage of the recreational fleet would provide better data on total catch of other groundfish, including discards. These alternative should substantially improve information and accountability compared to the first four alternatives. Another impact of 100% observer coverage would be very timely and accurate accounting of most of the catch. Indirect impacts of 100% observer coverage would be improved stock assessments and improved data on reasons for discard that may led to new methods of avoiding bycatch.

Potential impacts to the resource due to bias in catch estimates are thought to be minimal for more abundant species such as petrale sole and English sole, as current exploitation rates are thought to be low, thus catch and bycatch are low with respect to OY.

4.6 Summary of Impacts to Biological Environment

Relative effectiveness of each alternatives ability to reduce bycatch, bycatch mortality, and to increase accountability were compared. Alternatives were ranked according to tools used to create the alternative and summarized in Tables 4.6.1 and 4.6.2.

4.6.1 Summary of Alternative 1 *(No Action)*

The policy goal of Alternative 1 is to continue current fishery management provided by the FMP in a manner consistent with Council objectives of maintaining a year-round groundfish fishery, preventing overfishing, and rebuilding overfished stocks at current levels of effort. Trip limits are used to discourage fishing in certain areas based on species encounter rates of overfished species. Gear restrictions are used where possible to reduce expected bycatch rates. Area closures are also used to reduce or prohibit fishing within Rockfish Conservation Areas (RCAs) on the continental shelf. Management relies on logbooks, port sampling, and partial observer coverage of the groundfish fleet.

A major source of impacts to groundfish resources is regulatory discard due to tight trip limits needed to keep overall catch within OY. Primary affected groundfish species include overfished groundfish and highly valued groundfish with catches constrained by co-occurring overfished species limits. While current management protects rebuilding strategies, a significant fraction of the overall groundfish OY is discarded or not harvested due to constraints on overfished species. Gear restrictions and RCAs do have the added benefit of setting aside most fishing activities along with associated bycatch impacts from large areas of the continental shelf off Washington, Oregon, and California. Bycatch reductions within these areas not only benefit groundfish but also reduce the bycatch of halibut and impacts to benthic organisms. Pelagic trawling still occurs within the boundaries of RCAs and there is measurable bycatch of Pacific whiting, widow rockfish, yellowtail rockfish and prohibited species such as salmon.

Experimentation with gear designs and configurations may result in reduced observed bycatch of overfished species. The fate of fish excluded from fishing gears is largely unknown and excluded fish are likely to contribute to bycatch mortality to some degree.

Seaward and shoreward of the RCA boundaries, current management measures do not significantly affect market induced bycatch resulting from discard of undersized fish or fish having low or no present market value.

Alternative 1 management does have a sampling program designed to make improvements in historical estimates of catch, catch ratios of overfished to other groundfish, and estimated bycatch. The program is designed to provide a valid scientific basis for management at a low cost.

4.6.2 Summary of Alternative 2 *(Larger trip limits - fleet reduction)*

The policy goal of this alternative is to reduce bycatch by reducing harvest capacity and increasing trip limit size without reducing the length of the season. This goal supports Council objectives of maintaining a year-round groundfish fishery, preventing overfishing, and rebuilding overfished stocks while maintaining an economical monitoring program. It adds the new objective of reducing fleet capacity which is embodied in the Council adopted Strategic Plan for West Coast groundfish.

This alternative is similar to Alternative 1 in that trip limits, gear restrictions, RCAs, and an economical sampling program is used to manage the fishery. It differs significantly in that trawl effort is reduced 50% compared to Alternative 1. Reducing effort would tend to make other bycatch reduction tools work more efficiently. The primary effect of effort reduction is that trip limit size could be increased. Studies have shown that bycatch is inversely proportional to trip limit sized. This was found to be true for especially for West Coast groundfish species of concern. The primary benefit of increasing trip limit size in contemporary management of overfished species is to reduce regulatory induced bycatch. Bycatch reduction of highly valued but constrained species of other groundfish would also occur due to the larger trip limits. Other impacts would remain largely the same as Alternative 1.

Monitoring would improve marginally under this alternative compared to Alternative 1. If the number of observer days remains the same, coverage would likely increase as a proportion of observed to total trips would increase with a reduction in effective effort.

4.6.3 Summary of Alternative 3 *(Larger trip limits - shorten season)*

The policy goal of this alternative is to reduce bycatch by shortening the fishing season by 50%. It attempts to accomplish effort reduction sought in alternative 2 without reducing fleet size. This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks while maintaining an economical monitoring program. It may be contrary to the current goal of maintaining a year-round groundfish fishery, although platooning could be used to accomplish this objective.

Under this alternative, trip limit size would be increased to reduce bycatch and season would be shortened so that larger trip limits could be maintained. By careful platooning of the fleet, a year-round season might still be possible but at the cost of greater difficulty in predicting fishing effort and setting trip limits appropriately. Fleet response to this approach is hard to predict. The shortened season may result in some fishers choosing alternative non-groundfish fisheries, or electing to fish at a particular time of the year. Fishing could occur at a time of year when encounter rates of overfished species is higher. If too many fishers elected to fish during a certain period of the year, product flow could be interrupted. Aside from these concerns, the impacts of a reduced season and larger trip limit size should be similar to Alternative 2, without the cost of a buyback program.

Shortening the season should reduce the total number of trips possible within the year. Monitoring coverage should improve marginally, as they did under Alternative 2. The same number of observers days would be used to cover fewer total trips, increasing the proportion of total trips covered by observers.

4.6.4 Summary of Alternative 4 *(Sector catch limits)*

The policy goal of this alternative is to reduce bycatch by setting catch limits for the various fleet sectors and establishing an in-season catch monitoring or verification program to ensure catch caps are not exceeded. This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is increased over Alternative 1 at an increased cost.

4.6.5 Summary of Alternative 5 *(Vessel sector catch limits)*

The policy goal of this alternative is to significantly reduce bycatch by limiting catch of each vessel through the use of transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (IFQs). A robust monitoring or catch verification program would be implemented to ensure catch caps are not exceeded. Discarding of overfished species would be prohibited. Gear regulations would be flexible, allowing fishers the ability to modify gear and operations to avoid catch of overfished species and reduce unwanted bycatch of all species. A system of rewards in the form of reserved OY would be used to create vessel incentives to reduce bycatch of overfished species.

This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is increased over Alternative 1 at an increased cost.

4.6.6 Summary of Alternative 6 *(MPAs, Individual Caps, and Full Retention)*

The policy goal of this alternative is to reduce bycatch to near zero by establishing MPAs, prohibiting discard of groundfish, and accurately accounting for catch. This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is extensive compared to Alternative 1 at an increased cost.

4.7 Summary of Impacts to the Socioeconomic Environment

(To Be Completed)

4.8 Distribution of Landed Catch and Bycatch

(To Be Completed)

4.9 Cumulative Impacts

(To Be Completed)

4.10 Irreversible and Irretrievable Impacts

(To Be Completed)

4.11 Impacts to Management and Environmental Management Issues

(To Be Completed)

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Exhibit C.9
Attachment 2
September 2003

Groundfish Bycatch Program EIS

PFMC Initial Public Review Draft

Appendix A. Biological Environment: Distribution, Life History, and Status of Relevant Species

August 11, 2003

Table of Contents

Page

Appendix A

Appendix A. Distribution, Life History, and Status of Relevant Species

This appendix summarizes important life history, distribution, stock status, and trend information needed as background for evaluating impacts of management alternatives on the affected environment of groundfish. If available, historical data on biomass and landed catch are graphed.

A.1 Groundfish

For groundfish, biomass data are taken from recent stock assessments or NMFS trawl survey data. Landing statistics are also taken from recent stock assessments, SAFE documents, or PacFIN summaries. Unless otherwise noted, a coastwide perspective in these trends was presented.

Groundfish summaries are grouped into four main headings in the following sections:

- Roundfish
- Rockfish
- Flatfish
- Other groundfish

Within each of these sections, species are listed according to their stock status:

- Overfished
- Pre-cautionary
- Above Target Level (MSY)
- Unknown Status

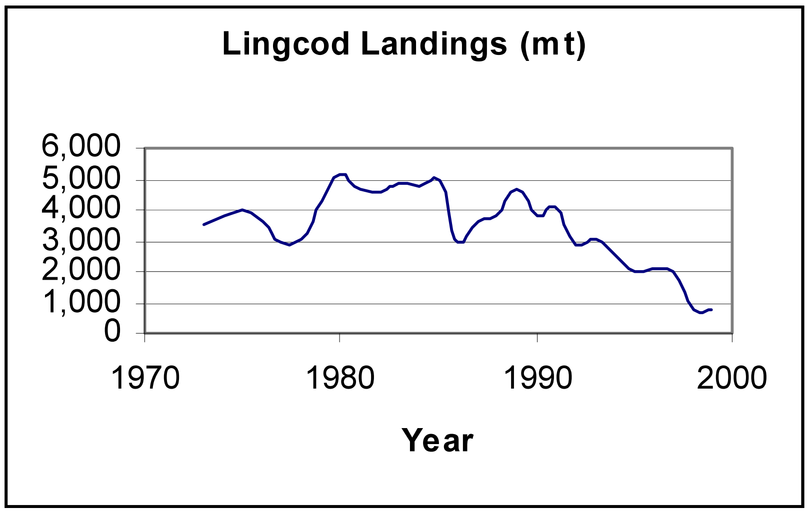
A.1.1 Roundfish

The lingcod stock has been designated as overfished. It appears to be rebuilding well.

A.1.1.1 Lingcod (*Ophiodon elongatus*) within the PFMC management area is a shelf roundfish species of the family *Hexagrammidae*. Most lingcod catch has occurred in the north in the Columbia and U.S.-Vancouver International North Pacific Fisheries Commission (INPFC) areas which is consistent with the estimated geographic center of biomass distribution occurring water off Washington and British Columbia

(Hart 1973). Lingcod were often caught in shelf trawl and recreational fisheries. Exploitation was estimated to be over the maximum fishing mortality threshold (MFMT) now used as a proxy MSY harvest rate for lingcod ($F_{45\%}$).

Lingcod are caught by nearly all gear types in bays, estuaries, and nearshore and offshore areas out to 200 fm on the continental shelf. It has a habitat preference for hard bottom and rocky high relief habitats. Lingcod was declared overfished in 1999 and the Council as developed a rebuilding plan with the goal of rebuilding sablefish to B_{MSY} in 10 years with a 60% probability (Jagielo and Hastie 2001).



Distribution and Life History Lingcod occur from Kodiak Island, Gulf of Alaska to Baja, California with the highest densities from Point Conception, California to Cape Spenser, Alaska. They are classified as an estuarine-mesobenthal species (Allen and Smith 1988).

Young lingcod larvae are demersal. Older larvae and young juveniles are epipelagic and primarily found in the upper 1.6 fm (3 m) of the water column. Off California, young juveniles are pelagic and occur in the upper 19 fm (35 m) of the water column. Juveniles move to deeper water as they grow, but are still most common in waters less than 82 fm (150 m). Adults are demersal along the continental shelf and most abundant in waters less than 109 fm (200 m) in depth. The catch of lingcod is generally highest in 38-82 fm (70-150 m) of water from Vancouver Island, British Columbia to the Columbia River estuary. Analysis of fishery and survey information show that male lingcod tend to be more abundant in shallower waters than females, and that larger fish of both sexes are found in deeper water (Jagielo 1994).

Adult lingcod prefer rocky banks on upper continental shelf.

In general, lingcod are patchily distributed among areas of hard bottom and rocky relief. Larvae are typically found in nearshore waters. Small juveniles can be found on sandy substrate in estuaries and subtidal zones all along the coast, but are more common in the northern extent of their range. Large juveniles settle to the ocean floor on sand, often near eelgrass or kelp beds. Adults prefer slopes of submerged banks with seaweed, kelp, and eelgrass beds 5-38 fm (10-70 m) below the surface and channels with swift currents flowing around rocky reefs. Adults are strongly residential, tending to remain near the reefs and rocky areas where they live (Adams and Starr 2001). Lingcod associate with other nearshore and shelf rockfish and cabezon which demonstrate similar habitat preferences.

Lingcod lay eggs in a nest which is guarded by the male.

Spawning lingcod are generally associated with nearshore, rocky reef habitat. During spawning, male and female lingcod gather along rocky reefs affected by strong wave action or tidal currents (Vincent-Lang 1994). Egg masses are usually found in rock crevices or under over hanging boulders and have been found to depths of 53 fm (97 m)(Karpov *et al.* 1995). As current flow is necessary for gas exchange, eggs are usually laid in areas with currents 3.5 km/h or greater. Male lingcod guard egg masses from predators during incubation, removal of the male results in a high incidence of egg loss (Karpov *et al.* 1995). Spawning adults and eggs are common in Puget Sound, Hood Canal, and Skagit Bay, Washington and in Humboldt Bay, California (PFMC 2002d).

Stock Status and Trends Coastwide commercial landings peaked in 1983 at 4,146 mt. Historically, trawl gear made up the majority of landings coastwide (76%). In 1999, trawl gear comprised 63% of the commercial total for the northern coast (US Vancouver and Columbia areas) and 50% of the total for the southern coast (Eureka, Monterey, and Conception areas). Historically, recreational landings comprised a larger proportion of the total landings for the southern area, compared to the northern area. In recent years, the recreational portion of the total landings has increased in the north. The 1995-99 average proportional recreational was 49% of the total weight in the south and 21% in the north.

Jagielo *et al.* (1997) estimated the abundance of the northern lingcod stock in the Columbia and U.S.-Vancouver INPFC areas to be at 8.8% of its estimated unfished spawning potential. Therefore, the National Marine Fisheries Service (NMFS) declared the stock overfished in March 1999. Jagielo *et al.*

(2000) estimated a coastwide biomass of lingcod to be at 15% of its unfished biomass, confirming the need to rebuild the stock coastwide. The most recent assessment applies to lingcod in the full PFMC management zone (the US-Vancouver, Columbia, Eureka, Monterey, and Conception INPFC areas. Separate assessment models were constructed to describe population trends in the northern (LCN: US-Vancouver, Columbia) and southern (LCS: Eureka, Monterey, Conception) areas.

Recruitment in both northern and southern areas has been low in recent years compared to recruitment before the 1990s.

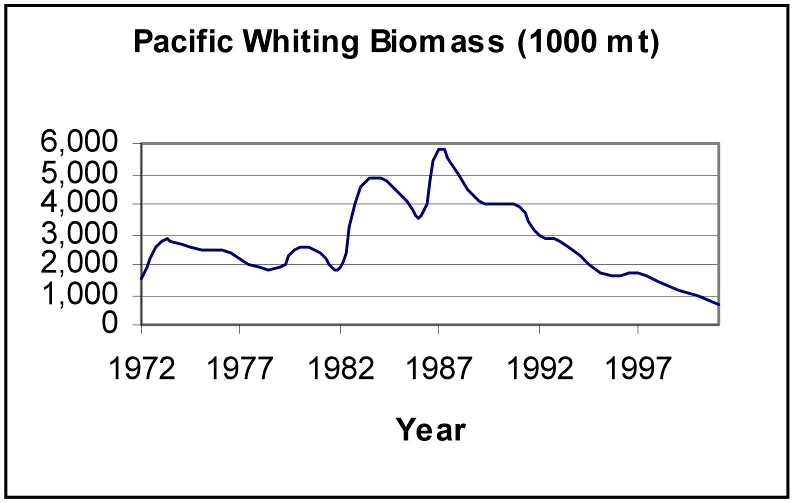
Total stock biomass (age2+) in the northern area declined from over 27,000 mt in the mid 1970s to approximately 6,500 mt in the mid-1990s. Estimates of recent biomass indicate an increase to approximately 8,900 mt in the northern area. In the southern area, total biomass declined from over 14,000 mt in the mid 1990s to approximately 5,700 mt in the late-1990s. Estimates of recent biomass indicate an increase to approximately 6,200 mt in the southern area. Female spawning biomass (SSB) in 2000 was estimated at 3,527 mt for the northern area, and 3,220 mt for the southern area. In both regions, recent recruitments during the 1990s have been low compared to the early part of the time series (1973-82). Estimates of female unfished spawning stock size (B_0), derived using historical recruitment averaged over 1973-82 were 31,033 mt for the northern area, and 22,800 mt for the southern area, respectively. Using these values, female spawning stock size in 2000 was 11% of the unfished stock size in the north, and 14% in the south (Jagielo *et al.* 2000).

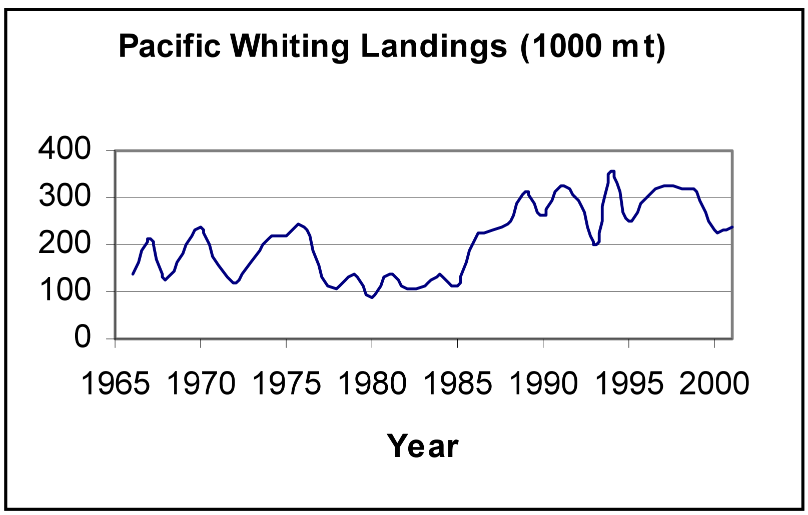
The southern stock appears to be relatively more abundant than the northern stock, but the southern assessment is based on less information.

Major uncertainties within the stock assessments are associated with differences in stock condition and data available for assessments. The southern stock assessment indicates relatively higher stock biomass but is based on a shorter time series of data compared with the northern area. The northern area assessment is based on a much longer time series and stock biomass appears to be at a lower level compared to B_0. Changes in minimum size limits may have compromised the ability to estimate recent recruitments and trip limits may have also compromised fishery CPUE data used as indices of abundance.

Pacific whiting is overfished. A strong year-class will help rebuilding.

A.1.1.2 Pacific Whiting (*Merluccius productus*), also called Pacific hake, is a codlike species distributed off the west coast of North America from 25° N. to 51° N. lat. The coastal stock of Pacific whiting is currently the most abundant groundfish population in the California current system. The fishery for Pacific whiting has supported total annual catches that have averaged in excess of 200,000 mt annually. The most recent stock assessment indicated a recent series of poor recruitments and a spawning biomass of 20% of the unfished stock. Because mature female spawning biomass was estimated to be less than 25% of an unfished stock abundance, NOAA Fisheries Service designated the Pacific whiting stock to be overfished in 2002. A strong 1999 year-class is entering the fishery however, and it is anticipated that restrictions on the fishery and the maturing year-class will contribute to an increase in the mature female spawning biomass over the next three years (Helser 2002a).





Historically, Pacific whiting spawn in January through April off southern California, and then migrate northward towards Vancouver Island, Canada. In recent years, spawning has been detected in northern areas, including Canadian waters.

Distribution and Life History Pacific whiting are a semi-pelagic roundfish distributed from the Gulf of California to the Gulf of Alaska and east to Asia in depths from 0 to 500 fm (usually in depths <125 fm). They are similar to true cods, but are in the family Merlucciidae due to some differences in internal and external structures. There are genetic differences between the West Coast whiting population and those found in the larger, semi-enclosed inlets of Puget Sound and the Strait of Georgia as well as the southern stock off Baja California. Only the main coastal population off the Pacific Coast waters of WOC are within Council purview and addressed here. The coastal Pacific whiting stock ranges from southern California to Queen Charlotte Sound. Spawning occurs off southern California during January to March and then the stock migrates northward to feed in the waters off the continental slope and shelf from northern California to Vancouver Island (PFMC 2002b).

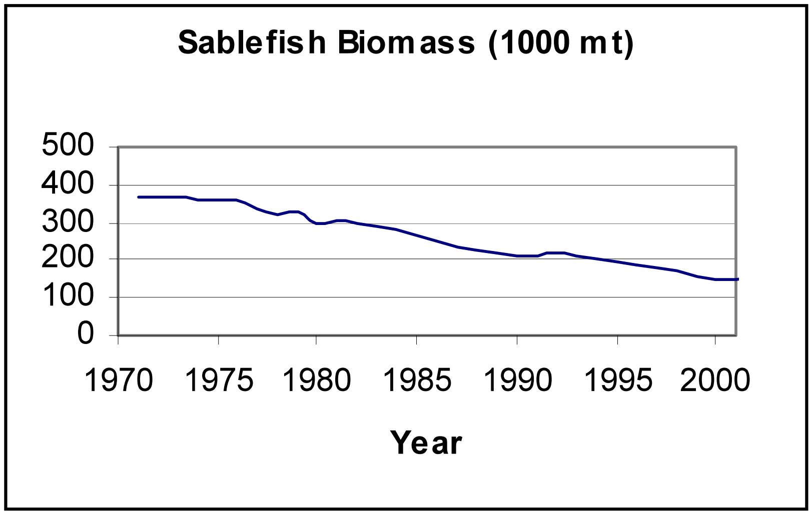
Pacific whiting is a trans-boundary stock - a joint U.S. and Canada assessment was conducted in 2001.

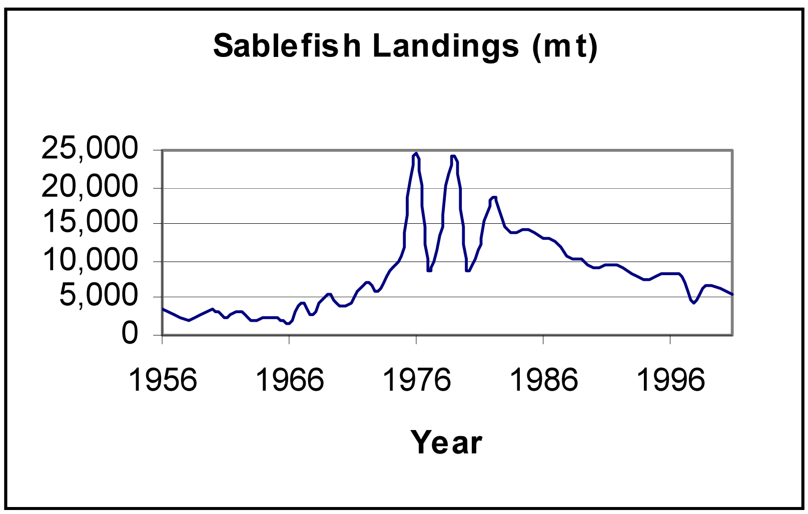
Stock Status and Trends The Pacific whiting fishery is annually assessed and managed jointly with the Canadian Department of Fisheries and Oceans. A total U.S./Canada ABC is determined from the assessment and the U.S. portion has been 80% of the ABC. A 1998 assessment concluded the stock was at moderate abundance (Dorn *et al.* 1999). Stock biomass increased to a historical high of 5.7 million mt in 1987 due to exceptionally large 1980 and 1984 year classes, then declined as these year classes passed through the population and were replaced by more moderate year classes. Stock size has been relatively stable over the past four years at 1.7 to 1.8 million mt. The mature female biomass in 1998 was estimated to be 37% of an unfished stock. Although 1998 stock size was near a historical low, it was close to average stock size under current harvest policies. The exploitation rate was below 10% prior to 1993, then increased to 17% during 1994 through 1998.
An update of the 1999 assessment was prepared in 2001 (Helser *et al.* 2002b). The fishery age composition and recruitment indices showed no indication of strong recruiting year classes, suggesting a continuing pattern of weak to moderate year classes consistent with the 1998 assessment. Yield projections from the 2000 assessment update for 2001 were within 5% of the projected yield for the 1998 model. The 1998 model projections were used to obtain the 2001 ABC. Whiting catch in 2000 will be approximately 75% of the ABC due to the scarcity of fishable aggregations of whiting off northern Washington and southeast Vancouver Island during the summer season. A “40-10” adjustment is made to the ABC to calculate the OY (with an $F_{40\%}$ MSY proxy harvest rate) since this stock is in the “precautionary zone”. The 1999 and 2000 OYs were based on an average value for the two years as the stock declined in abundance. The 2001 OY (190,400 mt) and 2002 OY (129,600) reflect reductions due to the current lower abundance. ABC for 2003 is 188,000 mt and the Council recommended OY for 2003 is 148,200 mt (PFMC 2002c).

A.1.1.3 Sablefish (*Anoplopoma fimbria*) are

found from the southern tip of Baja California to the Gulf of

Alaska, westward to the Aleutian Islands, and in gullies and deep canyons at depths greater than 109 fm (200m). The stock is currently between 27% and 38% of unfished biomass. "Precautionary" management principles are being applied and the ABC for sablefish is reduced by the 40-10 rule.





Distribution and Life History. While sablefish in the Northeastern Pacific Ocean are known to be highly migratory (Heifetz and Fujioka 1991; Maloney and Heifetz 1997), it appears there may exist at least three different stocks of sablefish along the west coast of North America. One stock south of Monterey Bay is characterized by slow growth and a small maximum size (Cailliet *et al.* 1988; Phillips and Imamura 1954). Another stock distributed from northern California to Washington is characterized by moderately fast growth and a large maximum size (Fujiwara and Hankin 1988; Methot 1994; 1995). This second stock supports the bulk of the fisheries in the Washington, Oregon, and California (WOC) management area and was the subject of the most recent stock assessments.

A third sablefish stock distributed from British Columbia, Canada and in the Gulf of Alaska has the fastest growth rate and attains the largest size in the Northeastern Pacific (Mason *et al.* 1983; McFarlane and Beamish 1990; Methot 1995). The sablefish stock assessment assumes a single unit stock for sablefish within Vancouver through Conception management areas (Schirripa and Methot 2001).

Age at 50% maturity is about 6 years for sablefish. Sablefish grow rapidly to maturity and both sexes stop growing at about 10 years of age, and have been known to reach ages of 55 years or more (Love 1991). Sablefish can reach sizes in excess of 1 meter in length. In the most recent assessment, the largest female aged was estimated to be between 80 and 82 years of age and was 102 cm in length. Mature females of the same age are generally larger than males. Sablefish spawn in deep water between October and April (Love 1991). Young-of-the-year swim onto the shelf and live at or near the surface. Some portion of adult sablefish appear to make seasonal migrations from deeper water off the continental slope and canyon areas onto the continental shelf during the summer months. Adult sablefish are top carnivores that feed primarily on fishes, cephalopods, and crustaceans (Low *et al.* 1976; Shaw 1984).

Sablefish recruitment appears to be correlated with periods of high copepod production associated with favorable climate and ocean conditions (King *et al.* 2000). A 15-year zooplankton time series off southern Vancouver Island showed large interannual anomalies of zooplankton biomass (Mackas *et al.* 2001; Schirripa and Methot 2001). Mackas *et al*.(2001) reported a significant relation between estimates of sablefish recruitment and these copepod anomalies.

The sablefish OY is allocated among users.

Stock Status and Trends. Sablefish harvest is allocated among the major commercial fishery sectors. (Recreational fishers rarely target sablefish and are not included within the allocation framework.) Overall fishing mortality is divided among tribal longline and domestic trawl, pot, longline, and hook and line fisheries. Currently, the tribal sablefish longline fisheries are allocated 10% of the total catch OY. The remaining 90% of the total catch OY was discounted 24 mt in 2002 for research then divided between open access (9.4% of the non-tribal OY) and limited entry fisheries (90.6% of the non-tribal OY). The limited entry allocation is divided between the trawl sector (58%) and the fixed gear sector (42%). Estimated discard mortality ranges from 3% to 22% and is deducted from total catch OY for each fishery sector.

A major uncertainty is the recruitment levels prior to 1980 when stock biomass was higher.

In 2001, two assessments were prepared for the sablefish stock north of Monterey (Hilborn *et al.* 2001; Schirripa and Methot 2001). Both assessments indicated a normal decline in biomass since the late 1970s due to the fishing down of the virgin stock and an unexpected decline in recruitment during the early 1990s. No reliable estimates of recruitment area available prior to 1980 when stock biomass was higher, adding uncertainty to the present assessment. See STAR Panel Report in PFMC(2002a). Sablefish stock status was updated in 2002. Newly available 2001 data documented two relatively strong incoming cohorts, the 1999 and 2000 year classes (Schirripa 2002).

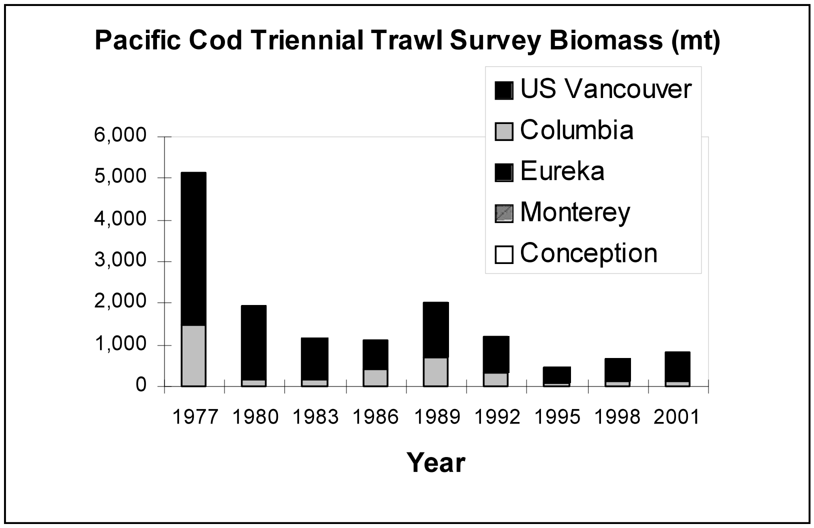
Declines in sablefish abundance are likely due to normal fishing down process and recent poor recruitment tied to environmental conditions.

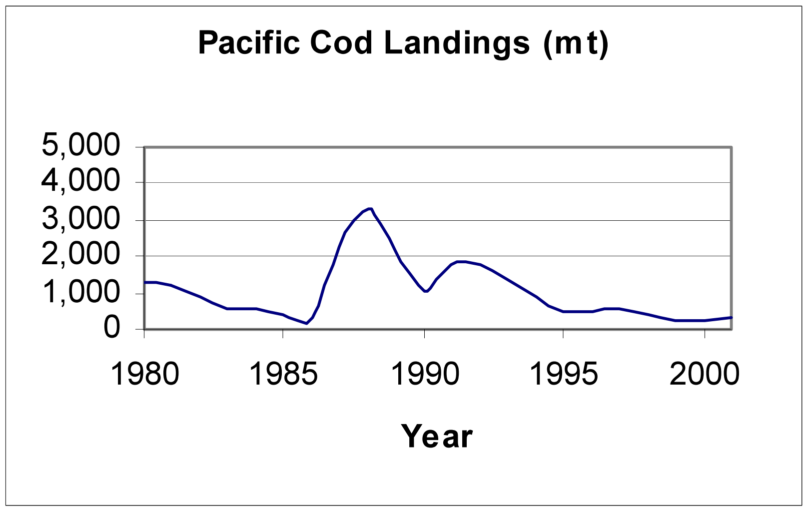
Change in environmental conditions may have been responsible for the abrupt decline in recruitment in the 1990s, or this low recruitment may have been the natural consequence of the gradual decline in spawning biomass. The sablefish stock is currently estimated to be between 27% and 38% of the unfished biomass depending on the assessment scenario and the basis for estimating unfished biomass. The harvest policy for sablefish sets target fishing mortality rate at F_{45}, the instantaneous rate of fishing mortality that, in theory, should maintain a minimum spawning biomass at 45% of virgin spawning biomass. Consequently, estimated sablefish abundance falls within the "precautionary zone" and is subject to the Council's 40-10 harvest policy (Schirripa and Methot 2001).

Abundance of Pacific Cod in PFMC waters is largely controlled by environmental conditions and productivity off Canada and Alaska.

A.1.1.4 Pacific Cod (*Gadus macrocephalus*)

are an important component of Canadian and Gulf of Alaska trawl fisheries. Periodic strong recruitment events increase trawl catches significantly of the Washington and Oregon coasts. Stock status in the West Coast management area is unknown.



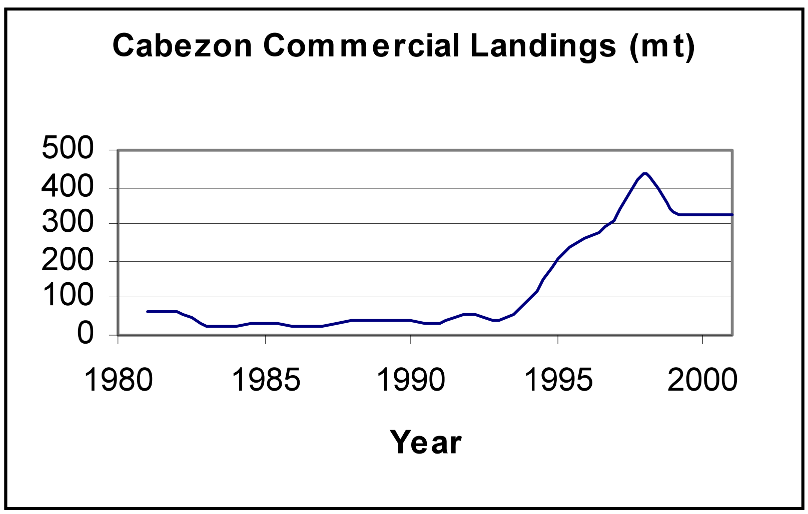


Distribution and Life History Pacific cod are widely distributed in the coastal north Pacific, from the Bering Sea to southern California in the east, and to the Sea of Japan in the west. Adult Pacific cod occur as deep as 481 fm (875 m) (Allen and Smith 1988), but the vast majority occur between 28 fm (50 m) and 165 fm (300 m) (Allen and Smith 1988; Hart 1973; Love 1991; NOAA 1990). Along the West Coast, Pacific cod prefer shallow, soft-bottom habitats in marine and estuarine environments (Garrison and Miller 1982), although adults have been found associated with coarse sand and gravel substrates (Garrison and Miller 1982; Palsson 1990).

Pacific cod have a fairly high rate of natural mortality and rapid growth rate (Hart 1973). Females reach 40 cm at 2 to 3 years - the age of first maturity. At 60 cm, females may produce 1.2 million eggs. Fifty percent of the males are mature at age 2. Larvae and small juveniles are pelagic; large juveniles and adults are parademersal (Dunn and Matarese 1987; NOAA 1990). Adult Pacific cod are not considered to be a migratory species. There is, however, a seasonal bathymetric movement from deep spawning areas of the outer shelf and upper slope in fall and winter to shallow middle-upper shelf feeding grounds in the spring (Dunn and Matarese 1987; Hart 1973; NOAA 1990; Shimada and Kimura 1994).

Stock Status and Trends The GMT set coastwide ABC for Pacific cod at 3,200 mt in 1989 near the highest catch on record. The coastwide catch reported by PacFIN shows a steady decline each year since then to about 1,500 mt in recent years. No quantitative assessment has been attempted for Pacific cod off Washington, Oregon, and California, because changes in stock abundance in this area are probably dominated by environmental factors which influence the contribution of fish from the north (PFMC 1999b).

A.1.1.5 Cabezon (*Scorpaenichthys marmoratus*) is the largest member of the sculpin family (Cottidae) and an important component of the nearshore recreational and commercial fisheries in the Washington, Oregon, and California management area (Weeks 2002).



Distribution and Life History Cabezon are found from central Baja California north to southeast Alaska (Eschmeyer *et al.* 1983; Hart 1973). The species is found in inshore waters from the intertidal out to depths of about 42 fm (76 m). It is most common at depths of 2.5 fm to 30 fm (5-59 m). Cabezon are found on rocky, sandy and muddy bottoms, and in kelp beds (Love 1996). They inhabit restricted home ranges based on a California tagging study (Leet *et al.* 1992). Fish tagged and displaced demonstrated some ability to return to their home area.

Cabezon have been reported to reach sizes of 39 in. (99cm) and 30.8 lb (14 kg). Expected maximum size from age and growth observations in California and Puget Sound are closer to 25 in (64.5 cm). Cabezon may live up to 20 years. A 25 inch (65 cm) male from Puget Sound was estimated to be 17 years old, and a 28 inch (72.5 cm) female was estimated to be 16 years old. Limited information suggests that males start to mature at age 3 and all are mature at age 4. Females begin to mature at age 4 and all may be mature at age 6.

Spawning takes place from late October to March in California (peaking in January), and from November through September (peaking in March and April) in Washington. Fecundity ranges from 49,000 eggs (produced by a 43 cm female) to 152,000 eggs (produced by a 77 cm female). Eggs are deposited in clusters in shallow waters or in the low intertidal on bedrock, or in crevices. Males guard the nest after spawning and nest sites may be re-used from year to year (Lauth 1987; Lauth 1988). Eggs hatch two to three weeks after spawning. Small juveniles spend three to four months in the water column feeding on small crustaceans and other zooplankton. At about 1.5 inches (approximately 4 cm) they take up a demersal life-style.

Cabezon prey largely on crustaceans, with differences based on size. Adults prey on crustaceans (crabs, small lobster), mollusks(squid, octopus, abalone), smaller fishes, and fish eggs. Small juveniles prey on copepods, amphipods, and larval barnacles. Small cabezon are preyed on by larger fishes including rockfishes, lingcod, adult cabezon, and other sculpins. Adults are taken by pinnipeds.

Eggs are reported to be poisonous to humans. They are lethal to laboratory test animals, and are avoided by potential natural predators such as raccoons, mink, and birds (Hubbs and Wick 1951; Parsons 1986; Pillsbury 1957).

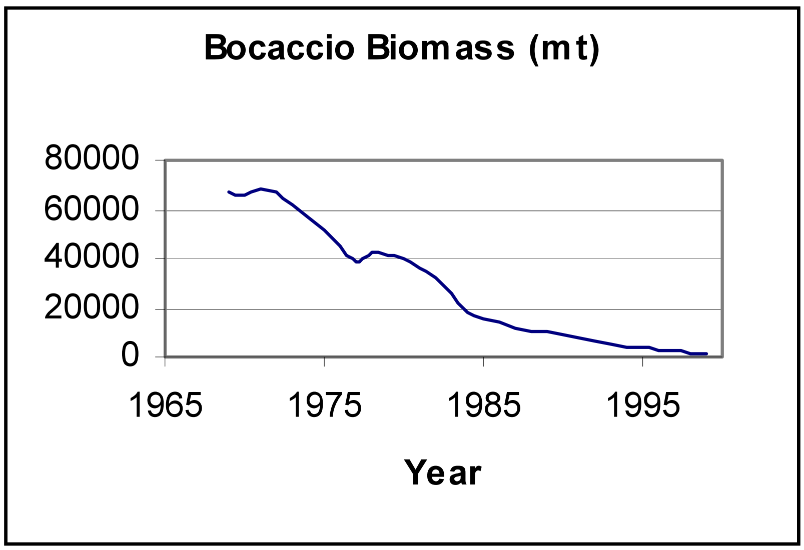
Status of Stocks and Trends There have been no quantitative assessments of cabezon populations. California Department of Fish and Game and the Oregon Department of Fish and Wildlife have ongoing nearshore reef mapping projects that may become the basis for stock assessments on cabezon and other nearshore reef species (Fox 2003). Until 2002, no species specific allowable biological catch (ABC) or optimum yield (OY) has been set for cabezon as they were included in a larger grouped OY for “other groundfish”. Most of the catch is taken by commercial fishers. Coastwide commercial catches increased rapidly in the 1990s and peaked in 1998 at 434 mt, principally due to the increase effort in the live-fish fishery (PacFIN 2002a).

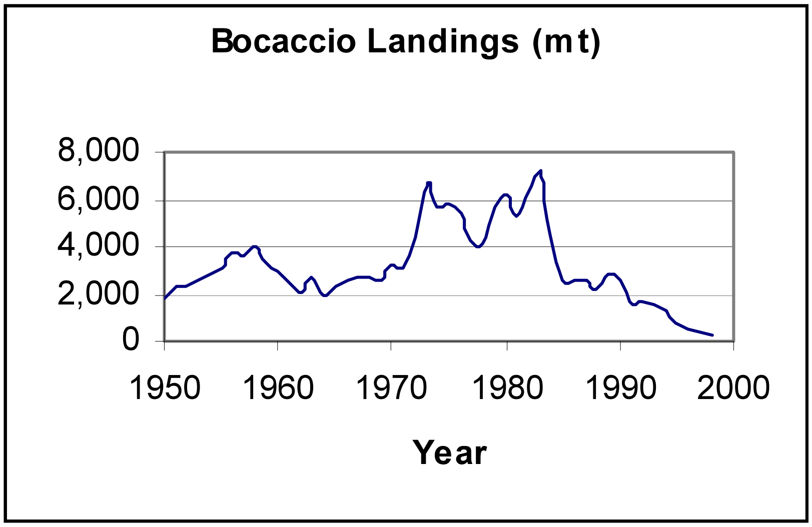
Oregon and California currently have 14 inch minimum size limits. The Council is considering minimum size limits of 15 to 16 inches for 2003.

A.1.2 Rockfish

The southern California bocaccio stock has been designated as overfished, with current biomass substantially below the 25% threshold.

A.1.2.1 Bocaccio (*Sebastes paucispinis*) is a rockfish species that ranges from Kodiak Island, Alaska south to central Baja California. The most recent published assessment for bocaccio (MacCall *et al.* 1999) indicated the stock off California was considerably below the overfished level. An unpublished update (MacCall 2002) concluded that stock remained in the severely overfished state and projections indicated rebuilding will take decades. Current regulations are intended to reduce harvest of this stock to near zero.





Distribution and Life History Love *et al*. (2002) and Thomas and MacCall (2001) described bocaccio distribution and life history. Bocaccio are historically most abundant in waters off central and southern California. Juveniles settle in nearshore waters after a several month pelagic stage. Adults range from depths of 6.5-261 fm (12-478 m). Most adults are caught off the middle and lower shelf at depths between 27 fm and 137 fm (50 and 250 m). Larger fish tend to be deeper. Bocaccio are found in a wide variety of habitats: often on or near bottom features but sometimes over muddy bottoms. While usually found near the bottom they also occur as much as 16.4 fm (30 m) off bottom. Tagging studies have shown that young fish move up to 148 km (92 miles).

Most adults occur on the middle and lower shelf.

Maximum age of bocaccio was radiometrically determined to be at least 40 and perhaps more than 50 years. Bocaccio are difficult to age and the assessment was length based. MacCall *et al*.(1999) estimated that the instantaneous rate of natural mortality was 0.20 (82% adult annual survival when there is no fishing mortality). Fifty percent of 48 cm (19 in) females are mature. Maximum size is 91 cm (36 in) and 6.8 kg (15 lb). Bocaccio are live bearers. Parturition occurs from October through July peaking January- February off California. Fecundity ranges from 20,000 to 2,300,000 eggs. Females produce up to three batches of larvae per year off southern California.

Adult bocaccio feed on fish and squid.

Little is known about ecological relationships between bocaccio and other organisms. Adult bocaccio are often caught with chilipepper rockfish and have been observed schooling with speckled, vermilion, widow, and yellowtail rockfish. Bocaccio begin feeding on other fish such as smaller rockfish and squid in their first year. Young bocaccio are known to be consumed by sea birds, chinook salmon, and harbor seals..

Status of Stocks and Trends Bocaccio have long been an important component of California fisheries for rockfish. Catches increased to high levels in the 1970s and early 1980s as relatively strong year-classes recruited to the stock. The Council began to recommend increasingly restrictive regulations after an assessment in 1990 (Bence and Hightower 1990) indicated that fishing rates were too high. The most recent assessment (MacCall *et al.* 1999) indicated that the stock is severely overfished and that estimates of stock productivity had been over-optimistic. An unpublished update (MacCall 2002) concluded that stock remained in the severely overfished state and projections indicated that rebuilding will take decades. The Council is developing recommendations to limit catches to near zero.

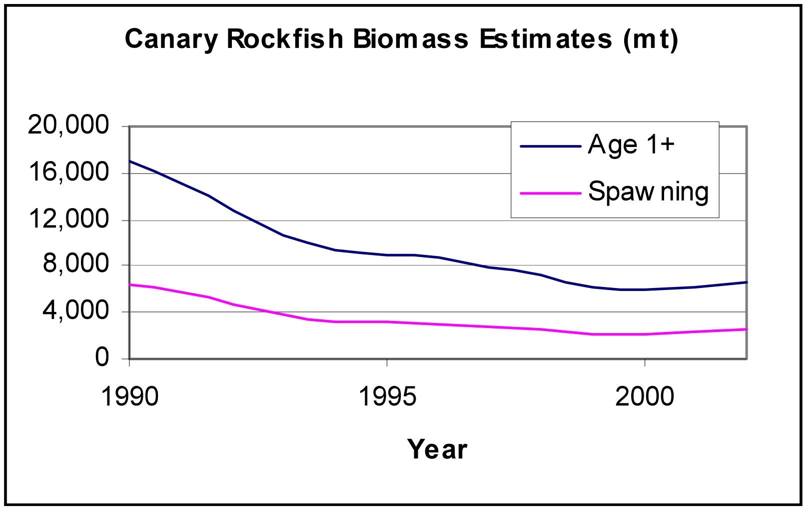
Natural mortality is moderate for bocaccio and maximum age is at least 40 years.

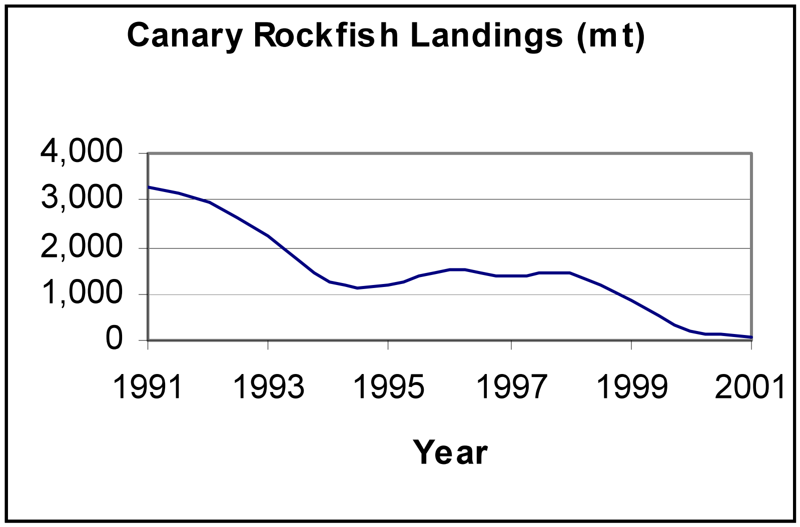
There is little doubt the bocaccio stock off California is severely overfished, but there are considerable uncertainties in the assessment. Genetic studies indicate that bocaccio off California are distinct from bocaccio off the Pacific northwest, but no work has been done to compare stocks off Baja California with stocks off California. Bocaccio off Mexico and the northwest have not been assessed. The rate of natural mortality was not well determined. Species composition data were lacking for pre-1980 catches and had to be estimated with data from later years. There appeared to be considerable error in the age composition data and they were not useful for the assessment.

There are considerable uncertainties in the bocaccio assessment, but there is little doubt the stock is overfished.

A.1.2.2 Canary Rockfish (*S. pinniger)* range from the western Gulf of Alaska to northern Baja California and are most abundant from British Columbia to central California. The last published assessments for canary rockfish (NMFS 1999b; Williams *et al.* 1999) indicated that stock was below and perhaps considerably below the overfished level. An unpublished update (Methot and Piner 2002) concluded that stock was in a severely overfished state and projections indicated that rebuilding will take decades. Current management measures severely limit catches.

Canary rockfish biomass is considerably below the overfished level.





Distribution and Life History Love *et al*. (2002) and Williams and Adams (2001) described canary rockfish distribution and life history. Juveniles settle in nearshore waters after a several month pelagic stage. Adults range from depths of 25-475 fm (46-868 m). Most adults are caught off the middle and lower shelf at depths between 44 fm and 109 fm (80 and 200 m). Larger fish tend to be deeper. Canary rockfish are usually associated with areas of high relief such as pinnacles, but also occur over flat rock or mud and boulder bottoms. They are usually found near the bottom. A tagging study showed that they can move up to 700 km (435 miles).

Most adults occur on the middle and lower shelf.

Maximum age of canary rockfish is 84 years. The three assessments (1999) estimated that the instantaneous rate of natural mortality was 0.06 (94% adult annual survival when there is no fishing mortality). Mature females may have higher natural mortality rates. Fifty percent of 38 cm (13.4 in and 7 years) females are mature. Maximum size is 76 cm (30 in) and

Natural mortality is low and maximum age is at least 84 years.

7.8 kg (17 lb). Females tend to be larger than males of the same age. Female canary rockfish reach 90% of their expected maximum size at 15 years. Canary rockfish are live bearers. Parturition occurs from September through March peaking December- January. Fecundity ranges from 260,000 to 1,900,000 eggs.

Adults feed on euphausiids, gelatinous zooplankton, and small fish.

Little is known about ecological relationships between Canary rockfish and other organisms. Adult canary rockfish are often caught with bocaccio, sharpchin, yelloweye, and yellowtail rockfishes, and lingcod. Researchers also have observed canary rockfish associated with silvergray, and widow rockfish. Young of the year feed on copepods, amphipods, and young stages of euphausids. Adults feed on euphausiids, gelatinous zooplankton, and small fish. Small canary rockfish are consumed by sea birds, chinook salmon, and marine mammals.

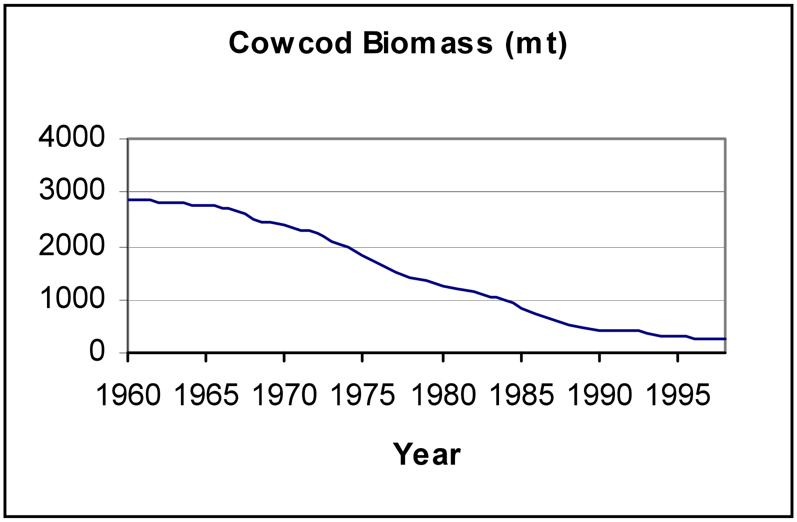
Stock Status and Trends Canary rockfish have long been an important component of fisheries for rockfish. The Council began to recommend increasingly restrictive regulations after an assessment in 1994 (Sampson and Stewart 1994) indicated that fishing rates were too high. The most recent assessments {Williams, 1999 #1499; NMFS, 1999b #1435} indicated that the stock was below and perhaps considerably below the overfished level. An unpublished update (Methot and Piner 2002) concluded that stock was in a considerably overfished state and projections indicated that rebuilding will take decades. The Council is developing recommendations to severely limit catches.

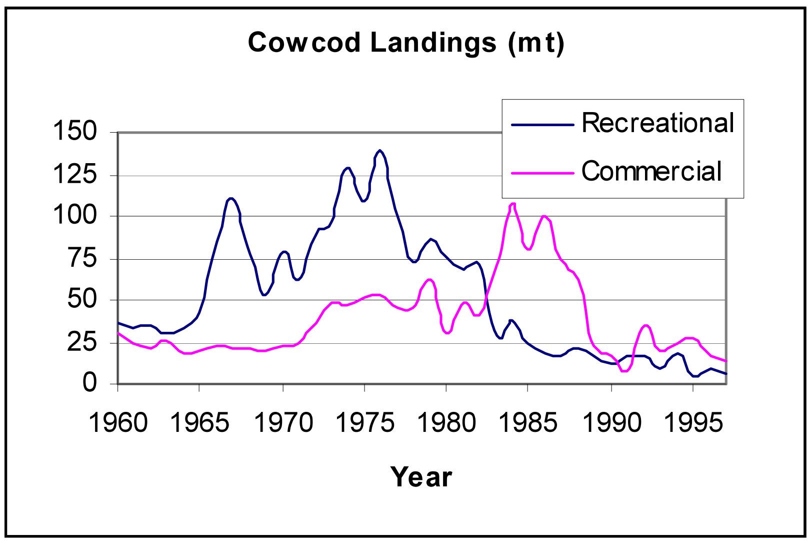
There are considerable uncertainties in the canary rockfish assessment but little doubt the stock is overfished.

There is little doubt the West Coast canary rockfish stock is overfished, but there are considerable uncertainties in the assessment. Genetic studies indicate that canary rockfish off California and southern Oregon may be different than fish to the north. However, the assessment by Williams *et al*. (1999) produced evidence suggesting that at least some recruitment to the southern area may come from fish to the north. No research has been done on the relationship between canary rockfish off Washington and British Columbia, but the assessment assumes that there is no relationship. The rate of natural mortality, especially for mature females, was not well determined. Species composition data was lacking for pre-1980 catches and had to be estimated with data from later years. The frequency of adult surveys and aerial coverage of recruitment surveys was inadequate.

The cowcod stock has been designated as overfished.

A.1.2.3 Cowcod (*S. levis*) is a species of large rockfish that ranges from Newport, Oregon to Isla Guadalupe, central Baja California. The only assessment for cowcod (Butler *et al.* 1999) indicated that stock off Southern California is below the overfished level. Current regulations are intended to reduce catches to as low as possible.





Distribution and Life History Love *et al*. (2002) and Barnes (2001) described cowcod distribution and life history. They are most abundant in waters off central and southern California. Young of the year have been observed on fine sand and clay sediment as well as oil platform shell mounds and other complex bottom features at depths ranging from 22-122 fm (40-224 m). Adults range from depths of 39-268 fm (72-491 m). Most adults occur on the lower shelf and upper slope at depths deeper than 82 fm (150 m) and 164 fm (300 m). Adults are often found on bottoms with high relief such as rocky reefs.

Maximum age of cowcod rockfish is 55 years and maximum size is 94 cm (37 in) and 13 kg (28.5 lb). The instantaneous rate of natural mortality is estimated at about 0.08 (92% adult annual survival when there is no fishing mortality) (Butler *et al.* 1999). Fifty percent of 43 cm (17 in) (about 11years old) females are mature. Average size at age of mature females is similar to males. Females reach 90% of their maximum expected size by 40 years (Butler *et al.* 1999). Cowcod are livebearers. Most larvae are released January through February. Fecundity is dependent on size and ranges from 181,000 to 1,925,000 eggs. Southern females may release more than one batch per year.

Little is known about ecological relationships between cowcod and other organisms. Small cowcod feed on planktonic organisms such as copepods. Larger animals such as fish, squid, and octopus have been found in stomachs of adult fish.

Most adults occur on the bottom in deep waters of the outer shelf and upper slope.

Stock Status and Trends While cowcod are not a major component of the groundfish fishery, they are highly desired by both recreational and commercial fishers because of their bright color and large size. The most recent assessment (Butler *et al.* 1999) indicated that the stock is considerably below the overfished level. The Council has recommended regulations to reduce catches to as low as possible. Large areas off southern California have been closed to fishing for groundfish.

Natural mortality is low and maximum age is 55 years.

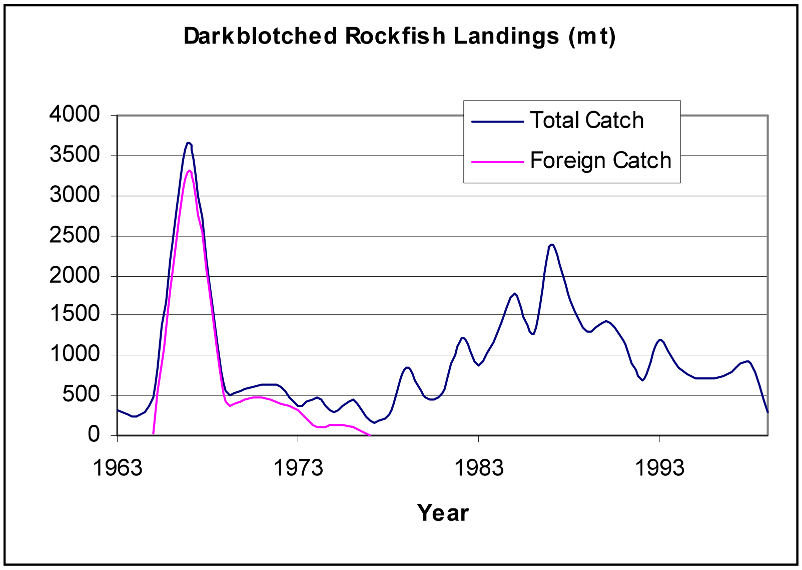
There is relatively little information about the cowcod stock and there are major uncertainties in the assessment. The assessment authors needed to make estimates of early landings based on more recent data and reported total landings of rockfish. Age and size composition of catches are poorly sampled. Population structure is unknown and the assessment was restricted to southern California waters. Since the species is not very abundant, it has been difficult to develop fishery independent indices of trends in abundance.

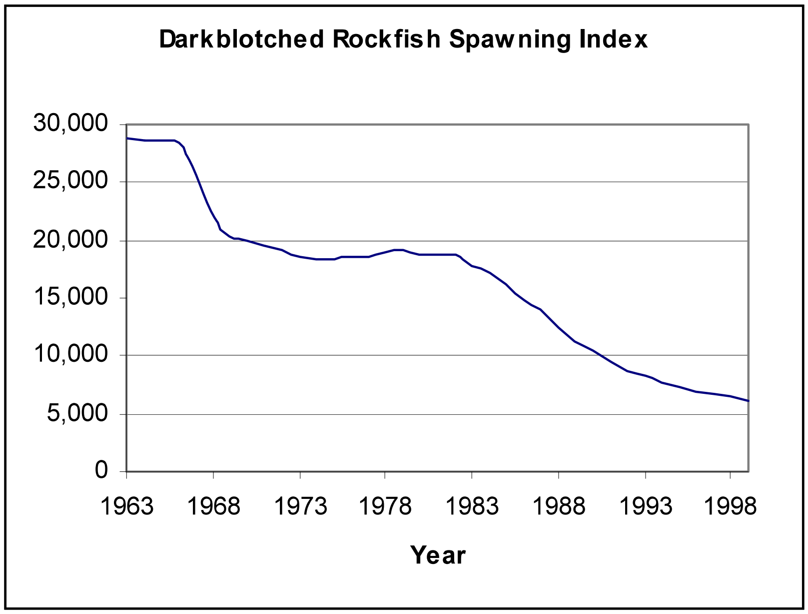
Darkblotched rockfish are overfished.

A.1.2.4 Darkblotched Rockfish (*S. crameri*)

occur from Tanaga Island (Aleutian Islands) and Bering Sea to near Catalina Island, California. They are most abundant from Oregon to British Columbia.

The latest assessment Rogers *et al*. (2000) indicated that darkblotched rockfish were overfished. The Council determined a darkblotched rockfish OY for the first time and recommended regulations to restrict catches.





Distribution and Life History Love *et al*. (2002) described darkblotched rockfish distribution and life history. Young of the year recruit to bottom at depths ranging from 30-109 fm (55-200 m) after spending up to 5 months as pelagic larvae and juveniles in offshore waters. Adults range from depths of 14-494 fm (25-904 m). Most adults occur on the lower shelf and upper slope at depths between 77 fm and 200 fm (140 m and 365 m). Adults are often found on mud near cobble or boulders. Fish tend to move into deeper waters as they age.

Most adults occur on the bottom of the lower shelf and upper slope.

Maximum age of darkblotched rockfish is 64 years. Rogers *et al*. (2000) estimated that the instantaneous rate of natural mortality was about 0.05 (95% adult annual survival when there is no fishing mortality). Fifty percent of 34.5 cm (13.6 in) (about 10 years old) females are mature (Nichol 1990). Average size at age of mature females is greater than males. Females reach 90% of their maximum expected size by 13 years (Rogers *et al.* 2000). Maximum size is 58 cm (23 in) and 2.3 kg (5.1 lb). Darkblotched rockfish are livebearers. Most larvae are released December through February. Fecundity is dependent on size and ranges from 20,000 to 610,000 eggs.

Adults feed on midwater organisms such as euphausiids and

Little is known about ecological relationships between darkblotched rockfish and other organisms. Pelagic juveniles feed on planktonic organisms such as copepods. Adults are often caught with other fish such as Pacific Ocean perch and splitnose rockfish. Midwater animals such as euphausiids and amphipods dominate the diet of adult fish. Albacore and chinook salmon consume pelagic juveniles. Little is known about predation of adults.

Stock Status and Trends Darkblotched rockfish are not a major component of the groundfish fishery. Foreign trawlers fishing for Pacific Ocean Perch made relatively large catches during the 1960s. A small group of fishers found a concentration of darkblotched rockfish off northern California and made relatively large catches in 1987. There is little fisheries dependent data available. The first assessment (Lenarz 1993) did not attempt to estimate biomass, but warned that life history characteristics indicated that productivity was low and decreases in fish size suggested that the stock had been impacted by the fishery. Rogers *et al*. (2000) estimated biomass and found that the stock was overfished. Beginning in 2001, the Council recommended an OY and management measures to begin rebuilding the stock.

There are considerable uncertainties in the assessments.

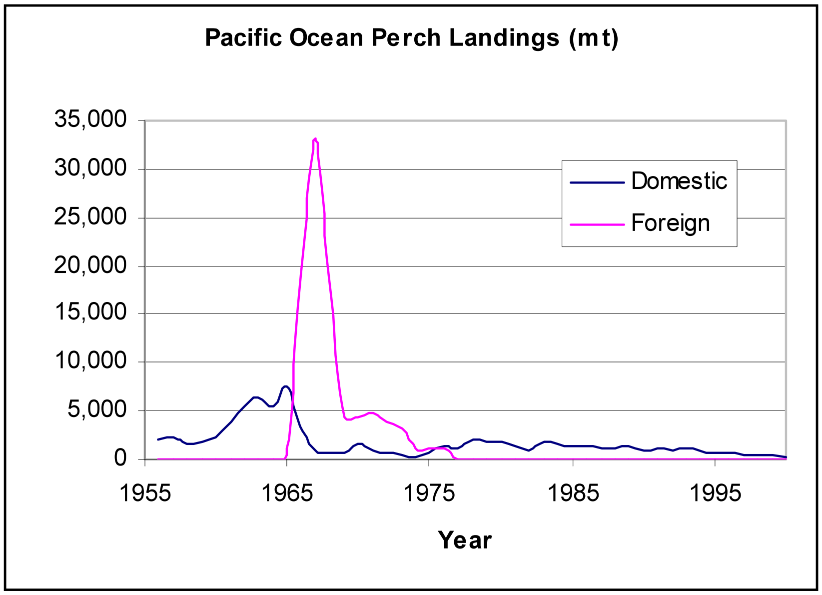
There are major uncertainties in the assessments. The assessment model estimate of unfished biomass is very sensitive to catches made by the foreign fishery in the 1960s. The foreign catches are poorly known, but new information is being evaluated. The domestic fishery is poorly sampled for age and size composition of darkblotched rockfish. The level of discards is poorly known. Trawl surveys were designed for other species and were not optimal for darkblotched rockfish. Stock structure is not known.

POP has been designated as overfished; recovery is expected by 2011.

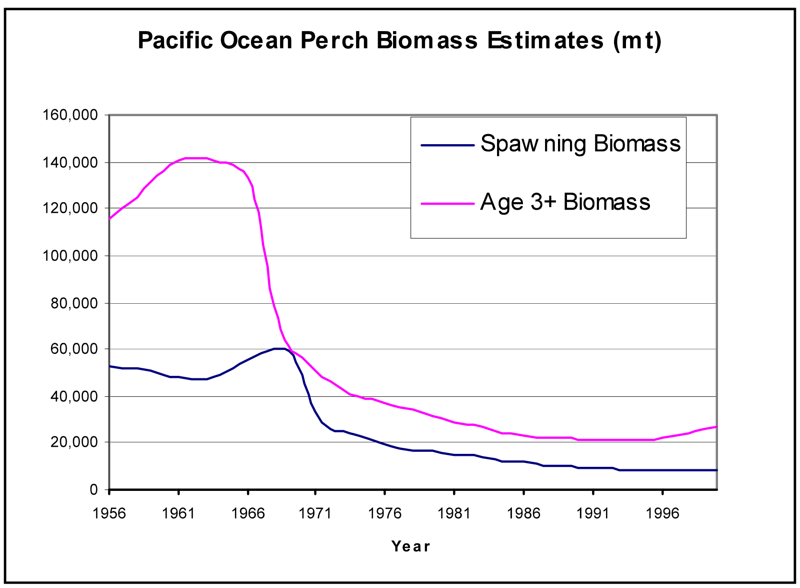
A.1.2.5 Pacific Ocean Perch (*S. alutus*) was over harvested by foreign fishing vessels prior to 1976. Since 1981, the Council has considered the Pacific Ocean Perch (POP) stock to be overfished, and has recommended conservative harvest policies to hasten rebuilding. The most recent assessment

(Ianelli *et al.* 2000) indicated that, after a long period of little change, the stock increased slightly in recent years. Projections indicated that the stock will likely recover to near or above the maximum sustainable yield level by 2011.

Most adults live in upper slope waters of the north Pacific.



Distribution and Life History Love *et al*. (2002) described POP distribution and life history. POP occur in western north



Pacific south to Honshu Japan, southern Bering Sea, and eastern north Pacific south to Baja California. They are common from northern California to the Kuril Islands and are the most abundant rockfish in the Gulf of Alaska. The shallowest recorded depth for juveniles is 37 m (122 ft/20.3 fathoms). Adults range from 49.5 fm (90 m) to at least 454 fm (830 m).

Most adults occur in upper slope waters at 109-150 fm (200-275 m) during the summer and occur at 164-246 fm (300-450 m) during the winter. Adults at times aggregate 0-16 fm (0-30 m) above hard-bottom features and may then disperse and rise into the water column at night (Love *et al.* 2002). However, Krieger (1993) indicated that POP generally live as adults near or on the bottom, generally in areas with smooth bottoms.

Natural mortality is low and maximum age is at least 100 years.

Maximum age of POP is at least 100 years (Love *et al.* 2002). Ianelli *et al*. (2000) estimated that the instantaneous rate of natural mortality was about 0.056 (95% adult annual survival when there is no fishing mortality). Age of maturity varies with locality. Ianelli *et al* (2000) assumed that 50% of 10 year old POP were mature, and also examined the assumption that 50% were mature at 8 years. Size at age also varies with locality (Love *et al.* 2002). POP reach 90% of their maximum size by age 20 years. Average size at age of mature females is greater than males. Maximum size is 53 cm (21 in) and 2.05 kg (4.5 lb). POP are livebearers. Most larvae are released February through May. Fecundity is dependent on size and ranges from 10,000 to 505,000 eggs. Researchers have not captured sufficient numbers of early stages to obtain an understanding of the early life history.

Adult POP eat krill and are eaten by marine mammals and larger fish.

Little is known about ecological relationships between POP and other organisms. Adult POP are often caught with other upper slope groundfish such as Dover sole, thornyheads, sablefish, and dark blotched, rougheye, and sharpchin rockfish. Small POP feed primarily on zooplankton such as copepods (Love *et al.* 2002; NMFS 2001b). Euphausiids dominate the diet of larger POP. Fur seals, sablefish, and Pacific halibut prey on sub-adult and adult POP. Albacore and salmon consume pelagic juveniles. Lingcod and other groundfish prey on benthic juveniles.

Stock size appears to be increasing.

Stock Status and Trends. Very high catches during the 1960s caused a rapid decrease in stock biomass. Domestic fishers were the sole exploiters of POP until 1965. Large trawlers from Japan and Russia entered the fishery. Catches increased from 8035 mt (375 mt foreign) in 1965 to 34,089 mt (33,204 mt foreign) in 1967. The stock could not sustain the high catches and total catch by the unregulated fishery decreased to 19,375 mt in 1968 and was only 2,512 mt in 1976. The Council determined that the stock was depleted in 1981 and recommended conservative harvest policies before the FMP was implemented in 1982. The Council formulated policies aimed at allowing continued fishing on other species while minimizing directed fishing on POP. The Council recommended more restrictive policies as experience showed that the stock was not rebuilding. The most recent assessment (Ianelli *et al.* 2000) indicated that the stock had started to increase, but still may be below the overfished level. The Council continues to allow only very low exploitation and the stock is projected to recover to near or above the MSY level by 2011.

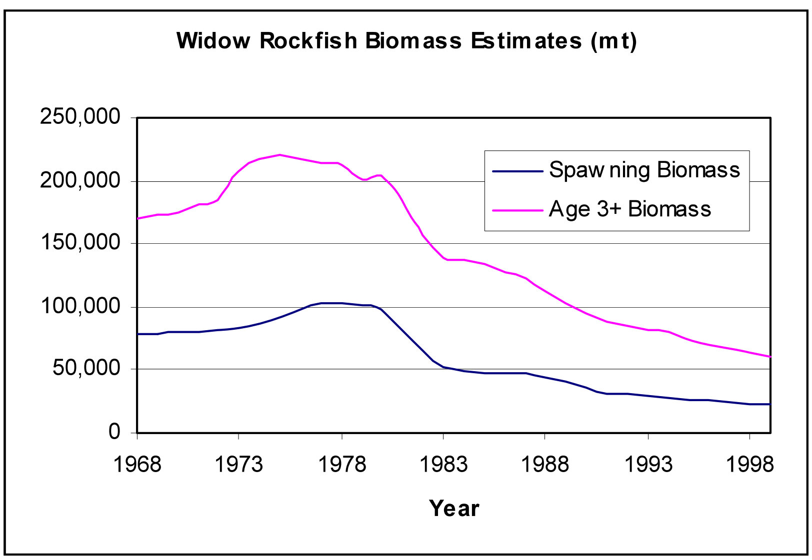
There are considerable uncertainties about the stock status.

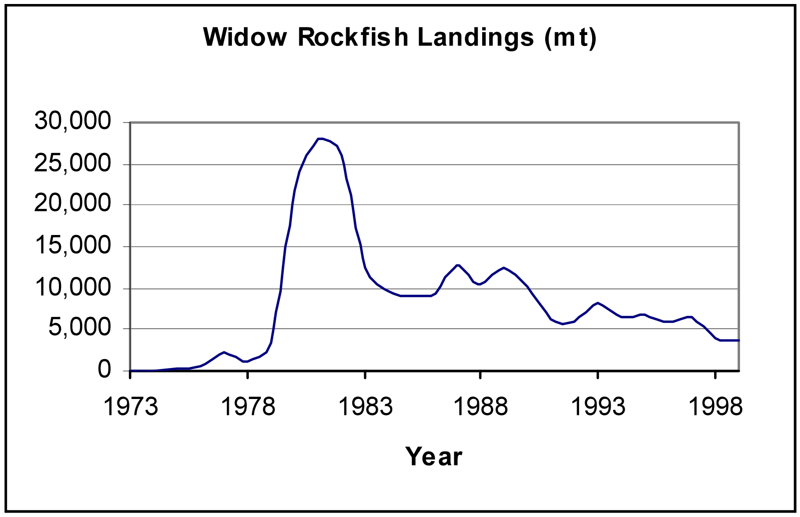
Several factors cause considerable uncertainties in the assessment. Species composition of catches by the USSR in the early fishery is not well known. There may be significant unreported discards by the domestic fleet in recent years. Resources are not sufficient to determine age composition of recent commercial and research catches. The assessment was not able to provide a definitive relationship between spawning biomass and recruitment. POP within the Council's jurisdiction may not be a distinct stock.

The widow rockfish stock has been designated overfished.

A.1.2.6 Widow Rockfish (*S. entomelas*) occur from near Kodiak Island, Alaska to Bahia de Todos Santos, Baja California. They are most abundant off northern Oregon and southern Washington and are one of the most abundant West Coast rockfish.

In 1982 the Council concluded that unrestricted fishing would deplete the widow rockfish stock and recommended restrictive harvest policies. Recruitment did not reach expectations and there was a long term decline in the stock. The most recent assessment (Williams *et al.* 2000) indicated that the stock had fallen below the overfished level. The Council recommended a very restrictive harvest policy to rebuild the stock.





Most adults are found near the shelf break and sometimes form large mid-water schools.

Distribution and Life History Love *et al*. (2002) and Ralston and Lenarz (2001) described widow rockfish distribution and life history. Young of the year recruit to shallow nearshore waters after spending up to 5 months as pelagic larvae and juveniles in offshore waters. Adults range from bottom depths of 13 fm to 300 fm (24 m to 549 m). Most adults occur near the shelf break at bottom depths between 77 fm to 115 fm (140 m to 210 m). Adults are semi-pelagic and their behavior is dynamic. They sometimes form large mid-water schools. At other times they may be dispersed either in mid-water or on the bottom. The large aggregations usually occur above bottom features known to fishermen.

Natural mortality is fairly low and maximum age is 59 years.

Maximum age of widow rockfish is 59 years (Ralston and Lenarz. 2001). Williams et al. (2000) estimated that the instantaneous rate of natural mortality was about 0.15 (86% adult annual survival when there is no fishing mortality). Age of maturity varies with locality. Barss and Echeverria (1987) found that 50% of 5 year old female widow rockfish were mature off California, and 50% of 7 year old fish were mature off Oregon. Size at age also varies with locality (Pearson and Hightower 1991). Female widow rockfish reach 90% of their maximum size by age 14 years off Oregon and by age 12 years off California. Average size at age of mature females is greater than males. Maximum size is 59 cm (23 in) and 3.3 kg (7.3 lb). Widow rockfish are livebearers. Most larvae are released January through March. Fecundity is dependent on size and ranges from 56,000 to 1,100,000 eggs.

Adults feed on midwater organisms such as small fish and euphausiids.

Little is known about ecological relationships between widow rockfish and other organisms. Adults are often caught with yellowtail rockfish off Washington, but California and Oregon fishers often make large pure catches of widow rockfish from mid-water schools. Small widow rockfish feed primarily on zooplankton such as copepods. Midwater animals such as euphausiids, small fish, sergestids, and salps dominate the diet of larger fish. Sea birds and chinook salmon consume pelagic juveniles. Little is known about predation of adults.

Stock Status and Trends The total catch of widow rockfish since 1960 is greater than any other species of rockfish in the Council jurisdiction. Catches were modest until mid-water trawlers began exploiting large schools in 1979. Landings by the unregulated fishery rapidly increased to 28,146 mt in 1981. Biologists documented that the stock was being impacted. Regulations were implemented in late 1982, but landings were still high, 25,967 mt. The Council recommended much more restrictive regulations in 1983 and landings were reduced to 12,594 mt. Regulations changed as knowledge of the productivity of the stock improved, but recruitment averaged less than expected. The most recent assessment (Williams *et al.* 2000) estimated that the stock was slightly below the overfished level as defined by FMP Amendment 11. The Council recommended very low harvest levels as required by the Amendment for overfished stocks. The harvest levels did not match those used in the assessment for projections, but interpolation indicated that expected biomass levels would be close to recovered levels by 2009.

> The widow rockfish stock is currently expected to rebuild by 2009.

Several factors caused uncertainties in the assessment. The lack reliable surveys to estimate biomass of adults causes considerable uncertainty in projections and estimates of recent biomass levels. Discards have seldom been estimated or sampled. Stock assessment authors have considerable difficulty in estimating long term stock productivity because the relationship between spawning stock and recruitment is not well understood. The relationship and exchange rates of fish between the northern and southern stock areas is not known. Exchange rates of fish between U.S. and Canadian waters is not known, but assumed to be zero.

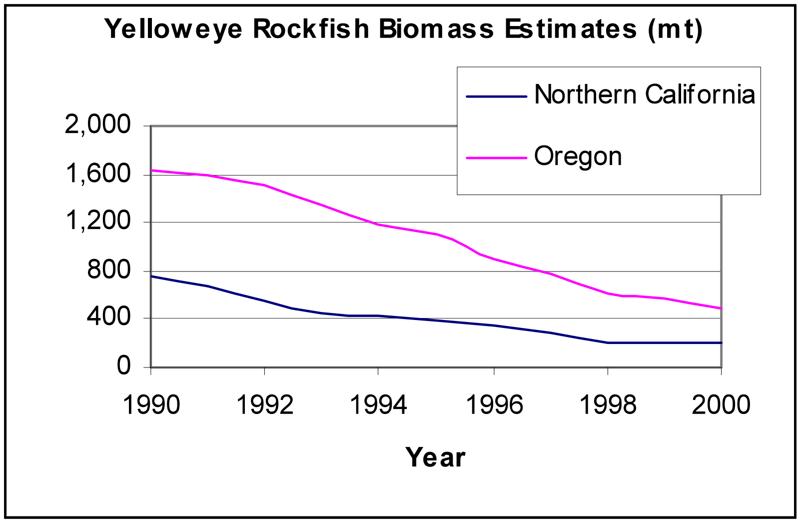
> There are considerable uncertainties in the assessments.

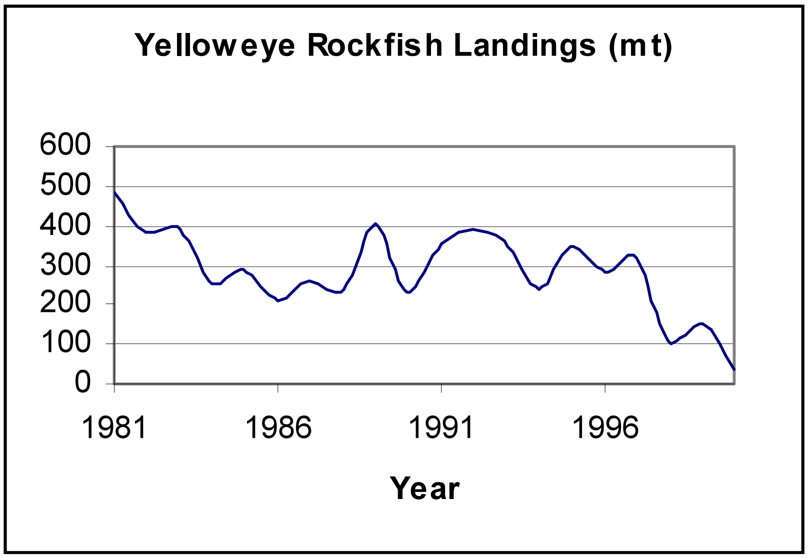
A.1.2.7 Yelloweye Rockfish (*S. ruberrimus*)

range from Umnak Island, Aleutian Islands to Ensenada, northern Baja California. They are most abundant from southeastern Alaska to central California.

> The yelloweye rockfish stock is overfished.

The only assessment for yelloweye rockfish (Wallace 2001) indicated that stocks off northern California and Oregon were considerably below the overfished level. Current regulations severely limit catches.





Distribution and Life History Love *et al*. (2002) described yelloweye rockfish distribution and life history. Juveniles have been found at depths greater than 8 fm (15 m) in areas of high bottom relief. Adults range to depths of 300 fm (549 m). Most adults are caught off the middle and lower shelf at depths between 50 fm and 98 fm (91 m and 180 m). Adult yelloweye rockfish tend to be solitary and are usually associated with areas of high relief with refuges such as caves and crevices, but also occur on mud adjacent to rock structures. They are usually found on or near the bottom.

Most adults occur on the middle and lower shelf.

Maximum age of yelloweye rockfish is 115 years. There are no published estimates of the instantaneous rate of natural mortality. Fifty percent of 46 cm (18 in and 19 years) females are mature. Maximum size is 91 cm (36 in) and 11.3 kg (25 lb). Females tend to be slightly larger than males of the same age. Yelloweye rockfish are live bearers. Parturition occurs from

March through September and peak May- June. Fecundity ranges from 1,200,000 to 2,700,000 eggs.

Maximum age for yelloweye rockfish is at least 118 years.

Little is known about ecological relationships between yelloweye rockfish and other organisms. Researchers have observed adult yelloweye rockfish associated with bocaccio, cowcod, greenspotted, and tiger rockfish. Adults feed on rockfishes, herring, sandlance, flatfishes, lingcod eggs, shrimp, and crab. Chinook salmon prey on small yelloweye and an orca stomach contained a yelloweye rockfish.

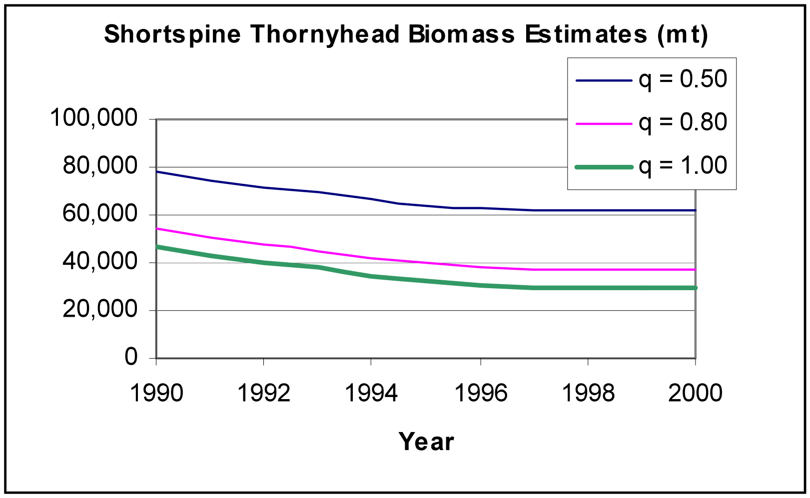
Stock Status and Trends Yelloweye rockfish have been a minor component of fisheries for rockfish. Catches have decreased in recent years. The only assessment for yelloweye rockfish (Wallace 2001) indicated that stocks off northern California and Oregon were considerably below the overfished level. Current regulations severely limit catches.

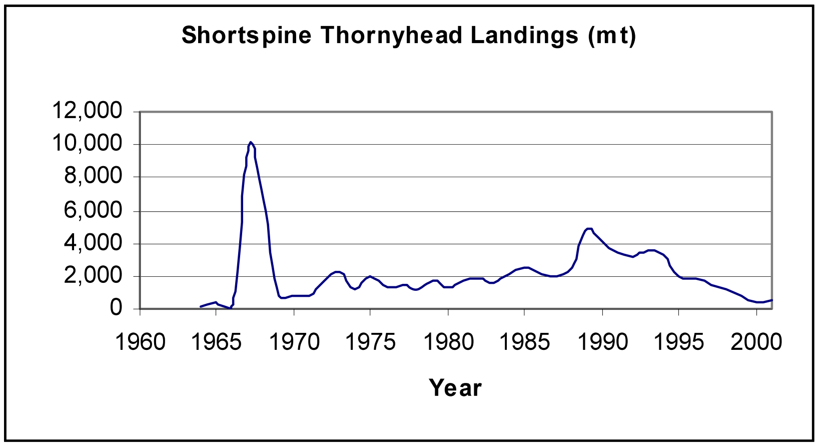
There is relatively little information about yelloweye rockfish and there are major uncertainties in the assessment. The assessment did not have sufficient fishery dependent data from the important Washington fishery or reliable fishery independent survey data to use. Life history data are questionable, and population structure is not known.

Shortspine thornyhead biomass is above the overfished level and below the target levels.

A.1.2.8 Shortspine Thornyhead (*Sebastolobus alascanus*) occur in the Sea of Japan, Sea of Okhotsk, Bering Sea, and eastern Pacific Ocean south to central Baja California. They are most abundant in waters off central California to the northern Kuril Islands.

The most recent assessment for shortspine thornyhead (Piner and Methot 2001) indicated that stock remains above the overfished level, consistent with the previous assessment by Rogers *et al*. (1998). An independent assessment, summarized but not published by the NOAA Fisheries Service Stock Assessment Team and Ocean Trust Stock Assessment Team (1998) indicated that the stock was closer to target levels. The most recent assessment indicates the stock to be between 24% and 48% of unfished biomass.





Most adults occur on the bottom of the upper slope to middle slope.

Distribution and Life History Love *et al*. (2002) and Barnes *et al*. (2001) described shortspine thornyhead distribution and life history. Juveniles settle to the bottom at depths of 55 fm to 328 fm (100 m to 600 m) after a 14-15 month pelagic stage. Immature and adult fish are often on mud bottoms usually near cobblestones, sponges and other small bottom features. Adults are also found on rocky bottoms. Adults range to depths of 833 fm (1,524 m) and often inhabit the oxygen-minimum layer off of California (Jacobson and Vetter 1996). Most adults occur on the upper to middle slope at depths between 82 fm (150 m) and 547 fm.

Natural mortality of shortspine thornyhead is low and maximum age is at least 80 years.

Maximum age of shortspine thornyhead is at least 80 and probably more than 100 years. Rogers *et al*. (1998) assumed an instantaneous rate of natural mortality of 0.06 based on a maximum age of 80 years (94% adult annual survival when there is no fishing mortality). Fifty percent of 22 cm (8.7 in) (about 12 years old) females are mature. Females reach 90% of their maximum expected size by about 80 years (Kline 1996). Maximum size is 80 cm (31.5 in) and 8.0 kg (17.6 lb). Shortspine thornyheads spawn gelatinous egg masses.

Spawning occurs from January through May with a peak in April off California. Fecundity ranges up to 400,000 eggs.

Adults feed on benthic invertebrates and fish such as smaller thornyheads.

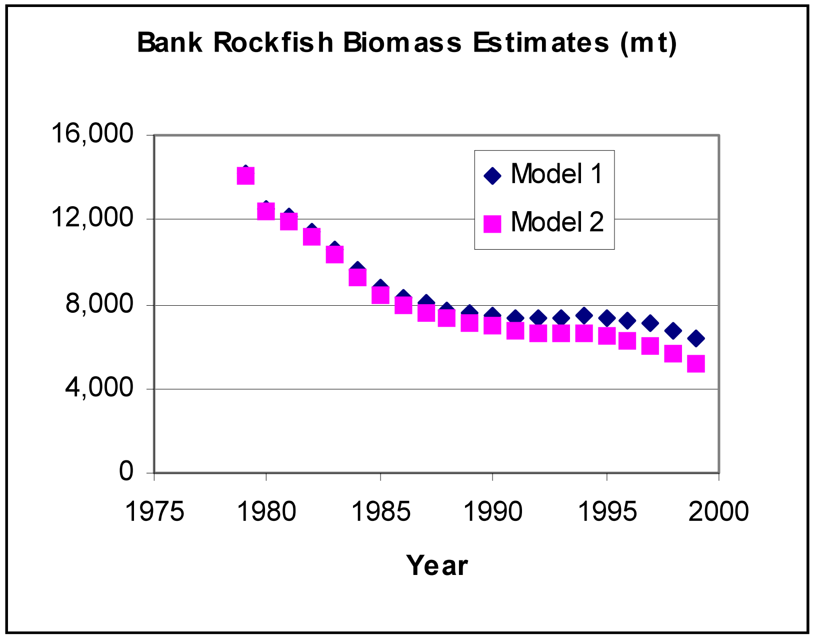
Little is known about ecological relationships between shortspine thornyheads and other organisms. Adult shortspine thornyheads are often caught with Dover sole, sablefish, and longspine thornyheads. Adults feed on fish such as smaller shortspine and longspine thornyheads, and benthic shrimp, amphipods, and crabs. California sea lions prey on shortspine thornyheads.

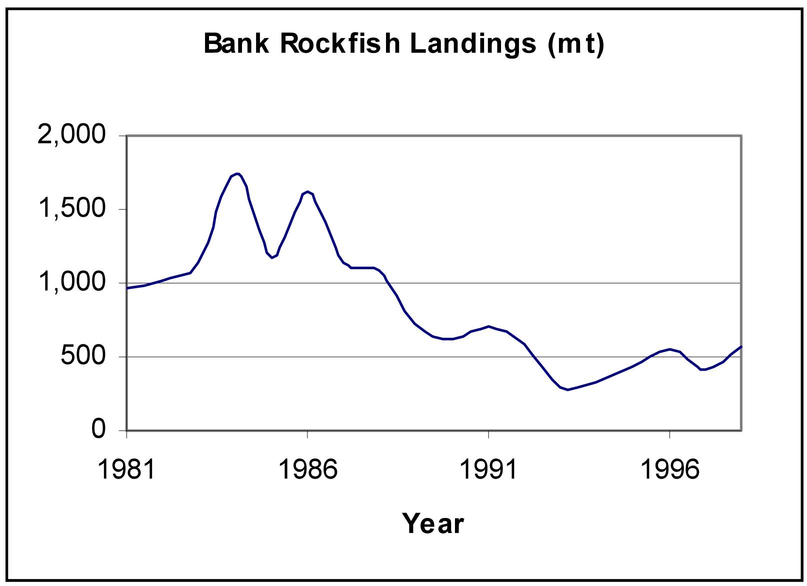
Stock Status and Trends Shortspine thornyheads are an important economic component of the groundfish fishery. Catches increased as markets developed and both demand and prices increased. Regulations became progressively more restrictive after 1989, with separate catch limits for shortspine thornyhead instituted in 1995. The most recent assessment (Piner and Methot 2001) indicates that spawning biomass is between 24% and 48% of unfished biomass levels.

Assessment of the shortspine thornyhead stock presents many challenges, as the information about stock abundance and trends is somewhat limited. This results in major uncertainties in the assessment. Model results indicate an upward trend in biomass, assuming recruitment remains constant. Sparse data and unknown life history traits contribute to the uncertainty in the true population dynamic. NMFS surveys have not covered the full range of the species off California, Oregon and Washington, and there are serious questions about estimates of "**q**" (the catchability coefficient) for the survey that was used. Stock structure is not known and the assessment only included data from central California to the Canadian border.

The bank rockfish stock is estimated to be slightly above the overfished level.

A.1.2.9 Bank Rockfish (*Sebastes rufus*) occur from Queen Charlotte Sound, British Columbia Sea to Isla Guadalupe, central Baja California. The latest assessment (Piner *et al.* 2000) indicated that bank rockfish were slightly above the overfished level. The Council recommends regulations for the slope rockfish group as a whole.





Distribution and Life History Love *et al*. (2002) and Love and Watters (2001) described bank rockfish distribution and life history. They are most abundant from central California to at least southern California. Young of the year have been observed in boulder fields at depths ranging from 52-115 fm (95-210 m). Adults range from depths of 71-248 fm (130-454 m). Most adults occur on the lower shelf and upper slope at depths between 71 fm (130 m) and 197 fm (360 m). Adults are often found on or above bottoms with high relief. Fishers are reported to have made large catches from aggregations over bottom features.

Most adults occur on the bottom of the lower shelf and upper slope.

Maximum age is 85 years.

Maximum age of bank rockfish is 85 years. Piner *et al*. (2000) used its longevity to estimate that the instantaneous rate of natural mortality was about 0.08 (92% adult annual survival when there is no fishing mortality). Fifty percent of 30 cm (12 in) (about 8 years old) females are mature. Average size at age of mature females is greater than males. Females reach 90% of their maximum expected size by 22 years (Piner *et al.* 2000). Maximum size is 55 cm (22 in) and 2.4 kg (5.2 lb). Bank rockfish are livebearers. Most larvae are released January through February. Fecundity is dependent on size and ranges from 65,000 to 608,000 eggs. Southern females may spawn more than once per year.

Adults feed on midwater organisms such as krill and amphipods.

Little is known about ecological relationships between bank rockfish and other organisms. Adults are often caught with other fish such as blackgill, darkblotched and splitnose rockfish. Midwater animals such as euphausiids and gelatinous plankton have been found in stomachs of adult fish.

Stock Status and Trends Bank rockfish are not a major component of the groundfish fishery and are the species is poorly known. Regulations aimed at reducing catches of other rockfish species probably contributed to the decline in catches of bank rockfish. The most recent assessment (Piner *et al.* 2000) indicated that the stock is slightly above the overfished levels. The Council neither sets OY for bank rockfish nor recommends regulations directed at bank rockfish. The GMT believes that regulations for slope rockfish as an aggregate are sufficient to restrict the fishery for bank rockfish to levels that will maintain the stock.

There is relatively little information about bank rockfish.

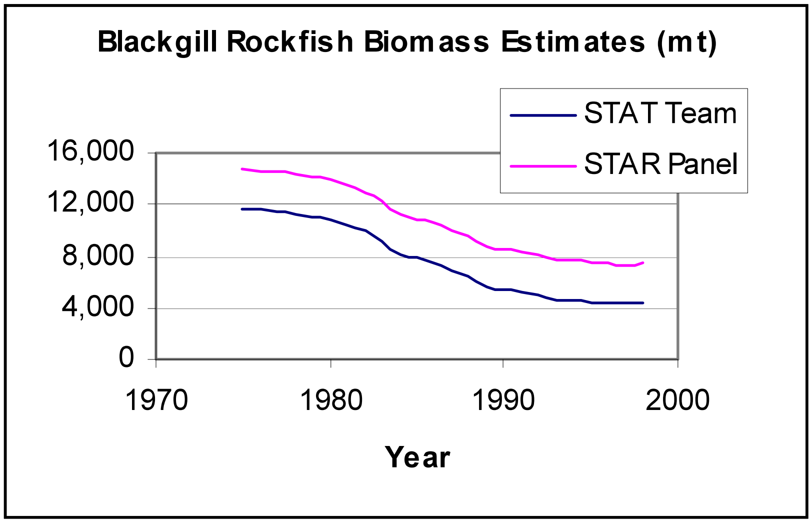
There is relatively little information about bank rockfish and there are major uncertainties in the assessment. The assessment did not have sufficient fishery dependent data from the important southern California fishery or reliable fishery independent survey data to use. Life history data are questionable, and population structure is not known.

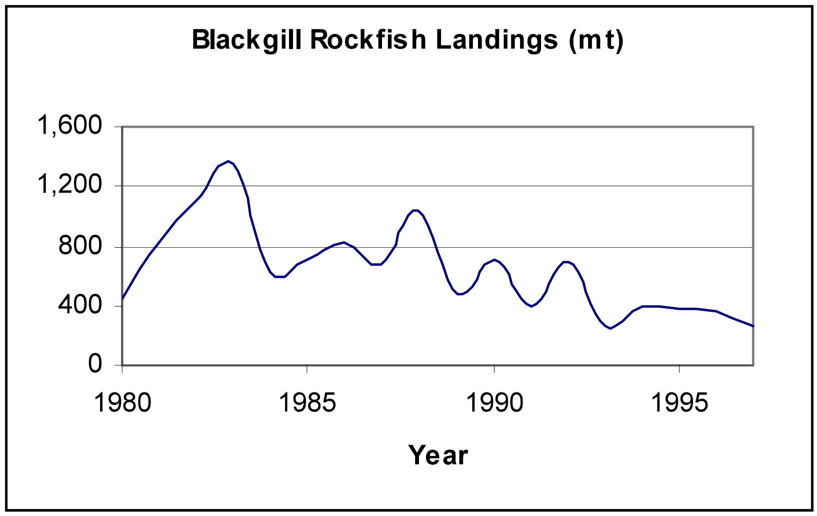
Blackgill rockfish biomass is slightly above the target level.

A.1.2.10 Blackgill Rockfish (*S. melanostomus*)

occur from Vancouver Island, British Columbia to Isla Cedros, central Baja California. They are most abundant in waters off central and southern California.

The only assessment for blackgill rockfish (Butler *et al.* 1998) indicated that stock off California was slightly above the overfished level. The Council recommends regulations for the slope rockfish group as a whole.





Distribution and Life History Love *et al*. (2002) and Love and Butler (2001) described blackgill distribution and life history. Young of the year have generally been caught at depths greater than 109 fm (200 m). Immature fish are usually caught on flat bottoms. Adults range from depths of 48-420 fm (87-768 m). Most adults occur on the upper slope at depths between 137 fm (250 m) and 328 fm (600 m). Adults are often found on bottoms with high relief such as rocky reefs. Fishermen report that they sometimes occur off the bottom.

Maximum age of blackgill rockfish is 87 years. Butler *et al*. (1998) estimated that the instantaneous rate of natural mortality was about 0.047 (95% adult annual survival when there is no fishing mortality). Fifty percent of 34 cm (13 in) (about 20 years old) females are mature. Average size at age of mature females is greater than males. Females reach 90% of their maximum expected size by 56 years (Butler *et al.* 1998). Maximum size is 61 cm (24 in) and 3.3 kg (7.3 lb). Blackgill rockfish are livebearers. Most larvae are released in February off southern California. Fecundity is dependent on size and ranges from 152,000 to 769,000 eggs.

Little is known about ecological relationships between blackgill rockfish and other organisms. Adult blackgill rockfish feed on fish such as lanternfish.

Natural mortality is low and maximum age is 87 years.

Most adults occur on the bottom of the upper slope.

Stock Status and Trends Blackgill rockfish are not a major component of the groundfish fishery. The most recent assessment (Butler *et al.* 1998) indicated that the stock is slightly above target levels. The Council recommends regulations for the slope rockfish group as a whole.

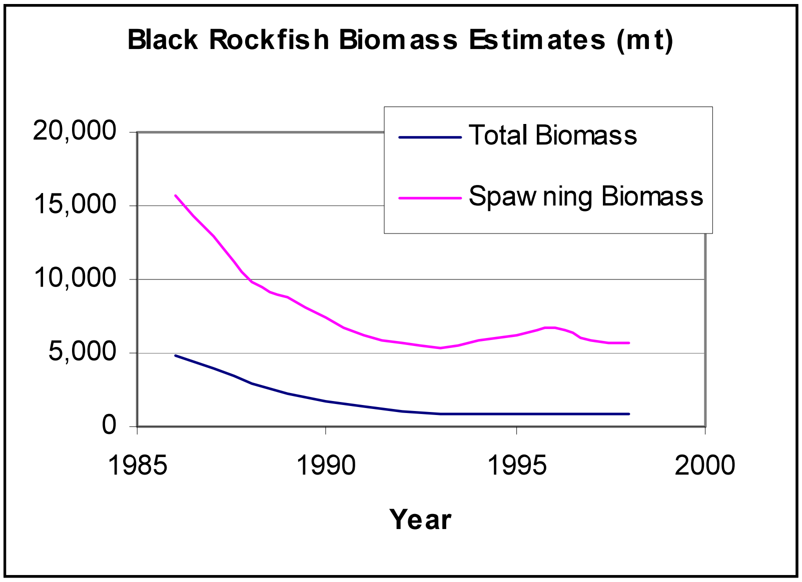
There is relatively little information about blackgill rockfish and there are major uncertainties in the assessment. The stock assessment authors needed to estimate early landings based on more recent data and reported total landings of rockfish. Catches and age and size composition of catches are poorly sampled. The STAT and STAR panel could not agree on estimates of fishing mortality. The assessment stated "Both estimates were educated guesses based on the available data, which were limited." Both estimates indicated that the stock was at or above target levels. Population structure is unknown and the assessment was restricted to U.S. waters. Fish off Mexico may be part of the same stock as U.S. fish.

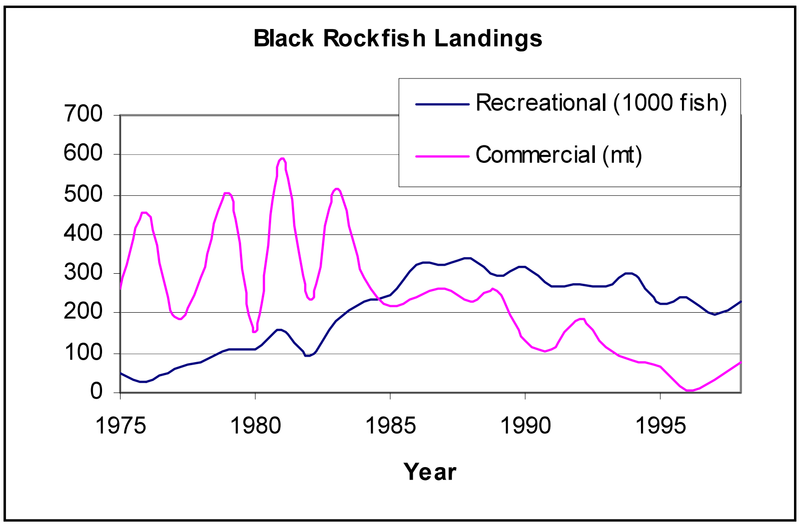
Black rockfish are above the biomass target level.

A.1.2.11 Black Rockfish (*S. melanops*)

occur from Amchitka Island (Aleutian Islands) to Huntington Beach, southern California. They are most abundant from northern California to southeast Alaska and are an important component of recreational fisheries from northern California through Washington.

The most recent assessment (Wallace *et al.* 1999) indicated that there has been a decline in biomass, but the stock off Washington and northern Oregon remains above the target level. Washington regulations are intended to maintain the stock at levels sufficiently high to satisfy the needs of its recreational fishery.





Distribution and Life History Love *et al*. (2002) and Reilly (2001a) described black rockfish distribution and life history. Young of the year recruit to shallow nearshore waters after spending up to 5 months as pelagic larvae and juveniles in offshore waters. Adults range from the surface to bottom depths of 200 fm (366 m). Most adults occur in nearshore waters at bottom depths less than 30 fm (55 m). Adults are semi-pelagic and their behavior is dynamic. They often form mid-water schools. At other times they may be on the bottom. They are often associated with kelp forests in areas with rocky bottoms.

Natural mortality is fairly high (compared to other rockfish species) and maximum age is 50 years.

Maximum age of black rockfish is 50 years. Wallace *et al*. (1999) estimated that the instantaneous rate of natural mortality for males was about 0..36 (70% adult annual survival when there is no fishing mortality), but that natural mortality of mature females increased with age. Wallace *et al*. (1999) found that 50% of 10.5 year old female black rockfish were mature.

Most adults are found in nearshore waters and often above the bottom.

Female black rockfish reach 90% of their maximum size by age 14 years. Average size at age of mature females is greater than males. Maximum size is 69 cm (27 in) and 5 kg (11 lb). Tagging results showed that most adults appear to remain near the area of release, but some moved as far as 619 km (384 miles). Black rockfish are livebearers. Most larvae are released January through March. Fecundity is dependent on size and ranges from 125,000 to 1,200,000 eggs.

Adults feed on midwater organisms such as small fish and krill.

Little is known about ecological relationships between black rockfish and other organisms. Adults are often caught with other fish such as dusky, widow, and yellowtail rockfish. Midwater animals such as small fish and young stages of crabs dominate the diet of adult fish, but they sometimes also consume benthic crustaceans and octopuses. Sea birds and chinook salmon consume pelagic juveniles. Lingcod and sea lions prey on adults.

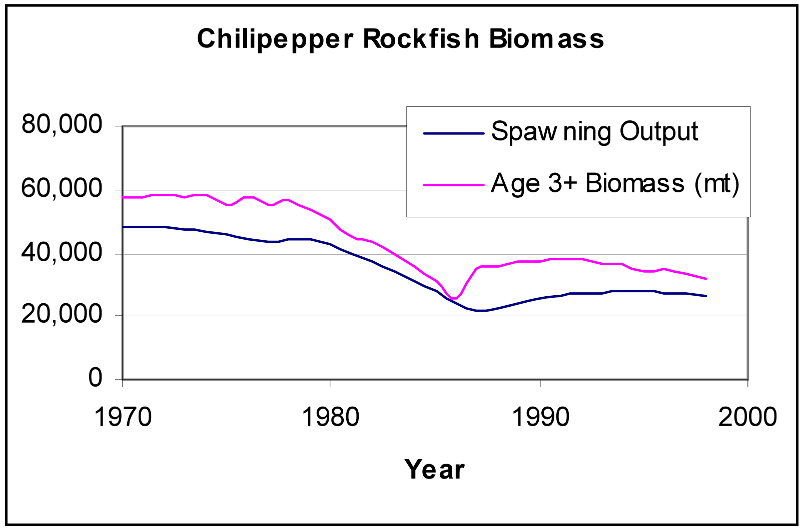
Stock Status and Trends Recreational fishers increased exploitation of black rockfish as salmon population decreased. The state of Washington decided to allocate the nearshore resource of black rockfish to the recreational fishery and implemented regulations to reduce the commercial catch. The Council recommended regulations for northern Oregon and Washington that are consistent with the Washington goals. Wallace *et al*.(1999) presented evidence the black rockfish off northern Oregon and Washington are genetically different from fish to the south and only assessed the northern stock. They estimated that biomass of the northern stock is declining but above target levels. Southern fish have not been assessed. The Council sets ABC for the southern fish at 50% of recent catches per its policy for un-assessed stocks.

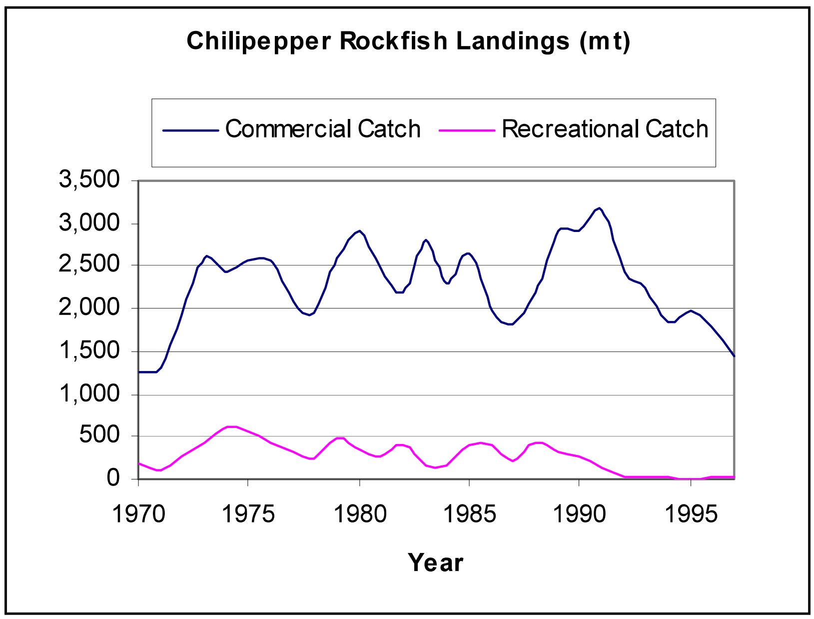
There are considerable uncertainties in the assessments.

There are major uncertainties in the assessments. The only index of biomass was obtained from tagging studies. The assessment model estimates are very sensitive to assumed rate of reporting of tag recoveries. The time series with sufficient data to use for assessment is short. There is genetic evidence that the stock extends into Canada, but the assessment was limited to U.S. waters. Black rockfish are also important for recreational fishing south of northern Oregon, but these stock(s) have not been assessed.

The chilipepper rockfish stock is above the target biomass level.

A.1.2.12 Chilipepper Rockfish (*S. goodei*) are an important component of California groundfish catches. The most recent assessment (Ralston *et al.* 1998) indicated a decline in biomass, but the stock remains above the target level. This species has been managed as a major component of the nearshore rockfish complex.





Distribution and Life History Love *et al*. (2002) and Ralston and Oda (2001) described chilipepper rockfish distribution and life history. Chilipepper rockfish occur from Queen Charlotte Sound, British Columbia to Magdalena Bay, Baja California. They are most abundant from Cape Mendocino to Point Conception and are one of the most abundant rockfish of the central California. Young of the year recruit to shallow nearshore waters usually just outside of kelp beds after spending up to 5 months as pelagic larvae and juveniles in offshore waters. Adults range from bottom depths of 25-268 fm (46-491 m). Most adults occur over the lower shelf and upper slope at bottom depths between 41 fm (75 m) and 168 fm (325 m). Adults are semi-pelagic and are found on deep rocky reefs as well as sand and mud bottoms. At times, they form large schools.

Maximum age of chilipepper rockfish is 35 years. Ralston *et al*. (1998) estimated that the instantaneous rate of natural mortality was about 0.22 for females and 0.25 for males (78-80% adult annual survival when there is no fishing mortality). Fifty percent of 3 year old females are mature. Female chilipepper rockfish reach 90% of their maximum size by age 13 years. Average size at age of mature females is greater than males. Maximum size is 59 cm (23 in) and 3.2 kg (7 lb). Chilipepper rockfish are livebearers, and most larvae are released December through January. Fecundity is dependent on size and ranges from 18,000 to 538,000 eggs.

Natural mortality is fairly high for rockfish and maximum age is 35 years.

Little is known about ecological relationships between chilipepper rockfish and other organisms. Pelagic juveniles feed on planktonic organisms such as copepods. Adults are often caught with bocaccio. Midwater animals such as euphausiids and small fish dominate the diet of adult fish. Sea birds and chinook salmon consume pelagic juveniles. Little is known about predation of adults.

Adults feed on midwater organisms such as small fish and euphausiids.

Stock Status and Trends Chilipepper rockfish are an important component of catches by California fishers. The most recent assessment estimated that the biomass of chilipepper rockfish is above target levels. The council recommends regulations for the nearshore complex of rockfish, including chilipepper, as a group. These regulations probably have reduced catches of chilipepper rockfish in recent years because of restrictions aimed at protecting the overfished stock of bocaccio.

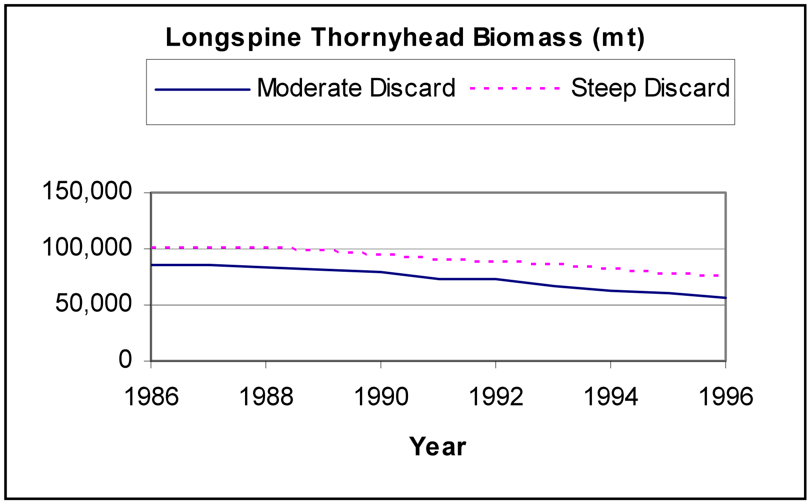
There are major uncertainties in the assessment. Catches of chilipepper rockfish prior to 1980 were estimated from compositions of rockfish catches after 1980. Catches by the fishery independent trawl survey for biomass were not aged. Logbooks did not report rockfish catches by species, and the assessment authors needed to estimate the species composition. The assessment did not include data from Mexico. The relationships between stock(s) of chilipepper in Mexican waters and the US stock is not known. The two survey estimates of adult abundance were somewhat disparate. Factors controlling recruitment strength were poorly known and there was difficulty in projecting future recruitment.

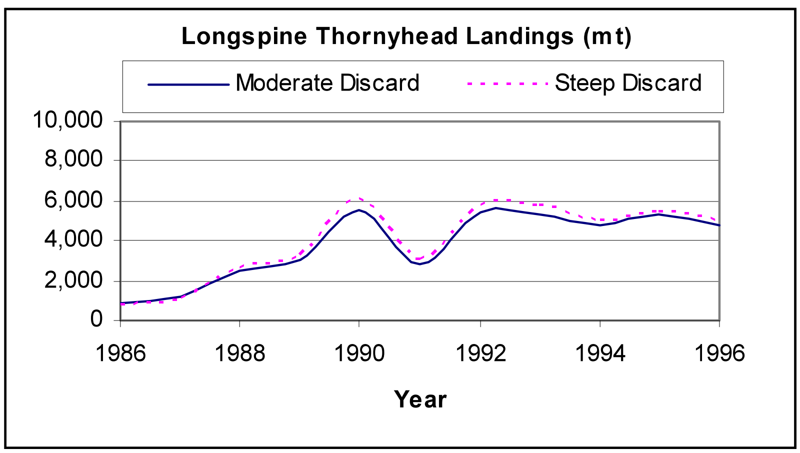
There are considerable uncertainties in the assessment.

Longspine thornyheads are thought to be above 40% of the unfished biomass level.

A.1.2.13 Longspine Thornyhead (*Sebastolobus altivelis*)

A.1.2.13 Longspine Thornyhead (*Sebastolobus altivelis*) are an important trawl-caught species thought at or above target levels. They are managed within the Dover sole, thornyhead, and sablefish complex. Longspine thornyheads have an overlapping distribution with shortspine thornyeads. The most recent assessment completed in 1997 (Rogers *et al.* 1997) indicated longspine thornyhead to be above 40% of the unfished biomass level.





Distribution and Life History Longspine thornyhead are found from the southern tip of Baja California to the Aleutian Islands (Eschmeyer *et al.* 1983; Hart 1973; Jacobson and Vetter 1996; Love 1991; Miller and Lea 1972; Smith and Brown 1983) but are abundant from southern California northward (Love 1991). Juvenile and adult longspine thornyhead are demersal and occupies the benthic surface (Smith and Brown 1983). Off Oregon and California, longspine thornyhead mainly occur at depths of 219-766 fm (400-1,400 m), most between 328 fm (600 m) and 547 fm (1,000 m) in the oxygen minimum zone (Jacobson and Vetter 1996). Thornyhead larvae (*Sebastolobus* spp.) Have been taken in research surveys up to 560 km off the

California coast (Cross 1987; Moser *et al.* 1993). Juveniles settle on the continental slope at about 328-656 fm (600-1,200 m) . Longspine thornyhead live on soft bottoms, preferably sand or mud (Eschmeyer *et al.* 1983; Jacobson and Vetter 1996; Love 1991). Longspine thornyheads neither school nor aggregate (Jacobson and Vetter 1996).

> Longspine thornyhead distribution overlaps shortspine thornyhead but typically do not extend as deep. They don't live as long as shortspine thornyheads and mature at a smaller size.

Spawning occurs in February and March at 328-547 fm (600-1,000 m) (Jacobson and Vetter 1996; Wakefield and Smith 1990). Longspine thornyhead are oviparous (egg layers) and may spawn 2-4 times per year (Love 1991; Wakefield and Smith 1990). Eggs rise to the surface to develop and hatch. Floating egg masses can be seen at the surface in March, April, and May
(Wakefield and Smith 1990). Juveniles (<5.1 cm long) occur in midwater (Eschmeyer *et al.* 1983). After settling, longspine thornyhead are completely benthic (Jacobson and Vetter 1996). Longspine thornyhead can grow to 38 cm (Eschmeyer *et al.* 1983; Jacobson and Vetter 1996; Miller and Lea 1972) and live more than 40 years (Jacobson and Vetter 1996). Longspine thornyhead reach the onset of sexual maturity at 17-19 cm (10% of females mature) and 90% are mature by 25-27 cm (Jacobson and Vetter 1996).

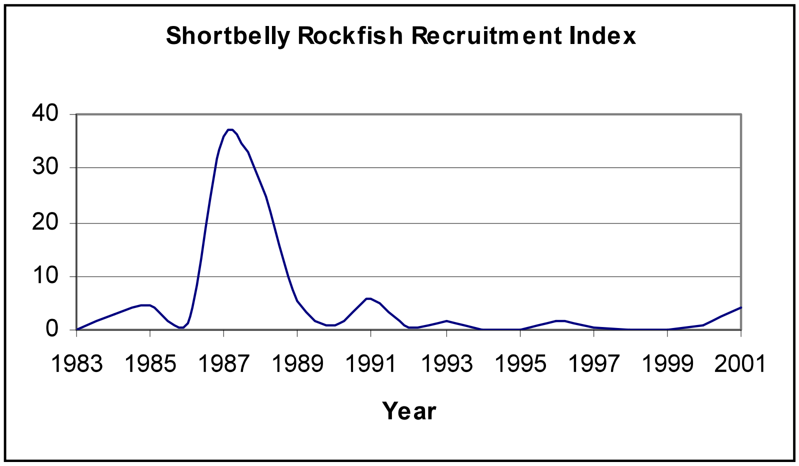
Longspine thornyhead are ambush predators (Jacobson and Vetter 1996). They consume fish fragments, crustaceans, bivalves, and polychaetes and occupy a tertiary consumer level in the food web. Pelagic juveniles prey largely on herbivorous euphausiids and occupy a secondary consumer level in the food web (Love 1991; Smith and Brown 1983). Longspine thornyhead are commonly found in shortspine thornyhead stomachs. Cannibalism of newly settled longspine thornyhead may occur because juveniles settle directly onto adult habitat (Jacobson and Vetter 1996). Sablefish commonly prey on longspine thornyhead.(NMFS 2002).

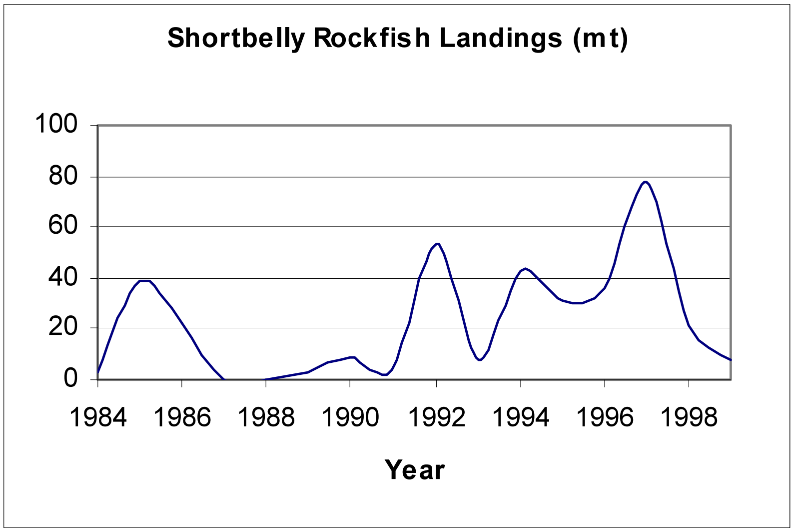
Stock Status and Trends The most recent stock assessment (Rogers *et al.* 1997) indicated longspine thornyheads to be near the target level. There are several uncertainties with the stock assessment. The catch history of longspine thornyheads was difficult to resolve due to lack of species composition information, possible confusion of landed catch with shortspine thornyheads, and different assumptions about discard. The range of uncertainty in the assessment was bracketed by estimating two different catch histories with different assumptions regarding discard rates.

There are currently no fisheries that target shortbelly rockfish.

A.1.2.14 Shortbelly Rockfish (*S. jordani*) occur from La Perouse Bank, southern British Columbia to Punta Baja, southern Baja California. They are most abundant off California and may be the most abundant rockfish in the Council area.

The shortbelly rockfish stock is one of the largest within Council jurisdiction. No directed fishing occurs on this stock, but the stock appears to have declined due to natural causes. The Council sets OY based on the most recently published assessment (Pearson *et al.* 1991).





Most adults are found near the shelf break and sometimes form large mid-water schools.

Distribution and Life History Love *et al*. (2002) and Lenarz (2001) described shortbelly rockfish distribution and life history. Young of the year recruit to the outer edge of kelp beds and deeper waters after spending up to 5 months as pelagic larvae and juveniles in offshore waters. Adults range from bottom depths of 50 fm to 300 fm (91 m to 491 m). Most adults occur near the shelf break at bottom depths between 82 fm to 109 fm (150 m to 250 m). Large adults tend to be in deeper waters than small adults. Adults are semi-pelagic and their behavior is dynamic. They sometimes form large mid-water schools near abrupt drop-offs including edges of submarine canyons. At other times they may be dispersed either in mid-water or on the bottom.

Natural mortality is fairly fairly high for shortbelly rockfish and maximum age is 32 years.

Maximum age of shortbelly rockfish is 32 years. Pearson *et al.* (1991) estimated that the instantaneous rate of natural mortality ranged from 0.2-0.35 (82-75% adult annual survival when there is no fishing mortality). About 50% of 3 year old female shortbelly rockfish are mature off California. Size at age also varies with locality (Pearson *et al.* 1991). Female shortbelly rockfish reach 90% of their maximum size by age 11 years off California. Average size at age of mature females is greater than males. Maximum size is 35 cm (14 in) and 0.4 kg (0.9 lb). Shortbelly rockfish are livebearers. Most larvae are released January through February. Fecundity is dependent on size and ranges from 6,200 to 50,000 eggs.

Adults primarily feed on krill.

Little is known about ecological relationships between shortbelly rockfish and other organisms. Small shortbelly rockfish feed primarily on zooplankton such as copepods and young stages of euphausiids. Euphausiids dominate the diet of larger fish. Shortbelly rockfish are an important forage fish. Sea birds, chinook salmon, coho salmon, and marine mammals consume pelagic juveniles. Large fish such as bocaccio and lingcod prey on adults.

Biomass estimates only apply to a small part of the range.

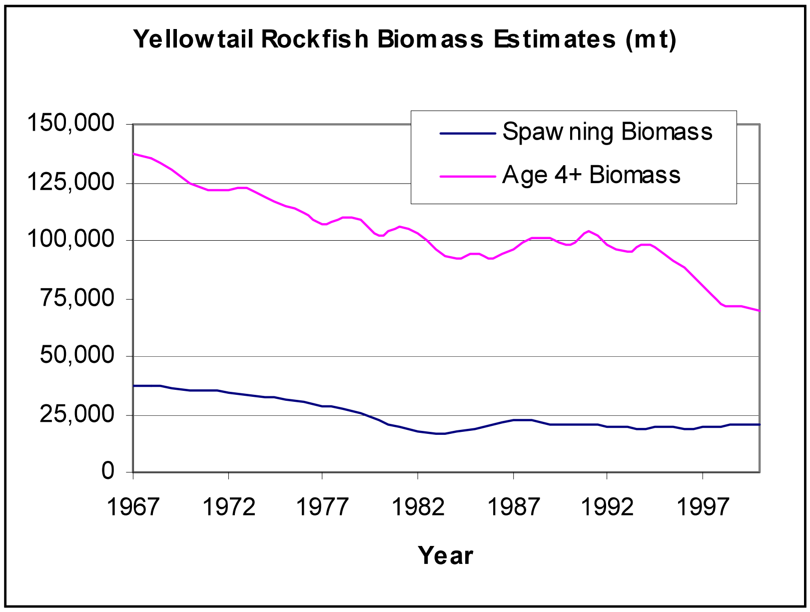
Stock Status and Trends Catches of shortbelly rockfish are minor and most catches are incidental to fishing for other species. Shortbelly rockfish are small and most pass through meshes allowed by regulations. A special permit would be required for a significant fishery to develop. The Council set OY at the low end of estimates of MSY in the most recent assessment (Pearson *et al.* 1991). A more recent study (Ralston *et al. In Press*) indicated that, while still large, biomass may have decreased due to natural causes such as poor ocean conditions (Lenarz *et al.* 1995; MacCall 1996).

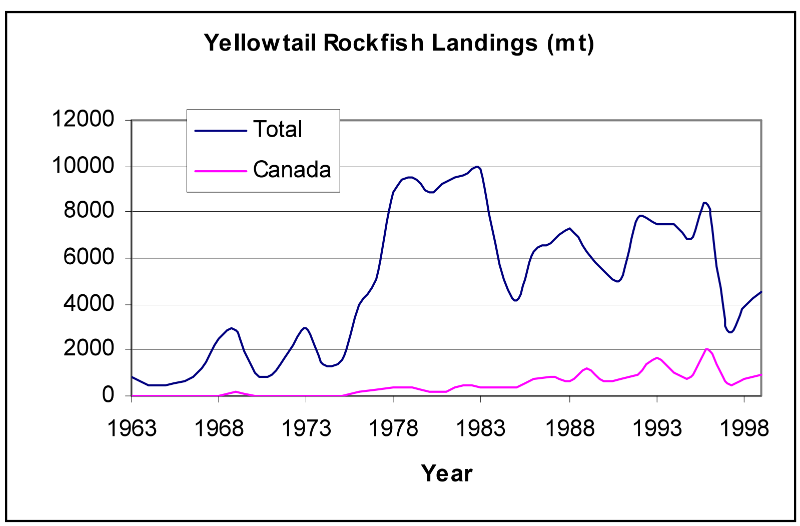
Several factors caused uncertainties in the assessment. The lack of a significant fishery precludes fishery dependent data. Thus there is no experience to base stock productivity on. There have been two types of estimates of biomass: hydro-acoustic and larval production. Both types require unverified assumptions. The biomass estimates only include fish between Monterey and San Francisco. While shortbelly rockfish appear to be most abundant in the assessed area, significant concentrations have been found elsewhere.

Yellowtail rockfish are above the biomass target level.

A.1.2.15 Yellowtail Rockfish (*S. flavidus*) occur from Unalaska Island (Aleutian Islands) to La Jolla, California. They are most abundant from Oregon to British Columbia and are one of the most abundant rockfish in the Council area.

The Council first recommended regulations for yellowtail rockfish (as part of the *Sebastes* complex) in 1983 and regulations specific to yellowtail rockfish in 1985. The most recent assessment (Tagart *et al.* 2000) indicated that there has been a long term decline in biomass, but the stock remains above the target level.





Distribution and Life History Love *et al*. (2002) and Ralston

(2001) described yellowtail rockfish distribution and life history. Young of the year recruit to shallow nearshore waters after spending up to 5 months as pelagic larvae and juveniles in offshore waters. Adults range from the surface to bottom depths of 300 fm (549 m). Most adults occur over the lower shelf at bottom depths between 49 fm and 98 fm (90 m and 180 m). Adults are semi-pelagic and their behavior is dynamic. They often form large mid-water schools. At other times they may be on the bottom. The large aggregations usually occur above bottom features known to fishermen.

Maximum age of yellowtail rockfish is 64 years. Tagart *et al*. (2000) estimated that the instantaneous rate of natural mortality was about 0.11 (90% adult annual survival when there is no fishing mortality), but that mortality of mature females increased with age. Age of maturity varies with locality. Tagart (1991) found that 50% of 9-10 year old female yellowtail rockfish were mature off northern California - southern Oregon, and 50% of 11 year old fish were mature off northern Washington. Size at age also varies with locality (Hart 1973; Tagart *et al.* 1997). Female yellowtail rockfish reach 90% of their maximum size by age 16 years off n. Washington and by age 13 years off n. California-s. Oregon. Average size at age of mature females is greater than males, and size at age has decreased since 1987. Maximum size is 70 cm (28 in) and 5.2 kg (11.5 lb). Tagging results showed that most adults appear to remain near the area of release, but some move as far as 1,400 km (757 miles). Yellowtail rockfish are livebearers. Most larvae are released January through March. Fecundity is dependent on size and ranges from 56,900 to 1,993,000 eggs.

> Most adults are found over the lower shelf and sometimes form large mid-water schools.

> Natural mortality is fairly low and maximum age is 64 years.

Little is known about ecological relationships between yellowtail rockfish and other organisms. Pelagic juveniles feed on planktonic organisms such as copepods. Adults are often caught with other fish such as canary, redstripe and widow rockfish. Midwater animals such as euphausiids and small fish dominate the diet of adult fish. Sea birds and chinook salmon consume pelagic juveniles. Little is known about predation of adults.

> Adults feed on midwater organisms such as small fish and krill.

Stock Status and Trends Catches of yellowtail rockfish were modest until large trawlers began exploiting large schools in 1976. Landings by the unregulated fishery rapidly increased to 9,508 mt in 1979. Biologists documented that the stock was being impacted. Regulations were implemented in late 1983, but landings were still high, 9,864 mt. The Council recommended more restrictive regulations in 1985 and landings

> There are considerable uncertainties in the assessments.

have fluctuated between 2,323 to 6,822 mt since then. The stock is estimated to be close to target levels.

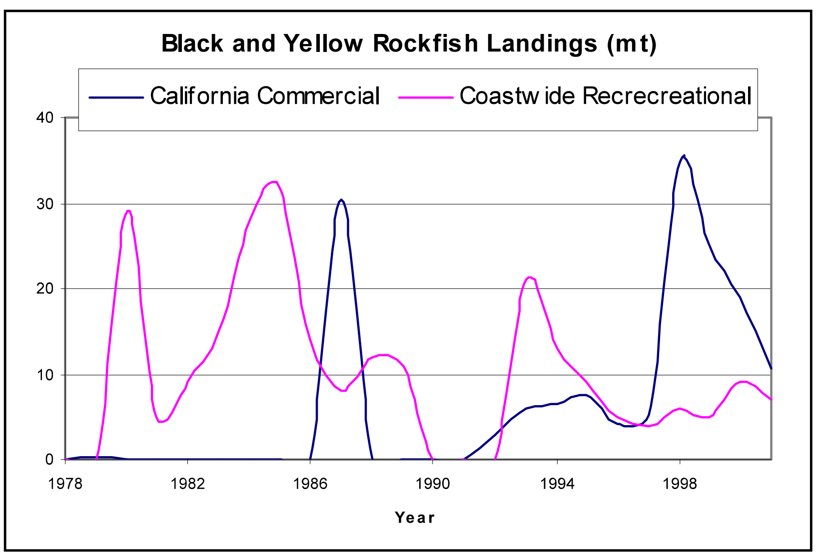
There are two major uncertainties in the assessments. The assessment model estimate of current biomass is very sensitive to results of the most recent trawl survey biomass index. The index undergoes considerable and poorly understood survey to survey fluctuations. Population structure of yellowtail rockfish is controversial. Some research indicates that there is one coastwide stock. Other research suggests that there are several stocks. The current assessment assumes that there is one stock from northern California to southern Canada. Management boundaries are placed at Cape Mendocino, California and the US-Canada border. There is no agreement with Canada about management of the stock that is assumed to be shared between the two countries. The Cape Mendocino boundary is based on the fishery rather than scientific evidence of stock structure.

The stock is estimated to be close to the target level.

A.1.2.16 Black and Yellow Rockfish (*S. chrysomelas*) occur from the Cape Blanco, Oregon to Isla Natividad, central Baja California. They are most abundant from Sonoma County, California to Point Conception, California.

The stock of black and yellow rockfish is abundant but has not been formally assessed. California has regularly sampled commercial landings. Commercial landings were restrained after 1998 because the Council recommended more restrictive commercial regulations for poorly known species.

Most adults are on the upper shelf.



Distribution and Life History Love *et al*. (2002) and Larson and Wilson-Vandenberg (2001) described black and yellow rockfish distribution and life history. Young of the year settle in shallow water after a short pelagic stage. The recently settled fish are mostly found close to fronds of giant and bull kelp. As they grow, they move down the kelp stipes to the bottom and inhabit the same type of rocky nearshore bottom as adults. Adults range to bottom depths of 20 fm (37 m). Most adults occur on the upper shelf at bottom depths less than 6.6 fm (12 m). Adult fish tend to be solitary and on the bottom. They defend territories and studies revealed very little movement.

Maximum age is about 30 years.

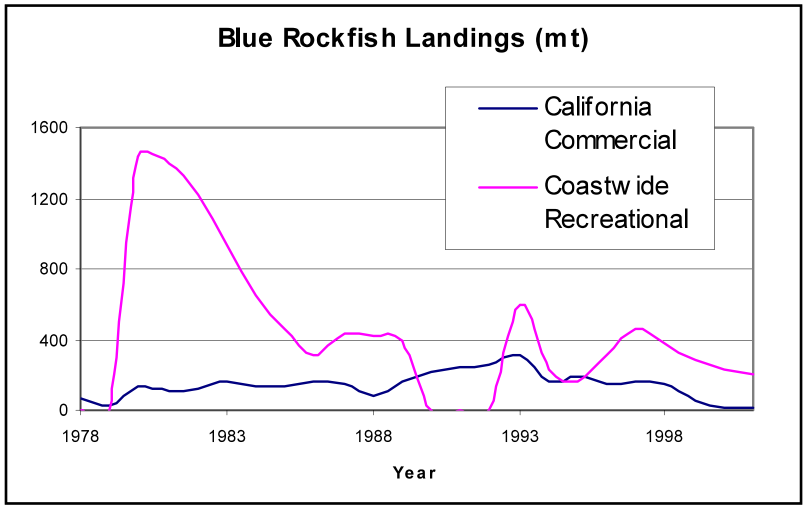
Maximum age of black and yellow rockfish is about 30 years. Mature male and females of the same age are about the same size. Female black and yellow rockfish are mature by 27 cm (11 in). Fish mature at a smaller size off southern California. Maximum size is 39 cm (15 in). Black and yellow rockfish are livebearers, and parturition extends from January to July. A 26 cm (10 inch) fish from central California had about 425,000 eggs.

Not much is known about ecological relationships between black and yellow rockfish and other organisms. Researchers have observed adults on the same reefs as blue, gopher, kelp, and olive rockfishes, and treefish. Adults mainly consume bottom organisms such as crabs, and shrimp. They also consume small fish, such as sculpins and juvenile rockfish, and cephalopods. Juveniles feed on planktonic crustaceans such as barnacle larvae. Researchers have not documented predation of china rockfish by other organisms.

Stock Status and Trends The status of black and yellow rockfish within the Council's jurisdiction is not known. They are a component of nearshore recreational and commercial catches and demand a premium price.

Blue rockfish have not been assessed.

A.1.2.17 Blue Rockfish (*S. mystinus*) occur from at least Sitka Strait, southeast Alaska to Punta Santo Tomas, northern Baja California. They have been reported north to the Bering Sea, but the northern fish may have been misidentified dusky rockfish. They are most abundant from Eureka, California to the northern Channel Islands, California.



The blue rockfish stock is abundant but has not been formally assessed. California has regularly sampled commercial landings. Blue rockfish are a member of the other rockfish category. The Council recommends regulations for other rockfish as an aggregate. Commercial landings were lower after 1998 because the Council recommended more restrictive commercial regulations for poorly known species.

Distribution and Life History Love *et al*. (2002) and Reilly (2001b) described blue rockfish distribution and life history. Young of the year settle in nearshore waters after a 3-5 month pelagic stage. At first they are often found in the surface canopies of bull or giant kelp or on rock bottoms and have been found in tidal pools. Soon after, almost all of the young descend to rocky bottoms. With further growth they move up into the water column during the day and continue to use rocky bottoms for shelter during the night. Adults range to bottom depths of 300 fm (549 m). Most adults occur over the upper shelf at bottom depths less than 49 fm (90 m). Adult and subadult fish are usually found in or near the kelp forest or offshore reefs, and can form large aggregations that extend to the surface. Tagging studies revealed that most adult blue rockfish moved very little if at all. One tagged fish moved 24 km (1 mile).

Maximum age of blue rockfish is 44 years.

Maximum age of blue rockfish is 44 years. Fifty percent of female blue rockfish are mature by 28 cm (11 in) when they are 6 years old. Females tend to be larger than males of the same age. Maximum size is 53 cm (21 in). Blue rockfish are livebearers. Parturition peaks in January. Fecundity is not well known. A 40.5 cm (16 in) female had 525,000 eggs.

Adults primarily feed on offshore macroplankton and occasionally on algae.

Because of the abundance and availability of blue rockfish for observation in nearshore waters, probably more is known about ecological relationships between blue rockfish and other organisms than for any other groundfish. Researchers have observed adults associated with olive, rosy, starry, and yellowtail rockfish. Juvenile blue rockfish mainly feed on planktonic micro-crustacea and larvaceans. In some years the young are extremely abundant in nearshore waters. A study documented that predation of larvae by young of the year blue rockfish can significantly reduce recruitment of barnacles to the intertidal zone. Adults mostly feed on offshore macroplankton such as pelagic tunicates, scyphozoans, hydromedusae, and, in El Niño years, may consume pelagic red crabs. Blue rockfish also consume squid and young of the year rockfish when available. Even nearshore fish primarily consume offshore macroplankton when there are onshore currents. At other times they may consume considerable amounts of algae. In years of high recruitment, juvenile blue rockfish are a major prey item in nearshore waters. They are consumed by kelp greenling, lingcod, various rockfishes (included adult blue), harbor seals, and sea birds. Lingcod, harbor seals, sea lions, and occasionally larger rockfish such as bocaccio consume adult blue rockfish.

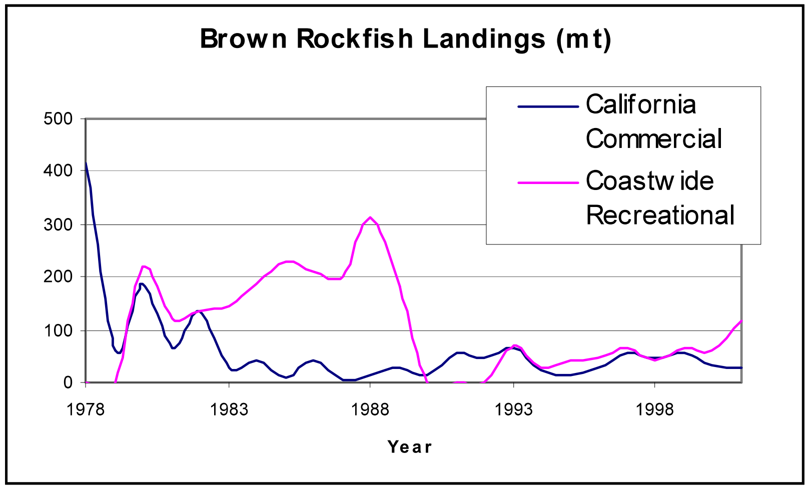
Most adults are on the upper shelf.

Stock Status and Trends The status of blue rockfish is not known. They are an important component of California recreational catches and are sometimes targeted by commercial fishers. CDFG biologists have expressed concerns about decreases in average size and abundance of the species (Reilly 2001b).

Brown rockfish have not been assessed.

A.1.2.18 Brown Rockfish (*S. auriculatus*) occur from Prince William Sound, Alaska to Bahia San Hipolito, southern Baja California. They are most abundant in Puget Sound, Washington and from Bodega Bay, California to Bahia Tortugas, southern Baja California.

The stock of brown rockfish is abundant but has not been formally assessed. California has regularly sampled commercial landings. Brown rockfish are a member of the other rockfish category. The Council recommends regulations for other rockfish as an aggregate. Commercial landings were lower after 1998 because the Council recommended more restrictive commercial regulations for poorly known species.



Maximum age is at least 34 years.

Adults primarily feed on crabs and fish.

Distribution and Life History Love *et al*. (2002) and Ashcraft and Heisdorf (2001) described brown rockfish distribution and life history. Young of the year settle in shallow water to 20 fm (36 m) after a 3 month pelagic stage. They tend to be found over rocks, in pieces of drift algae on the bottom, and on walls of submarine canyons. Adults range to bottom depths of 74 fm (135 m). Most adults occur over the upper shelf at bottom depths less than 66 fm (120 m). Juveniles, subadults, and to a much lessor degree adults are common in estuaries such as San Francisco Bay. Adult and subadult fish tend to be solitary, are usually within a few meters of the bottom and over bottoms of both low and high relief or occasionally associated with eelgrass or other vegetation . Tagging studies revealed that subadults can move from San Francisco Bay to as far as 50 km (31 miles) away along the outer coast. Genetic studies indicate that fish in Puget Sound were distinct from offshore fish.

Maximum age of brown rockfish is at least 34 years. Fifty percent of female brown rockfish are mature by 24-31 cm (9.5-12 in) when they are 4-5 years old. Mature females are about the same size as males of the same age. Maximum size is 56 cm (22 in). Brown rockfish are livebearers. Parturition extends from December to August, with two peaks off central and northern California (December-January and May-June). Fecundity is size dependent and ranges from 42,500 to 339,000 eggs..

Not much is known about ecological relationships between brown rockfish and other organisms. Researchers have observed adults associated with calico, canary, copper, quillback, and vermillion rockfish. Juvenile brown rockfish mainly feed on small crustaceans. Subadults consume shrimp, small fish, and , when available herring eggs, in San Francisco Bay. Adults mainly consume crabs and fish in offshore waters.

Chinook salmon and harbor seals prey on small brown rockfish.

Stock Status and Trends The status of brown rockfish is not known. They are an important component of nearshore recreational and commercial catches, and command a premium price. NOAA Fisheries Service recently reviewed a petition to list the species under the ESA and determined that listing was not warranted.

Calico rockfish have not been assessed.

A.1.2.19 Calico Rockfish (*S. dallii*) occur from San Francisco, California to Bahia de Sebastian Vizcaino, central Baja California. They are most abundant south of Point Arguello, central California. The stock is abundant but has not been formally assessed.

Most adults are on the upper shelf.

Distribution and Life History Love *et al*. (2002) and Ono (2001) described calico rockfish distribution and life history. Young of the year settle onto soft, sand-rock, or low-lying hard bottom at depths between 11 fm and 23 fm (20 m and 42 m). Adults occur to bottom depths of 140 fm (256 m) and are most common on the upper shelf between 33 fm and 66 fm (60 m and 120 m). Calico rockfish are usually on or near the bottom and are solitary or in small groups.

Maximum age is at least 12 years.

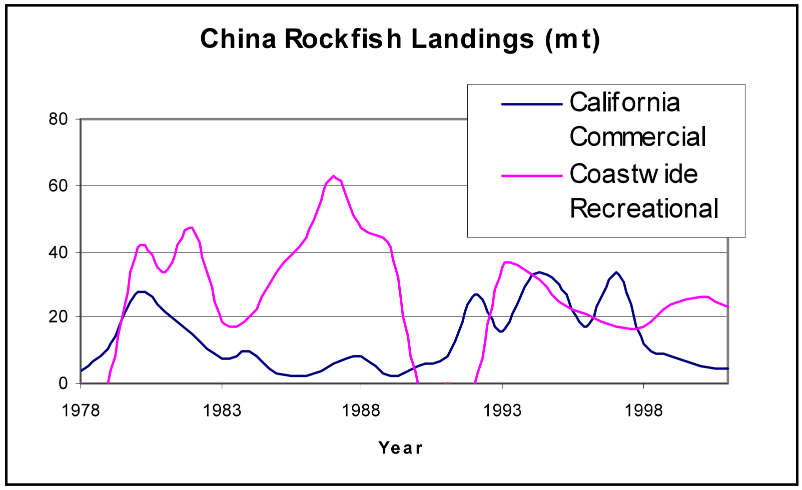
Maximum age of calico rockfish is at least 12 years. Maximum size is 20 cm (8 in). About 50 % of 9 cm (3.5 in) fish are mature. Calico rockfish are livebearers. Parturition occurs in to January to May with a peak in February. Fecundity ranges between 3,900 and 18,000 eggs.

Adults consume a wide variety of bottom and water column organisms.

Not much is known about ecological relationships between calico and other organisms. Adults consume both water column and bottom dwelling organisms such as bivalves, brittle stars, copepods, crabs, euphausiids, gammarid amphipods, fish larvae, shrimp, and worms. Dolphins, larger fish, and sea birds are known to prey upon young and adult calico rockfish.

China rockfish have not been assessed.

A.1.2.20 China Rockfish (*S. nebulosus*) occur from the Kachemak Bay, Alaska to San Nicolas Island and Redondo Beach, southern California. They are most abundant from Prince William Sound, Alaska to northern California. This is an abundant stock but it has not been formally assessed. California has regularly sampled commercial landings.



Most adults are on the upper shelf.

Distribution and Life History Love *et al*. (2002) and Larson and Wilson-Vandenberg (2001) described China rockfish distribution and life history. Young of the year settle in shallow water after a probably short pelagic stage. Adults range to bottom depths of 70 fm (128 m). Most adults occur on the upper shelf at bottom depths greater than about 5.5 fm (10 m). Adult fish tend to be solitary and on the bottom, and occur in areas high-relief rocky outcrops, often boulder fields with numerous crevices. They defend territories and studies revealed very little movement.

Maximum age of China rockfish is 79 years.

Maximum age of China rockfish is 79 years. Female China rockfish are mature by 30 cm (12 in) when they are 6 years old. Maximum size is 45 cm (18 in). China rockfish are livebearers. Parturition extends from January to August and occurs later off Alaska than California. Fecundity is not known.

Adults feed on brittle stars, chitons, crabs, and other bottom organisms.

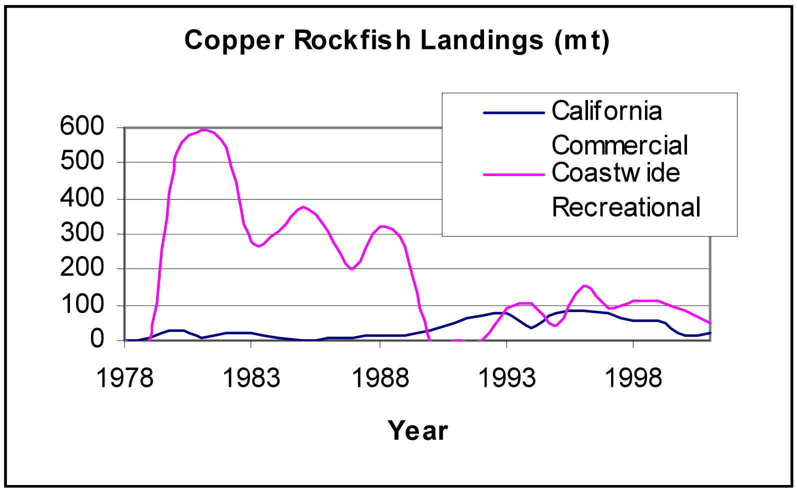
Not much is known about ecological relationships between China rockfish and other organisms. Researchers have observed adults in dens of the large Pacific octopus. Adults mainly consume bottom organisms such as brittle stars, chitons, crabs, nudibranchs, octopuses, red abalone, shrimp, small fishes, and snails. Juveniles feed on planktonic crustaceans such as barnacle larvae. Researchers have not documented predation of China rockfish by other organisms.

Stock Status and Trends The status of China rockfish within the Council's jurisdiction is not known. They are a component of nearshore recreational and commercial catches and demand a premium price.

Copper rockfish have not been assessed.

A.1.2.21 Copper Rockfish (*S. caurinus*) occur from Kachemak Bay, Alaska to Islas San Benito, central Baja California. They are most abundant in Puget Sound, Washington and from Valdez, Alaska to Punta Banda, northern Baja California.

The stock of copper rockfish is abundant but has not been formally assessed. California has regularly sampled commercial landings. Copper rockfish are a member of the other rockfish category. The Council recommends regulations for other rockfish as an aggregate. Commercial landings were lower after 1998 because the Council recommended more restrictive commercial regulations for poorly known species.



Most adults are on the upper shelf.

Distribution and Life History Love *et al*. (2002) and Lea (2001) described copper rockfish distribution and life history. Young of the year settle in shallow water after a short pelagic stage. They often settle within kelp or eelgrass beds. If a canopy exists, the young occur near the surface, otherwise they are closer to the bottom. The young fish then settle to the bottom after a few months. Adults range to bottom depths of 100 fm (183 m). Most adults occur over the upper shelf at bottom depths less than 49 fm (90 m). Adult and subadult fish tend to be solitary or in small aggregations, are usually within a few meters of the bottom, and occur in boulder fields and over high-relief rocks. Adults are also sometimes found over low relief rocks. Tagging studies revealed very little movement. Genetic studies indicated that fish in Puget Sound were distinct from offshore fish, and there may be distinct groups along the outer coast.

Maximum age is at least 50 years.

Maximum age of copper rockfish is at least 50 years. Fifty percent of female copper rockfish are mature by 34 cm (13.4 in) when they are 6 years old. Mature females are about the same size as males of the same age. Maximum size is 66 cm (26 in). Copper rockfish are livebearers. Parturition extends from January to July over its entire range with southern fish releasing larvae first. Fecundity is size dependent and ranges from 16,000 to 640,000 eggs.

Adults primarily feed on crabs, shrimp, and fish.

Not much is known about ecological relationships between copper rockfish and other organisms. Researchers have observed adults associated with black, brown, dusky, quillback, silvergrey, tiger, vermillion, and yelloweye rockfish. While near the surface, juvenile copper rockfish mainly feed on copepods and invertebrate larvae. After settling to the bottom, the young fish prey on shrimps and caprellid and gammarid amphipods. Adults mainly consume crabs, shrimp, and fish, but also consume amphipods, mysids, squid, and octopuses. Chinook salmon prey on small copper rockfish.

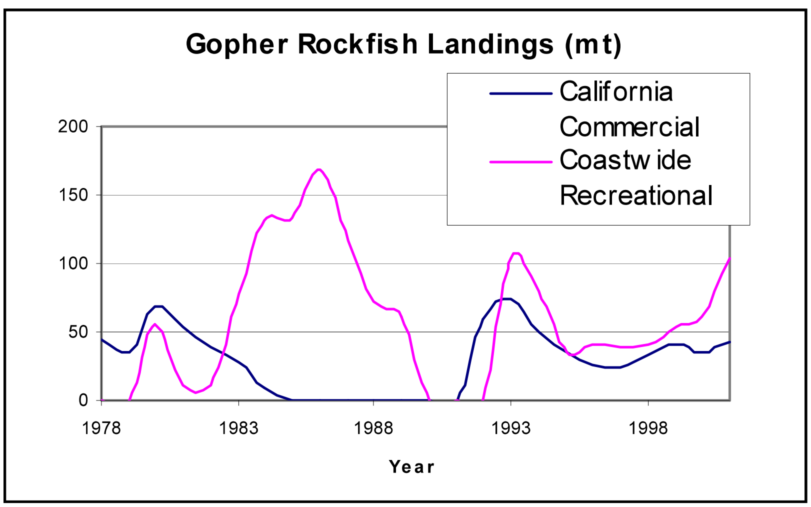
Stock Status and Trends The status of copper rockfish is not known, but evidence indicates that there have been local depletions (Lea 2001). They are an important component of nearshore recreational and commercial catches. NOAA Fisheries Service recently reviewed a petition to list the species in Puget Sound under the ESA and determined that listing was not warranted.

A.1.2.22 Gopher Rockfish (*S. carnatus*) occur

from Cape Blanco, Oregon to Punta San Roque, southern Baja California. They are most abundant from Sonoma County, California to Arrecife Sacramento, Central Baja California.

Gopher rockfish have not been assessed.

Gopher rockfish are abundant but have not been formally assessed. California has regularly sampled commercial landings.



Most adults are on the upper shelf.

Distribution and Life History Love *et al*. (2002) and Larson and Wilson-Vandenberg (2001) described gopher rockfish distribution and life history. Young of the year settle in shallow water after a short pelagic stage. The recently settled fish are mostly found close to fronds of giant and bull kelp. As they grow, they move down the kelp stipes to the bottom and inhabit the same type of rocky nearshore bottom as adults. Adults range to bottom depths of 44 fm (80 m). Most adults occur on the upper shelf at bottom depths greater than 9.8 fm (18 m). Adult fish tend to be solitary and on the bottom. They defend territories and studies revealed very little movement.

Maximum age of gopher rockfish is not known. Female gopher rockfish are mature by 31 cm (12 in). Maximum size is 42.5 cm (17 in). Gopher rockfish are livebearers. Parturition extends from January to July. Fecundity is not known.

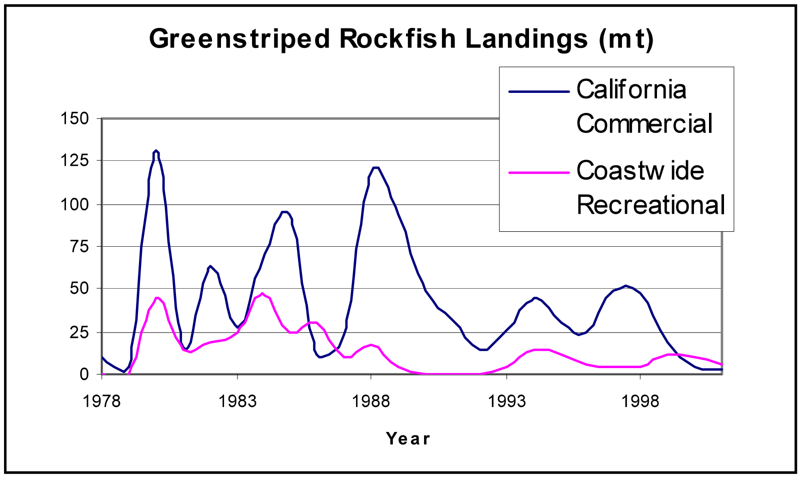
Adults mainly feed on crab and shrimp.

Not much is known about ecological relationships between gopher rockfish and other organisms. Researchers have observed adults on the same reefs as black and yellow, blue, kelp, and olive rockfishes, and treefish. Adults mainly consume bottom organisms such as crabs, and shrimp. They also consume small fish, such as sculpins and juvenile rockfish, and cephalopods. Juveniles feed on planktonic crustaceans such as barnacle larvae. Researchers have not documented predation of China rockfish by other organisms.

A.1.2.23 Greenstriped Rockfish (*S. elongatus*)

occur from Chirikof Island, Aleutian Islands to Isla Guadalupe, central Baja California. They are most abundant from British Columbia to northern Baja California.

Greenstriped rockfish are abundant but have not been formally assessed. Oregon did not report commercial landings before 1987 and recreational landings were not reported before 1980 and between 1990 and 1992.



Most adults are on the lower shelf and upper slope.

Distribution and Life History Love *et al*. (2002) described greenstriped rockfish distribution and life history. Young of the year settle to the bottom in water deeper than 40 m (131 ft/ 22 fathoms) after a several month pelagic stage. They are usually found at the interface between fine sand and clay bottoms. Some young of the year are also found within sand and cobblestone patches and sand-mud bottoms that surround rock outcrops. They move into deeper water as they mature. Adults range from bottom depths of 6.6 fm to 71 fm (12 m to 495 m). Most adults occur on the lower shelf and upper slope at bottom depths between 55 fm to 137 fm (100 m to 250 m). Adults are usually solitary and on cobble, rock rubble, or mud bottom. They also occur in boulder fields and other high relief areas.

Maximum age is 54 years.

Maximum age of greenstriped rockfish is 54 years. Fifty percent of females off Oregon and Washington are mature by 22 cm (8.7 in) when they are 7 years old. Female tend to be larger than males of the same age. Maximum size is 43 cm (17 in). Greenstriped rockfish are livebearers. Parturition occurs January through July, primarily April through May. Fecundity is dependent on size and ranges from 11,000 to 295,000 eggs. Females off southern California release two broods per year, but northern fish only release one.

Adults feed on krill, fish and many other planktonic and benthic organisms.

Little is known about ecological relationships between greenstriped rockfish and other organisms. Researchers have observed adults associated with cowcod, greenblotched, greenspotted, halfbanded, pygmy, stripetail, and swordspine rockfish. Adults feed on euphausiids, fish, shrimp, calanoid copepods, squid, and gammarid amphipods. Chinook salmon prey on small greenstriped rockfish.

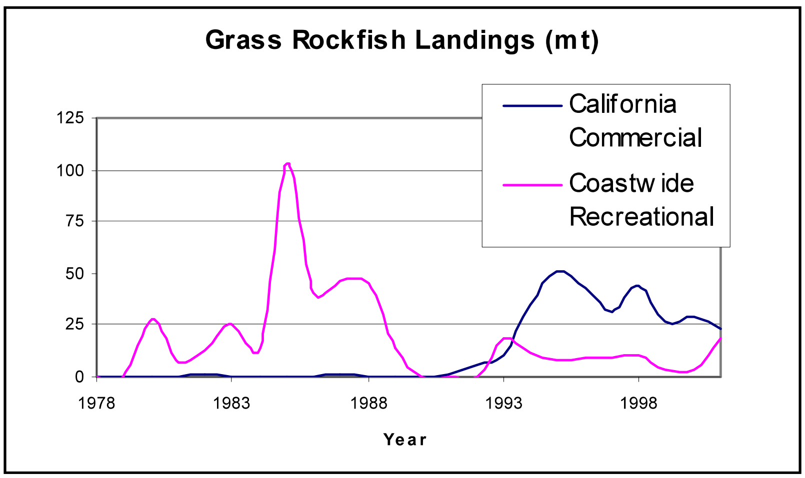
Stock Status and Trends The status of greenstriped rockfish is not known. Fishers do not target them because of their small size. Many that are caught by both commercial and recreational fishers are discarded because of their small size.

Grass rockfish have not been assessed.

A.1.2.24 Grass Rockfish (*S. rastrelliger*) occur from Yaquina Bay, Oregon to Bahia Playa Maria, central Baja California. They are most abundant from southern Oregon to about Bahia San Quintin, northern Baja California.

Adults are on the upper shelf.

The stock of grass rockfish is abundant but has not been formally assessed. California has regularly sampled commercial landings. Grass rockfish are a member of the other rockfish category. The Council recommends regulations for other rockfish as an aggregate. Commercial landings were restrained after 1998 because the Council recommended more restrictive commercial regulations for poorly known species.



Distribution and Life History Love *et al*. (2002) and Larson and Wilson-Vandenberg (2001) described grass rockfish distribution and life history. Adults are occasionally caught in San Francisco Bay. Young of the year settle in shallow water after a short pelagic stage. Adults and sub-adults occur on the upper shelf at bottom depths less than 25 fm (46 m). Some adults are found in tide pools. Adult fish tend to be on the bottom of rocky reefs.

Maximum age is at least 23 years.

Maximum age of grass rockfish is at least 23 years. Mature male and females of the same age are about the same size. All female grass rockfish are mature by 33 cm (13 in). Fish mature at a smaller size off southern California. Maximum size is 56 cm (22 in). Grass rockfish are livebearers. Parturition extends from January to March. Fecundity ranges from 80,000 to 760,000 eggs.

Adults mainly feed on bottom organisms such as crab and shrimp.

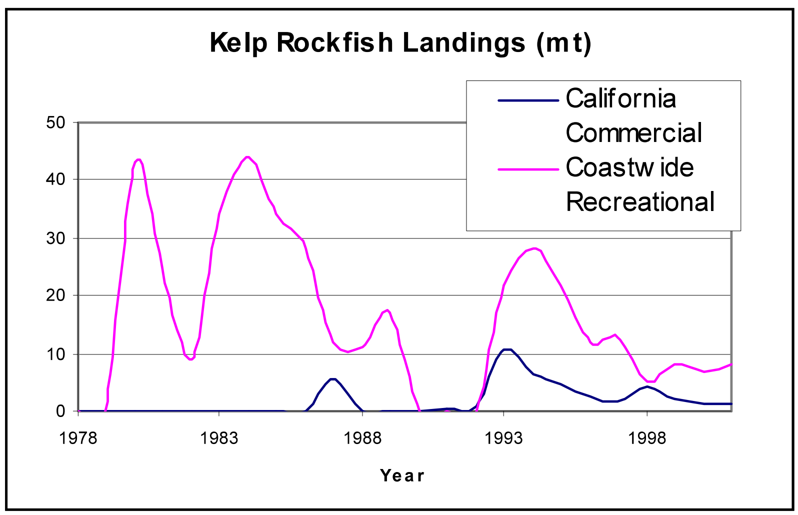
Not much is known about ecological relationships between grass rockfish and other organisms. Adults mainly consume bottom organisms such as crabs, gammarid amphipods, isopods, snails and pistol shrimp. They also consume small fish, such as seaperch and midshipmen. Juveniles feed on planktonic crustaceans such as barnacle larvae. Researchers have not documented predation of grass rockfish by other organisms.

Stock Status and Trends The status of grass rockfish within the Council's jurisdiction is not known. They are an important component of nearshore recreational and commercial catches and demand a premium price, especially as live fish.

Kelp rockfish have not been assessed.

Most adults live in kelp forests.

A.1.2.25 Kelp Rockfish (*S. atrovirens*) occur from Albion, northern California to Bahia San Carlos and Islas San Benitos, central Baja California. They are most abundant from central California to Arrecife Sacramento, central Baja California. They have not been formally assessed. California has regularly sampled commercial landings.



Distribution and Life History Love *et al*. (2002) and Larson and Wilson-Vandenberg (2001) described kelp rockfish distribution and life history. Young of the year settle in shallow water after a short pelagic stage. After settlement this species is usually found in kelp forests and range from canopy to bottom. However adults occur bottom depths of 32 fm (58 m). Young fish sometimes occur in the tidal zone. Adult fish tend to be solitary but aggregations of up to 50 fish occur.

Maximum age is at least 25 years.

Adults mainly feed on both canopy and bottom dwelling organisms.

Maximum age of kelp rockfish is at least 25 years. Mature male and females of the same age are about the same size. All female kelp rockfish are mature by 34 cm (13 in). Maximum size is 42.5 cm (17 in). Kelp rockfish are livebearers.

Parturition extends from February to June. Fecundity ranges from 10,000 to 275,000 eggs.

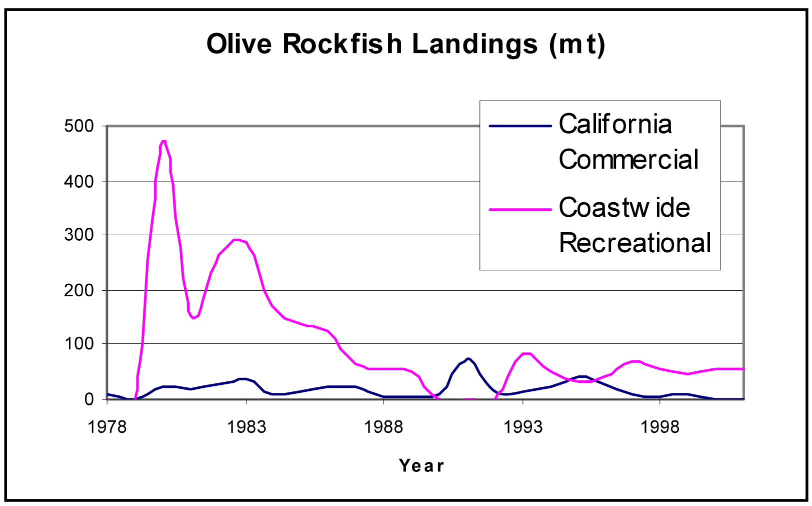
Not much is known about ecological relationships between kelp rockfish and other organisms. Adults occur on the same reefs as black and yellow, blue, gopher, and olive rockfish. Adults consume both bottom and canopy dwelling organisms such as small crustaceans typical of the kelp canopy, crabs, bottom shrimp, and fish eggs. They also consume small fish, such as young of year rockfish, kelp fish, pricklebacks, and sculpins. Juveniles feed on planktonic crustaceans such as barnacle larvae. Researchers have not documented predation of kelp rockfish by other organisms.

Stock Status and Trends The status of kelp rockfish within the Council's jurisdiction is not known. They are an important component of nearshore recreational and commercial catches.

Most adults are on the upper shelf.

Olive rockfish have not been assessed.

A.1.2.26 Olive Rockfish (*S. serranoides*) occur from southern Oregon to Islas San Benitos, central Baja California. They are most abundant from Cape Mendocino, California to the northern Channel Islands, southern California. They not been formally assessed. California has regularly sampled commercial landings.



Distribution and Life History Love *et al*. (2002) and Love (2001) described brown rockfish distribution and life history. Young of the year settle in nearshore water as shallow as 1.6 fm (3 m) after a pelagic stage. They are associated with kelp beds, oil platforms, surfgrass, and other structures. During the day they are in the water column and seek shelter at night among rocks or under algae. Adults range to bottom depths of 94 fm (172 m). Most adults occur over the upper shelf at bottom depths less than 66 fm (120 m). Adult and subadult fish are often in the water column over high relief bottom and form small to moderate sized schools. Tagging studies revealed that olive rockfish can move as far as 33 km (20 miles), but usually do not move much.

Maximum age is at least 30 years.

Maximum age of olive rockfish is at least 30 years. Fifty percent of female olive rockfish are mature by 33-35 cm (13-13.8 in) when they are 5 years old. Females tend to be larger than males of the same age. Maximum size is 61 cm (24 in). Olive rockfish are livebearers. Parturition extends from December to March, with a peak in January. Fecundity is size dependent and ranges from 30,000 to 490,000 eggs.

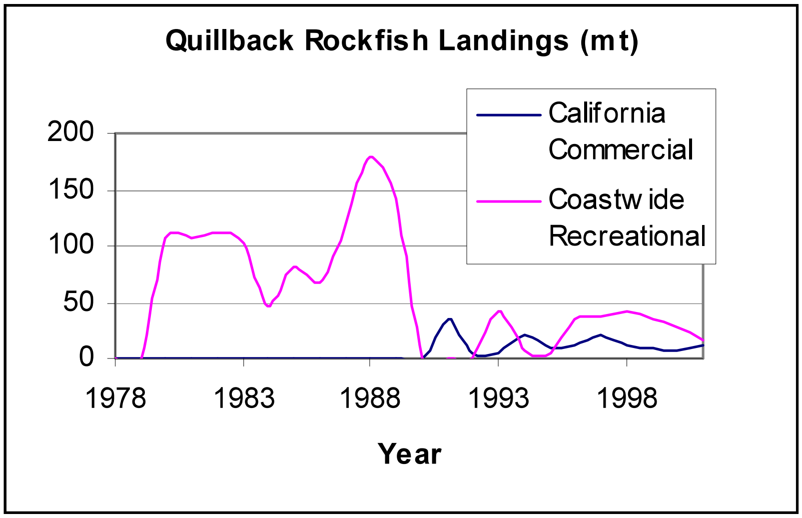
Adults consume many types of organisms including small fish squid, and polychaete worms.

Not much is known about ecological relationships between olive rockfish and other organisms. Researchers have observed adults in the same habitat as black and yellow, blue, copper, gopher, and kelp rockfish. They are sometimes caught with yellowtail rockfish off northern California. Juvenile olive rockfish mainly feed on small planktonic crustaceans and fish larvae. Older fish consume small fish such as juvenile rockfish, squid, octopuses, isopods, polychaete worms, and euphausiids, (and pelagic red crabs during El Niños). Researchers have not documented predators of olive rockfish.

Stock Status and Trends The status of olive rockfish is not known. They are not important in the commercial fishery. They were a significant component of the southern California recreational fishery, but their abundance has considerably decreased in the southern range. The decrease may be due to a shift in the ocean climate that began about 1976 and/or fishing.

Quillback rockfish have not been assessed.

A.1.2.27 Quillback rockfish (*S. maliger*) is a shelf rockfish. The species has not been formally assessed but is believed to be abundant. California has regularly sampled commercial landings.



Most adults are on the upper shelf.

Distribution and Life History Love *et al*. (2002) and Osorio and Klingbeil (2001) described quillback rockfish distribution and life history. Quillback rockfish occur from the Kenai Peninsula, Alaska to Anacapa Passage, southern California. They are most abundant in Puget Sound, Washington; Strait of Georgia, Canada; and along the outer coast from southeast Alaska to northern California. Young of the year settle in shallow water after a short pelagic stage, and are sometimes associated with detached plant material on sandy bottoms. Adults range to bottom depths of 150 fm (274 m). Most adults occur on the upper shelf at bottom depths less than about 55 fm (100 m). Adult fish tend to be solitary and on the bottom, and occur in areas of high-relief broken rock. Adults sometimes rise into the water column to feed on fish and may form small schools in the process. Tagging studies revealed very little movement. Genetic studies indicated that fish in Puget Sound were distinct from offshore fish.

Maximum age is 95 years.

Maximum age of quillback rockfish is 95 years. Fifty percent of female quillback rockfish are mature by 29 cm (11.4 in) when they are 11 years old. Mature females are about the same size as males of the same age. Maximum size is 61 cm (24 in). Quillback rockfish are livebearers. Parturition extends from April to July. Fecundity is not known.

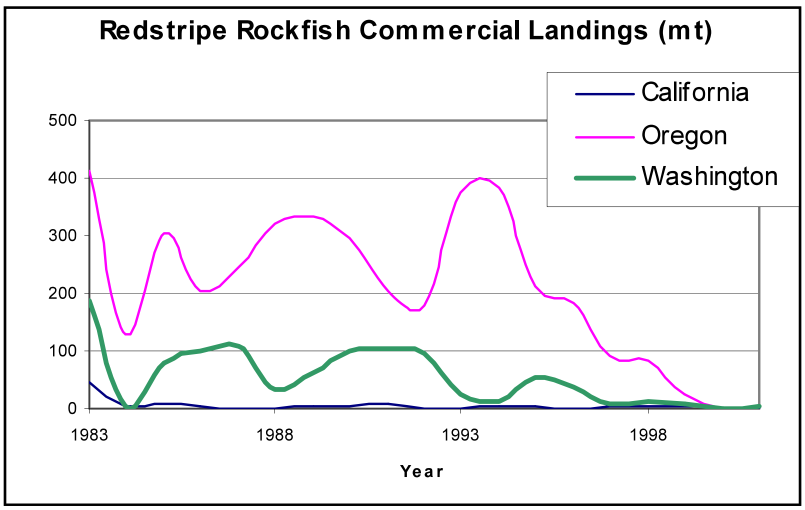
Adults feed on crabs, shrimp, amphipods, isopods, and fish.

Not much is known about ecological relationships between quillback rockfish and other organisms. Researchers have observed adults associated with copper, and quillback rockfish. Adults mainly consume bottom organisms such as crabs, shrimp, amphipods, and isopods, and sometimes rise in the water column to prey on fish. Juveniles are consumed by larger rockfishes, lingcod, cabezon, salmon, sea birds, and marine mammals. Adults are subject to predation by larger fish, sea lions, and seals.

Stock Status and Trends The status of quillback rockfish within the Council's jurisdiction is not known. They are an important component of nearshore recreational and commercial catches. The NMFS reviewed a petition to list the species in Puget Sound under the ESA and determined that listing was not warranted.

Redstripe rockfish have not been assessed.

A.1.2.28 Redstripe Rockfish (*S. proriger*) occur from southeastern Bering Sea and Aleutian Islands to southern Baja California. They are most abundant from southeast Alaska to cental Oregon. The stock of redstripe rockfish is abundant but has not been formally assessed.



Most adults are over or on the lower shelf and upper slope.

Distribution and Life History Love *et al*. (2002) described redstripe rockfish distribution and life history. Adults range from bottom depths of 7 fm to 232 fm (12 m to 424 m). Most adults occur over or on the lower shelf and upper slope at bottom depths between 82 fm to 150 fm (150 m to 275 m). Adults are semi-pelagic and are associated with high relief bottom. They may be on or near the bottom as individuals, small groups or sometime schools. Off British Columbia they apparently sometimes form dense schools by day and then rise and disperse at night.

Maximum age is at least 55 years.

Maximum age of redstripe rockfish is at least 55 years. Fifty percent of females off Oregon and Washington are mature at 28 cm (11 in) when they are 7 years old. Mature females are larger at a specific age than males. Maximum size is 51 cm (20 in). Redstripe rockfish are livebearers. Parturition occurs April to July.

Adults primarily feed on krill, shrimp, and small fish.

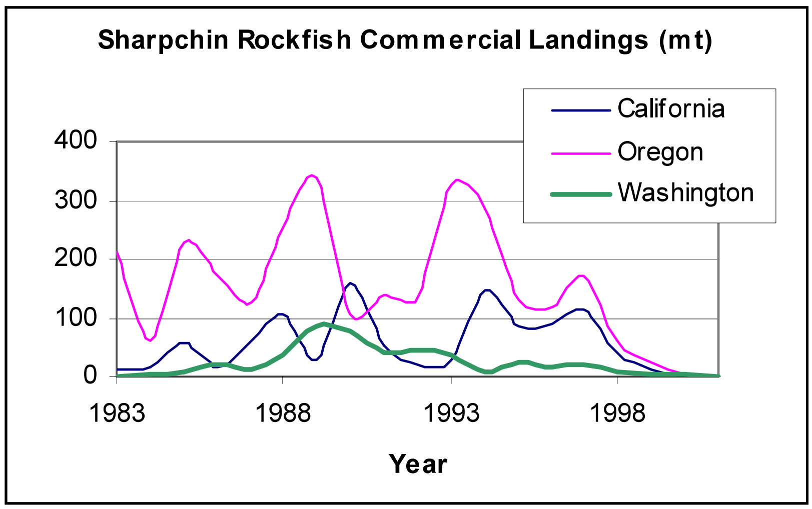
Little is known about ecological relationships between splitnose rockfish and other organisms. Adults are often caught with Pacific Ocean Perch and yellowmouth rockfishes and sometimes with widow rockfish. Researchers have observed them with harlequin, sharpchin, and yelloweye rockfish. Euphausiids, shrimp, and small fish dominate the diet. Chinook salmon consume them.

Stock Status and Trends The status of redstripe rockfish is not known. They are often caught by midwater trawls. Recreational fishers seldom capture redstripe rockfish. Because of its longevity, populations of the species probably can only support low rates of exploitation.

Sharpchin rockfish have not been assessed.

A.1.2.29 Sharpchin Rockfish (*S. zacentrus*)

occur from Attu Island, Aleutian Islands to San Diego, California. They are most abundant from the Gulf of Alaska to northern California. The stock has not been formally assessed.



Distribution and Life History Love *et al*. (2002) described sharpchin rockfish distribution and life history. Adults range from bottom depths of 14 fn to 271 fm (25 m to 495 m). Most adults occur over or on the lower shelf and upper slope at bottom depths between 55 fm and 164 fm (100 m and 300 m) over cobble-mud or boulder-mud bottoms. Fish size tends to increase with depth. Small fish have been observed in vase sponges and among dense fields of crinoids. Fish are usually on or near the bottom and often in small groups. They sometimes school.

Most adults are over or on the lower shelf and upper slope.

Maximum age of sharpchin rockfish is at least 58 years. Maximum size is 45 cm (18 in). Fifty percent of females off Oregon and Washington are mature at 22 cm (8.7 in) when they are 6 years old. Sharpchin rockfish are livebearers. Parturition occurs March to July, and appears to be latter towards the north.

Maximum age is at least 58 years.

Little is known about ecological relationships between sharpchin rockfish and other organisms. Adults are often caught with Pacific Ocean Perch and darkblotched, splitnose and yellowmouth rockfishes Euphausiids, shrimp, amphipods, copepods, and small fish dominate the diet. Researchers have not documented predators of sharpchin rockfish.

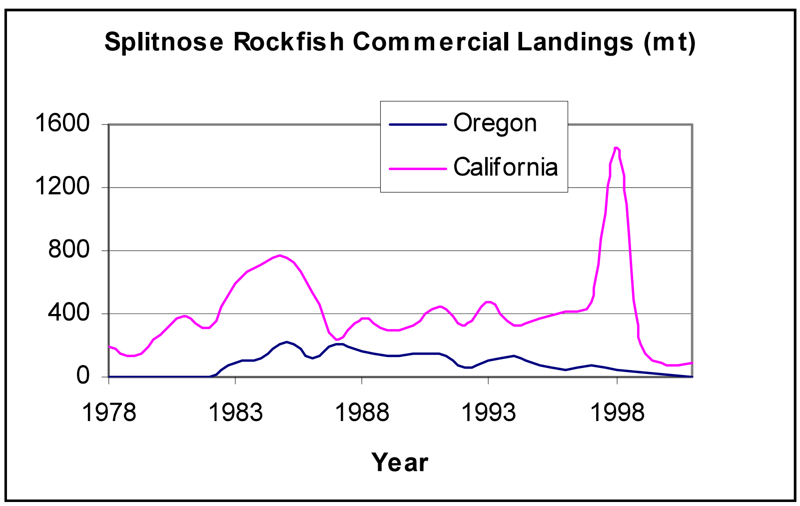
Adults primarily feed on euphausiids, shrimp, amphipods, copepods, and small fish.

Stock Status and Trends The status of sharpchin rockfish is not known. They are often caught by bottom trawl. Recreational fishers seldom capture sharpchin rockfish. Because of its longevity, populations of the species probably can only support low rates of exploitation.

A.1.2.30 Splitnose Rockfish (*S. diploproa*)

Splitnose rockfish are an upper slope species. Adults occur over or on the bottom, sometimes forming large mid-water schools.

occur from Prince William Sound, Alaska to Isla Cedros, central Baja California. They are most abundant from British Columbia to southern California. The stock has not been formally assessed. California and Oregon have regularly sampled commercial catches. Splitnose rockfish are a member of the other rockfish category. The Council recommends regulations for other rockfish as an aggregate. Catches were lower after 1998 because the Council recommended more restrictive regulations for poorly known species.



Distribution and Life History Love *et al*. (2002) described splitnose rockfish distribution and life history. Young of the year spend at least a few months near the surface often associated with drifting vegetation. They then begin a slow transition moving deeper in the water column until they reach the bottom near the end of their first year. Adults range from bottom depths of 50 to 435 fm (91 m to 795 m). Most adults occur over or on the upper slope at bottom depths between 118 fm to 191 fm (215 m to 350 m). Large adults tend to be in deeper waters than small adults. Adults are semi-pelagic. Solitary individuals often are observed on low-relief mud fields near isolated rock, cobble, or shell debris. These individuals often create shallow depressions for shelter. Splitnose rockfish sometimes form large mid-water schools up to 55 fm (100 m) off the bottom.

Maximum age is 86 years.

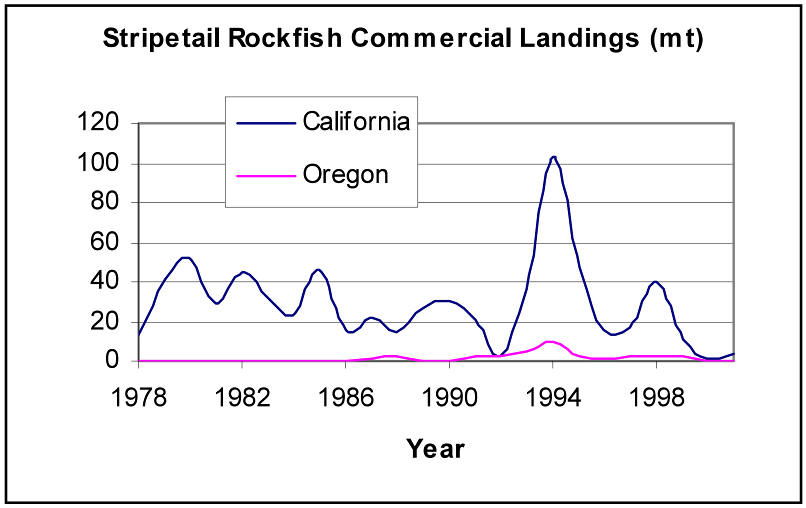
Maximum age of splitnose rockfish is 86 years. Female splitnose rockfish off California are mature at 18-23 cm (7-9 in) when they are 6-9 years old. Female reach a longer length and grow faster than males. Maximum size is 46 cm (18 in). Splitnose rockfish are livebearers. Parturition occurs January through September, primarily in July, off central California. Fecundity is dependent on size and ranges from 14,000 to 255,000 eggs.

Adults primarily feed on krill.

Little is known about ecological relationships between splitnose rockfish and other organisms. Adults are often caught with Pacific Ocean Perch, darkblotched, sharpchin, and yellowmouth rockfishes. Pelagic juveniles feed primarily on zooplankton such as calanoid copepods and amphipods. Euphausiids dominate the diet of benthic juveniles and adults fish. The larger fish also consume copepods, sergestid shrimp, and amphipods. Steller sea lions and other pinnipeds prey on splitnose rockfish (probably juveniles or small adults).

Stock Status and Trends The status of splitnose rockfish is not known. The fish are very spinney, produce low fillet yields, and market demand is often limited. They are often caught incidently to fishing directed at other species, but at times there has been a directed fishery on large aggregations found off central California. Recreational fishers seldom capture splitnose rockfish. Because of its longevity, populations of the species probably can only support low rates of exploitation.

A.1.2.31 Stripetail rockfish (*S. saxicola*) is a shelf rockfish. The species has not been formally assessed but is believed to be abundant. Oregon did not report landings before 1987.



Distribution and Life History Love *et al* (2002) described stripetail rockfish distribution and life history. Stripetail rockfish occur from Yakutat Bay, Alaska to Bahia Sebastian Vizcaino, central Baja California. They are most abundant from British Columbia to southern California. Young of the year settle to nearshore benthic habitats after a several month pelagic stage. They are often found in pieces of drift algae or other bottom debris on sandy bottoms. Some are found in kelp beds and over cobblestones. They gradually move into deeper water as they mature. Adults range from bottom depths of 14 fm (25 m) to 299 fm (547 m). Most adults occur on the lower shelf at bottom depths between 55 fm (100 m) to 109 fm (200 m). Large adults tend to be in deeper waters than small adults. Adults often are on low-relief mud or mud and scattered small rock bottoms. They can be abundant on shell mounds surrounding deep oil platforms. Stripetail rockfish usually are on or within a few meters of the bottom.

Maximum age is at least 38 years.

Maximum age of stripetail rockfish is at least 38 years. Female stripetail rockfish off California are mature by 18 cm (7 in) when they are 4-9 years old. Females tend to be larger than males of the same age. Maximum size is 41 cm (16 in). Stripetail rockfish are live bearers. Parturition occurs November through March, primarily December through February. Fecundity is dependent on size and ranges from 15,000 to 230,000 eggs.

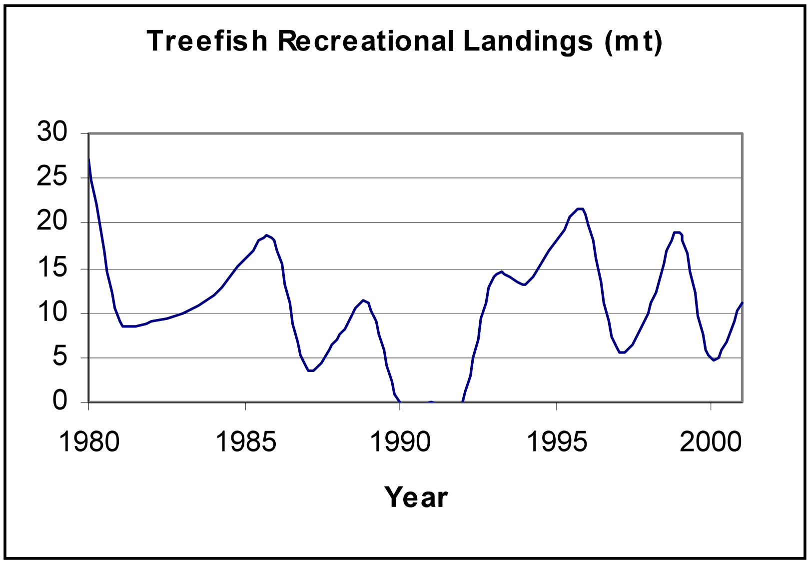
Adults primarily feed on euphausiids and copepods.

Little is known about ecological relationships between stripetail rockfish and other organisms. Adults are often found in the same habitat as greenstriped, splitnose rockfishes, Dover sole, poachers, and/or thornyheads. Euphasiids and copepods dominate the diet of adults. Chinook salmon prey on stripetail rockfish.

Stock Status and Trends The status of stripetail rockfish is not known. Fishers do not target them because of their small size. Most landed stripetail rockfish are females; male stripetail rockfish may be too small to be retained by commercial trawls. Recreational fishers seldom capture stripetail rockfish.

Treefish have not been assessed.

A.1.2.32 Treefish Rockfish (*S. serriceps*) are a shelf species that occurs from San Francisco, California to Isla Cedros, central Baja California. They have not been formally assessed.



Distribution and Life History Love *et al*. (2002) and Larson and Wilson-Vandenberg (2001) described treefish distribution and life history. Young of the year occur under drifting kelp mats and then settle to bottom at depths between 5 fm and 8 fm (9 m and 15 m). Adults occur on the upper shelf to bottom depths of 49 fm (90 m) and are most common in waters less than 33 fm (60 m). Treefish inhabit crevices and caves of high relief bottoms and are territorial.

Maximum age is at least 23 years.

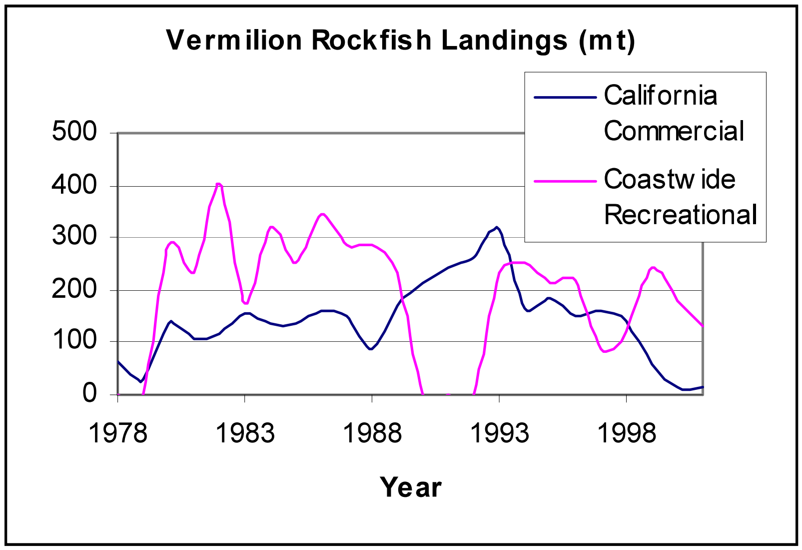
Maximum age of treefish is at least 23 years, and they grow to 41 cm (16 in). Parturition occurs in to June and July. Fecundity of a 28.5 cm female was 70,000 eggs.

Adults eat bottom dwelling organisms such as crab, fish and shrimp.

Not much is known about ecological relationships between treefish and other organisms. Adults occur on the same reefs as black and yellow, gopher, and kelp rockfish. Adults eat bottom dwelling organisms such as crab, fish, and shrimp. Least terns prey on young treefish.

Stock Status and Trends The status of treefish within the Council's jurisdiction is not known. They are an important component of nearshore recreational catches. The southern California nearshore live fish fishery also takes treefish.

A.1.2.33 Vermilion Rockfish (*S. miniatus*) occur from Prince William Sound, Alaska to Islas San Benito, central Baja California. They are most abundant from northern California to northern Baja California. The stock has not been formally assessed.



Most adults are on the mid shelf.

Distribution and Life History Love *et al*. (2002) described vermilion rockfish distribution and life history. Young of the year settle to waters 3-20 fm (6-36 m) deep after a several month pelagic stage. They are usually found hovering near sand patches adjacent to structures such as worm tubes and pier pilings or the interface of sand and hard substrata. They tend to move into deeper water as they mature. Adults range from bottom depths of 3 fm to 238 fm (6 m to 436 m). Most adults occur on the mid shelf at bottom depths between 27 fm to 82 fm (50 m to 150 m). Adult and subadult fish usually aggregate on high relief bottoms. Solitary fish are sometimes found in shallow-water caves and crevices.

Maximum age is at least 60 years.

Maximum age of vermilion rockfish is at least 60 years. Fifty percent of vermilion rockfish are mature by 37 cm (14.5 in) when they are 5 years old. Female tend to be larger than males. Maximum size is 76 cm (30 in) and 6.8 kg (15 lbs). Vermilion rockfish are livebearers. Parturition occurs July through March, primarily November, off southern California, and September-June off central and northern California. Fecundity is dependent on size and ranges from 63,000 to 2,600,000 eggs.

Adults feed on small fish and squid, krill, octopus, and many other planktonic and benthic organisms.

Little is known about ecological relationships between vermilion rockfish and other organisms. Researchers have observed adults associated with blue, bocaccio, brown, canary, copper, and yellowtail rockfish. Adults feed on small fish, squid, euphausiids, and octopuses. They also take salps, pelagic red crabs, shrimp, copepods, mysids, amphipods, isopods, and polychaetes. Sea birds prey on small vermilion rockfish.

Stock Status and Trends The status of vermilion rockfish is not known. Both recreational and commercial fishers value them.

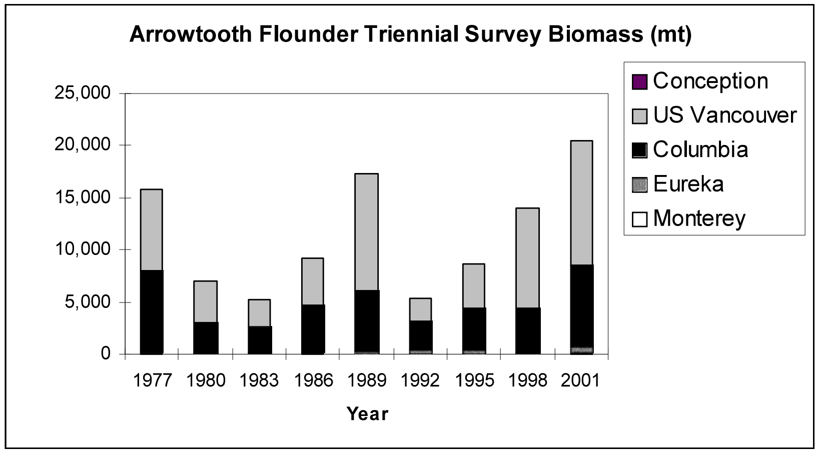
A.1.3 Flatfish

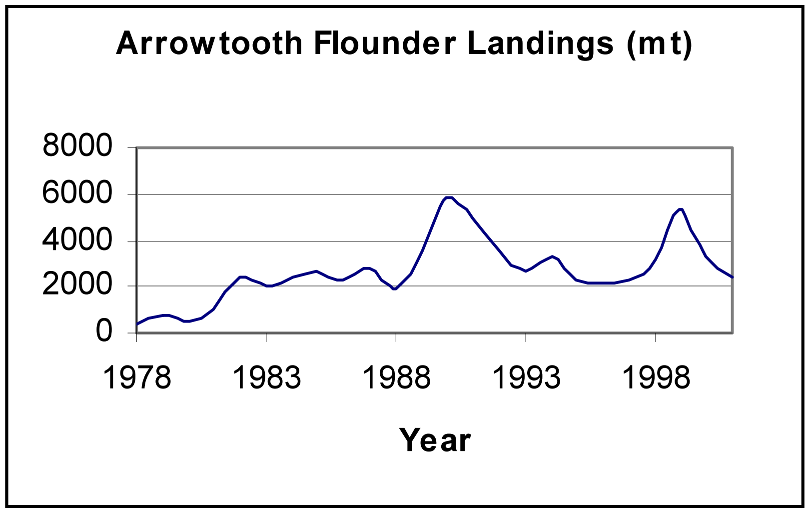
A.1.3.1 Arrowtooth Flounder (*Atheresthes stomias*)

ranges from the Bering Sea to coast off San Pedro, California, although it is more common offshore from Alaska to British Columbia (Eschmeyer *et al.* 1983).

Biomass appears to be highly variable - Arrowtooth flounder are at the southern end of their range in the Pacific region.

Although abundant within the northern part of the Columbia and Vancouver areas, historical catches were low until the past two decades. Flesh quality has generally been considered poor, but new markets and improved handling have increased demand for this trawl caught species.





Distribution and Life History Arrowtooth flounder ranges from the Chukchi Sea and Bearing Sea to southern California off San Pedro. It is more common offshore from Alaska to B.C. It is one of the right-eyed flounders and lives on soft bottom habitat from 10 to 400 fm (18-731 m). It is characterized by a large jaw and long and rather sharp teeth. State sampling programs have collected length and age data since 1986. They can reach lengths of up to 84 cm (Eschmeyer *et al.* 1983). Growth completion rates range from 0.140 to 0.156 for females and 0.312 to 0.348 for males. Length at 50% maturity was estimated to be 37.3 cm for females and 27.8 cm for males. Arrowtooth flounder are difficult to age and ages have not been validated. Assigned ages ranged from 3 to 27 years.

Stock Status and Trends Beginning in the 1980s, landings of arrowtooth flounder gradually increased to resent averages of around 3,500 mt. Discarding of arrowtooth is thought to be substantial over the catch history. Landed as mink food in the 1950s and 1960s, catches declined in the 1970s. The last stock assessment on arrowtooth flounder was conducted in 1993

(Rickey 1993) for the U.S. portion of the Vancouver and Columbia areas combined. An equilibrium yield per recruit was estimated using a dynamic pool model for females only. Recruitment was assumed to be constant with no spawner-recruit relationship. Model results were used to estimate fishing mortality and exploitation rates.

NMFS survey biomass estimates reviewed in the assessment were highly variable. Arrowtooth in the assessed area are at the southern end of their range and the variability may have been due to environmental factors.

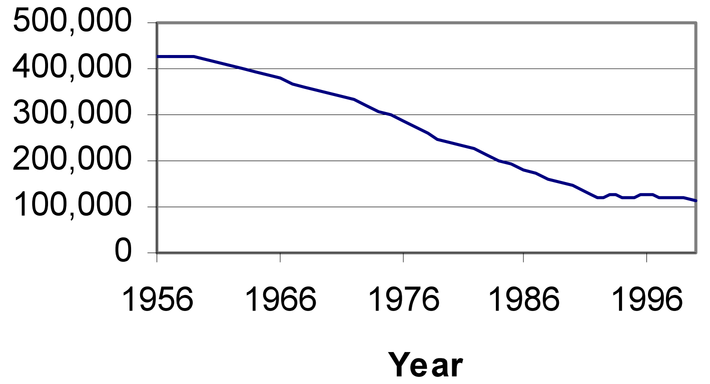
A joint U.S. and Canadian assessment is recommended.

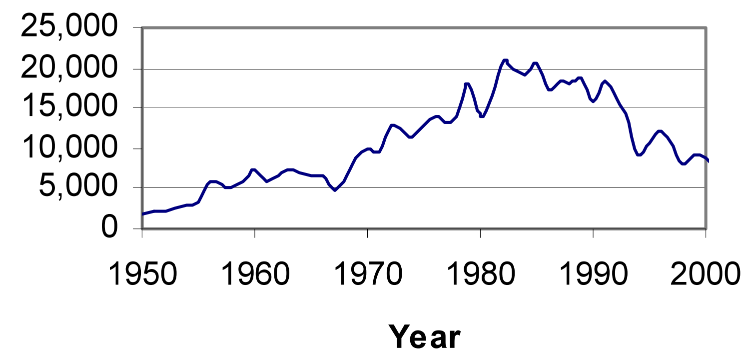
Future assessments should include the Canadian zone. Fishery logbook data indicate that most of the U.S. catch occurs near the U.S.-Canada border. The survey indicates that the biomass is about two times higher in the surveyed portion of the Canadian zone than in U.S. waters. Catch in Canada increased greatly in 1990 and was nearly 50% of the U.S. catch in 1992 (PFMC 2000).

Dover sole are at 29% of pristine biomass.

A.1.2.2 Dover Sole (*Microstomus pacificus*) is a deep water flatfish that ranges from northern Baja California to the Bering Sea and inhabits depths up to 800 fm (Kramer *et al.* 1995). This commercially important flatfish species has been the target of trawl operations along the west coast of North America since before World War II. Coastwide catches peaked in 1980s, exceeding 20,000 mt.

The most recent stock assessment for Dover sole completed in 2001 indicates current spawning stock size to be about 29% of the unexploited biomass (Sampson and Wood 2002). Recent recruitments have been lower than average.





Distribution and Life History Dover sole are generally found on mud or muddy-sand deeper than 20 fm (37 m) and out to 750 fm (1,372 m). They feed on polychaete worms, pink shrimp, brittle stars, gammarid amphipod, and small bivalves (Gabriel and Pearcy 1981; Pearcy and Hancock 1978). Stomach content analysis from trawl survey samples indicate polychaete worms as the dominant food item (Buckley *et al.* 1999).

Dover sole are found on mud or sandy mud bottom types, deeper than 20 fm and out to 750 fm.

Dover sole may reach 40 years in age.

Dover sole live to a maximum age of about 40 years, with females attaining a maximum length of 55-60 cm, about 5-10 cm longer than males. The sex ratio in the landed catch is almost 50:50, with males predominating at lengths less than about 38 cm, females predominating at greater lengths, and males being slightly dominant overall. Based on research survey tows, Jacobson and Hunter (1993) found that the catches of Dover sole in a given area and depth zone were not randomly distributed by sex, with males and females tending to occur in separate patches. Furthermore, Dover sole undergo ontogenetic shifts in their distribution with fish gradually moving to deeper water as they age and grow (Sampson and Wood 2002).

Dover sole have an extended pelagic larval phase that can last over one year. Larval dispersal is considered to be extensive due to the extended larval phase and the influence of Pacific Coast currents. Recruitment is probably correlated to variation in current patterns and ocean regime shifts. Adult Dover sole are relatively sedentary with no evidence of extensive latitudinal movements. They do, however, make seasonal migrations from the continental slope to the shelf in the spring and back to the slope in the fall to spawn.

Dover sole are managed as part of the Council's Dover sole, thornyhead, and sablefish (DTS) complex.

Dover sole are managed as part of the Council's Dover, thornyhead, and sablefish (DTS) complex. Other important species associations in the catch include Pacific ocean perch and dark blotched rockfish on the continental slope , and shelf rockfish, other flatfish, and ocean shrimp (*Pandalas jordani*) on the continental shelf.

Spawning biomass was expected to increase from 1997 through 2000 due to an exceptionally strong 1991 year-class. This was confirmed in the most recent assessment.

Stock Status and Trends The 1997 Dover sole stock assessment treated the entire population from the Monterey area through the U.S./Vancouver area as a single stock based on recent research addressing the genetic structure of the population. The assessment author generated projections of spawning biomass and expecting landings for 1998 to 2000 under a variety of harvest policies and three recruitment scenarios. The hypothetical harvest policies ranged from an immediate reduction to the $F_{45\%}$ harvest rate to an increase up to the $F_{20\%}$ harvest rate. In all cases, for each of the low, medium, and high projected recruitments, the expected spawning biomass increased from the estimated year-end level in 1997 through the year 2000 due to growth of the exceptionally large 1991 year class and to the lower catches observed in the fishery since 1991 (PFMC 2002b).

Recent ocean conditions may have produced a series of poor recruitments.

The most recent Dover sole in 2001 indicated current spawning stock size to be about 29% of the unexploited biomass (Sampson and Wood 2002). Recent abundances appear to be without trend, but were preceded by a steady decline since the late 1950s. The last strong year class was the one produced in 1991, which confirms the findings of the 1997 assessment. Poor ocean conditions associated with the El Niños in the 1990s have likely affected Dover sole recruitment. The 2001 assessment authors projected five years of Dover sole harvest levels based on preferred, optimistic, and pessimistic projections of recruitment. These options varied the harvest rate from $F_{40\%}$ (the current F_{MSY} proxy) to $F_{50\%}$.

The size-sex distributions of Dover sole vary between areas and have changed over time. Major uncertainties with the assessment and stock status are related to size-related discarding or differences in selection due to gear or depth of fishing. These effects are confounded in the fishery size-composition data.

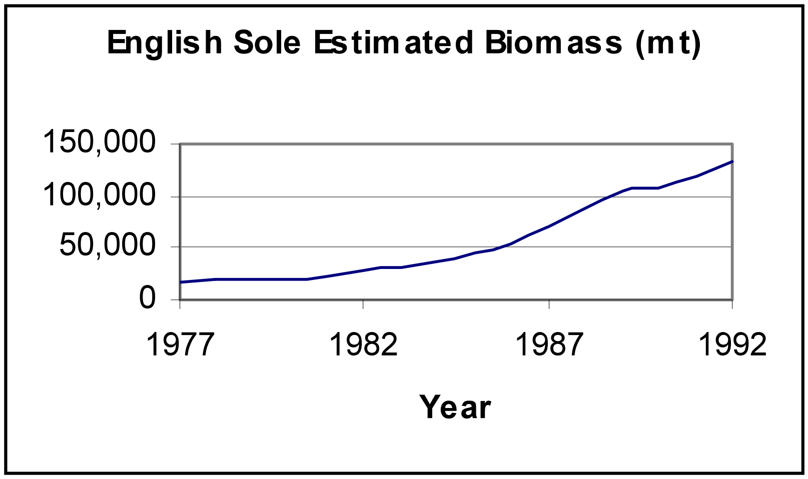
English sole biomass is above target levels and increasing.

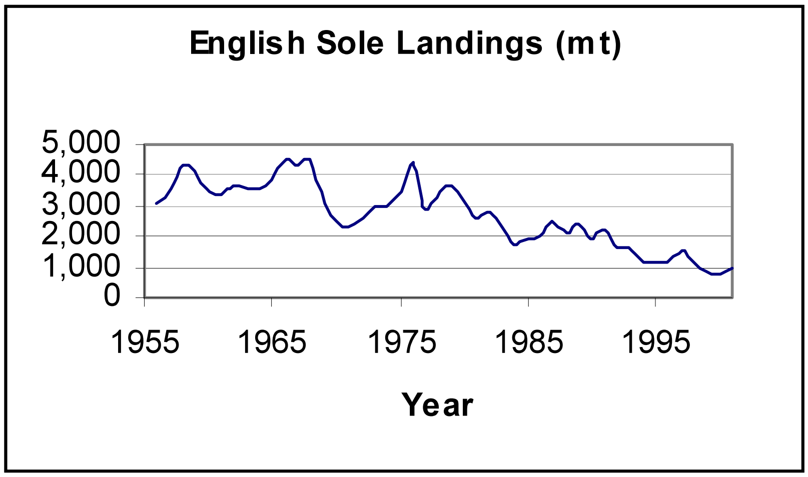
A.1.2.3 English Sole (*Parophrys vetulus*) are found in relatively shallow water (less than 300m) from Baja California to the Gulf of Alaska (Miller and Lea 1972). Although English sole are not as highly prized as other flatfish such as petrale sole, or landed in as large quantities as Dover sole, the abundance of this resources and its proximity to the shore have made English sole an important component of the trawl fishery off Oregon and Washington since this fishery began just prior to World War II.

The most recent stock assessment completed in 1993 (Sampson and Stewart 1993) indicated nearly a 7-fold increase in biomass since the 1970s to about 133,000 mt. The large biomass is attributed to strong recruitment and relatively low exploitation rates. Current catch levels are well below ABC.

During the 1950s and 1960s, flatfish dominated landings of groundfish exceeding 50% of the landed weight (Fishery Statistics of the US, 1950-69). In the 1980s and 1990s, rockfish became the dominant landings of groundfish (PacFIN). Recent restrictions on rockfish will likely reverse this trend and inshore flatfish species like English sole may again become a more important component of the landed catch if bycatch of overfished species can be minimized.

English sole are found over sandy bottom habitat in shallow water.





Distribution and Life History Spawning occurs offshore in waters shallower than 100 m, primarily during the autumn and winter, but the timing is variable (Kruse and Tyler 1983). Although spawning occurs on the bottom, the eggs are buoyant and rise to the surface and hatch about seven days after spawning. The planktonic larvae metamorphose, settle to the bottom, and assume their demersal form about two months after hatching (Kruse and Tyler 1983). The 0-age fish occur in estuaries and in shallow waters along the open coast (Krygier and Pearcy 1986). As the fish grow they move into deeper water where the adult population is found. English sole are generally found on sandy substrate (Demory *et al.* 1976), and juveniles and adults feed largely on polychaetes and amphipods (Kravitz *et al.* 1976).

English sole exhibit sexual dimorphism with the females attaining a greater sizes than males. The size difference in English sole is so great that landings of English sole are almost exclusively female fish.

English sole may reach ages in excess of 20 year and females are nearly all mature after age 4. Stock assessments have used a natural mortality coefficient between 0.26 and 0.294 per year.

Stock Status and Trends. English sole, like Dover and petrale sole, have been the target of trawl operations along the west coast of North America since before World War II. Almost all of the harvests have been taken by groundfish trawl. Since 1956 the reported landings of English sole off the US West Coast have been relatively stable, ranging from a peak of 4,539 mt in 1968 to a low of 1,678 mt in 1984. The landings in recent years have generally been below average.

The increase in English sole biomass is attributed to recent strong recruitments and low exploitation rates.

The most recent assessment addressed English sole in US Vancouver and Columbia areas (northern stock). An age-structured version of the Stock Synthesis program was applied to female age composition data from the Oregon and Washington trawl fisheries. Since catches were taken at very low rates of fishing, fishery independent auxiliary information were used in the assessment. NMFS survey data on female length composition and the NMFS survey estimates of population abundance (sexes combined) were used to "tune" the stock synthesis model. Biomass appears to be increasing due to a period of strong recruitment and low fishing mortality. Current spawning biomass in the northern range appears to be at an historical high.

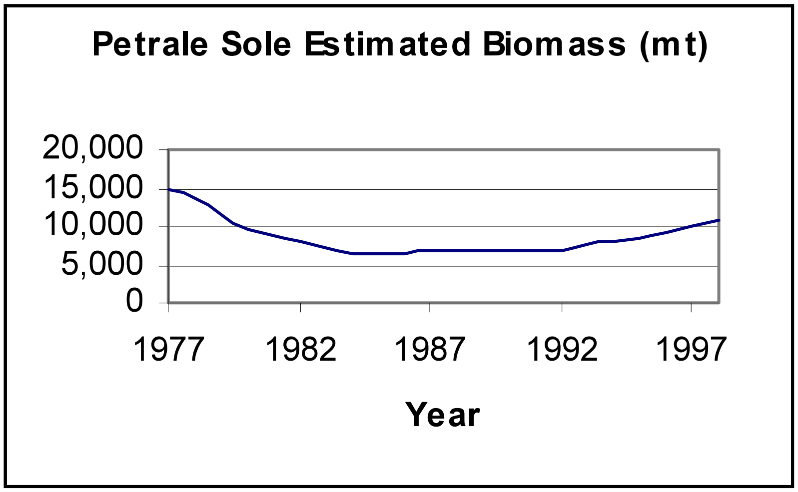
Sensitivity analysis of the base-run model for the northern stock indicated a very low survey catchability coefficient (Q) and unreasonably high level of biomass. The model was also sensitive to assumptions about selectivity. The final model constrained survey Q to 0.35 and allowed for dome-shaped selectivity with time varying selectivity patterns. Uncertainty in the assessment is related to causes of the increase in biomass. The apparent increase is due to either a period of favorable ocean conditions and strong recruitment, or low fishing mortality, or a combination of these factors. Much of the female spawning biomass is unavailable to the gear with current mesh size and fishing practices.

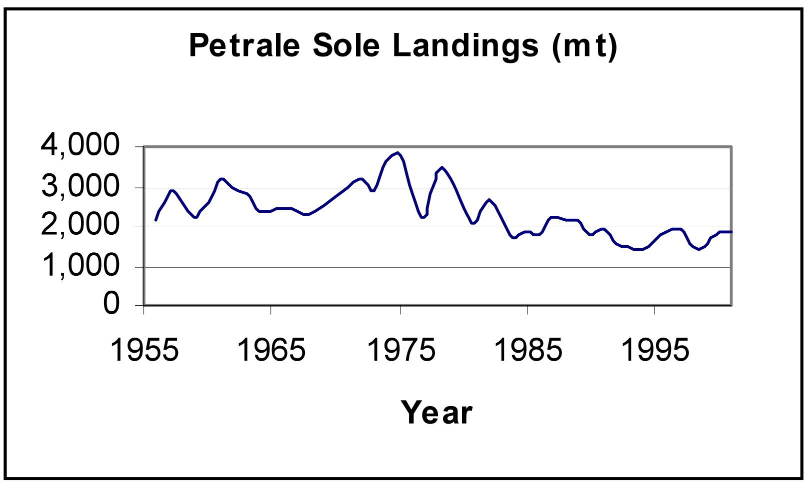
The previous assessment for English sole in the INPFC Conception, Monterey and, Eureka areas (southern stock) was conducted by Jow and Geibel (1985). Their results suggested that the abundance in 1984 was only 30% of the peak estimated abundance of 47 million fish in 1978. The authors estimated MSY to be 1,281 mt, which may be conservative since catches of English sole exceeded this estimate in 55 out of 60 years

(1924-1984). Landings since 1984 in the southern INPFC areas have been well below Jow and Geibel's estimate of MSY.

Petrale sole biomass is thought to be in excess of 39% of pristine levels.

A.1.2.4 Petrale Sole (*Eopsetta jordani*) range from northern Baja California to the Bering Sea and Aleutian Islands (Kramer *et al.* 1995). Petrale sole is a commercially important flatfish species that has been the target of trawl operations along the west coast of North America since before World War II. Current spawning biomass is estimated to be in excess of 39% of pristine spawning biomass.





Stock structure is not well understood. Petrale sole are targeted during the winter months when they aggregate in discrete areas to spawn.

Distribution and Life History Petrale sole are generally found on sand and mud bottoms at depths from about 10 to 300 fm (18-549 m) and feed on euphausids, herring, sand lance and shrimp (Ketchen and Forrester 1966; Kravitz *et al.* 1976). They live to a maximum age of about 20 to 25 years, with females attaining a maximum length of about 60-65 cm, about 20 cm longer than the males. The sex ratio in the landed catch is almost 50:50, with males predominating at lengths less than about 38 cm and females predominating at greater lengths.

Ketchen (1966) estimated natural mortality coefficients to be 0.18-0.26 / yr for males and 0.19-0.21 for females based on catch curve analysis lightly exploited stocks. The most recent stock assessment uses a mortality coefficient of 0.20 / yr for males and females.

Stock structure is not well understood. There are several relatively discrete spawning sites in deep water (150-250 fm) off the US west coast. Spawning occurs from about November through March but seems to be variable among the spawning grounds. Females spawn once per year and fecundity varies with fish size with one large female laying as many as 1.5 million eggs (Porter 1964). Petrale sole eggs are buoyant (Alderdice and Forrester 1971; Ketchen and Forrester 1966) and after hatching the larvae spend their first 5-6 months up in the water column before they metamorphose to their adult form and settle to the bottom (Pearcy *et al.* 1977). No specific areas have been identified as nursery grounds for juvenile petrale sole.

> Biomass of petrale sole is stable or increasing and above the target level.

Stock Status and Trends. Petrale sole have been the target of trawl operations along the west coast of North America since before World War II. Almost all of the harvests have been taken by groundfish trawl. Annual landings from US waters averaged 2,600 mt during the 1960s, 3,100 mt during the 1970s, 2,100 mt during the 1980s, and 1,700 mt during the 1990s. For the past several decades, the fishery has been markedly seasonal, with substantial portions of the annual harvest taken from spawning grounds and landed during December and January. Discarding of small, unmarketable fish (5-15%) is an important, but poorly documented feature of the fishery.

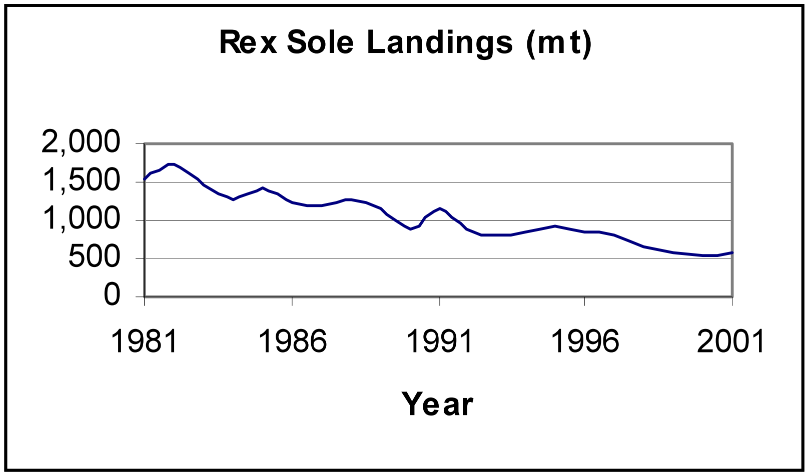
The most recent assessment addressed the northern stock of petrale sole in US Vancouver and Columbia areas (Sampson and Lee 1999). A length-based version of the Stock Synthesis program was used with length and age composition data separated into a winter and summer fishery. Biomass appears to be stable or increasing after an initial fishing down process. Current spawning biomass is estimated to be in excess of 39% of pristine spawning biomass.

> Uncertainty in the assessment is associated with inconsistencies in length and age information - especially affected are growth parameters for males.

Sensitivity analysis of the base-run model for the northern stock indicated inconsistencies among the age and length composition data and the underlying models for growth, particularly for the males - contributing to uncertainty in the assessment. No acceptable base-run models were found for the southern stocks of petrale sole in the Eureka and Monterey areas (Sampson and Lee 1999).

Rex sole has contributed significantly to the trawl fishery. Its stock status is unknown.

A.1.2.5 Rex Sole (*Glyptocephalus zachirus*) has been an important flatfish in the trawl fishery since before World War II. Rex sole are distributed from the western Bering Sea to Cedros Island, Baja California. No stock assessment has been done on Rex sole.



Distribution and Life History Rex sole are distributed from the western Bering Sea to Cedros Island, Baja California (Eschmeyer *et al.* 1983; Love 1991; Miller and Lea 1972). They are found from the surface down to 400 fm (732 m) occupying the upper continental slope and shelf. Rex sole is most abundant in water deeper than 200 fm (366 m) (Hart 1973) and prefers muddy-sand bottom. Adult rex sole apparently have a wide bathymetric distribution compared to other flatfish (Hosie 1976). Rex sole is a middle shelf-mesobenthal species, occurring from 0-850 m. In survey catches, most (96%) occurred from 50-450 m (Allen and Smith 1988). Rex sole are probably the most widely distributed sole on the continental shelf and upper slope off Oregon, occupying a large bathymetric range with diverse sediments (Pearcy 1978). They can occur in water as shallow as 18 m (Eschmeyer *et al.* 1983) and occur in Puget Sound (Becker and Chew 1987).

Rex sole move inshore in the summer and make offshore spawning movements in the winter (Love 1991). They undergo a modest ontogenetic movement from the shelf to upper slope habitat (Vetter *et al.* 1994). The maximum movement of a recaptured tagged rex sole was only 54 km, suggesting only limited movement (Hosie and Horton 1977).

Off Oregon young-of-the-year rex sole are most abundant at 200 m (Pearcy 1978). Juveniles (40-60 mm SL) are common in beam trawls on the outer edge of the continental shelf (150-200 m) during winter months off Oregon (Pearcy *et al.* 1977). Rex sole are most abundant from Heceta Bank at 55-150 m and intermediate-sized rex sole (75-150 mm) inhabit shallower water of the inner shelf (Pearcy 1978).

Rex sole can be distinguished from other soles by its long pectoral fin on the eyed side of the body (Hosie 1976).

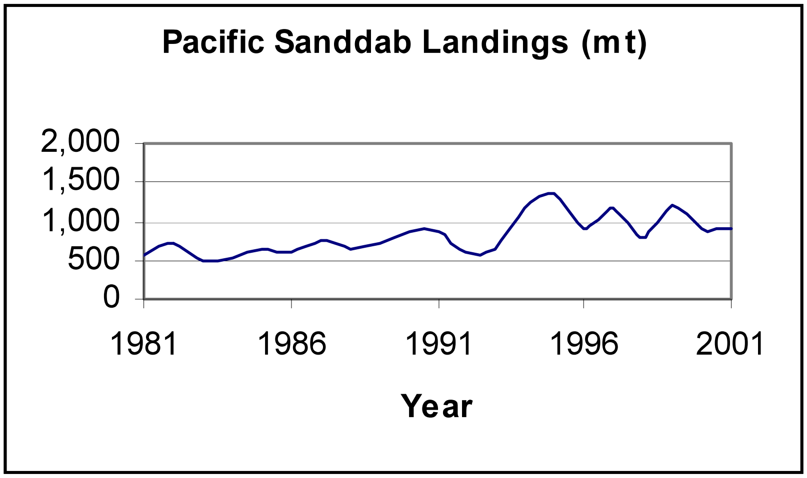
Size and age of first maturity for females is 19 cm at about age four and most females are mature at about 24 cm and 5 years of age. Males begin to mature at 13 cm and at only 2 years of age. They will be fully mature at 10 cm and five years of age (Hosie 1976; Hosie and Horton 1977). Spawning occurs between 50 and 150 fm from January through June with peaks in March and April (Hosie and Horton 1977). The spawning period coincides with the months of peak average surface and subsurface sea temperature (Castillo 1995). Females produce a wide range of eggs depending on size. A 24 cm female produces about 3,900 eggs while a 59 cm female may produce as many as 238,000 eggs (Hosie 1976; Hosie and Horton 1977). After release eggs and fertilization, the eggs rise from the sea bed into the water column, hatch and become pelagic, planktonic larvae. Larvae feed on plankton. After about a year, larvae metamorphose into bottom dwelling juvenile sole approximately 5 cm long. Rex sole grow rapidly and recruit to the trawl fishery at age three when they are about 16 cm long. Adult rex sole feed on small invertebrates including polychaete worms and amphipods. They are known to live at least 23 years (Eschmeyer *et al.* 1983; Love 1991).

Rex sole feed almost exclusively on benthic invertebrates (Pearcy and Hancock 1978; Stull and Tang 1996). Small (<15 cm SL) rex sole feed mainly on amphipods and other crustaceans. Large (15-45 cm SL) rex sole prey chiefly on polychaetes. Rex sole <20 cm SL prey primarily on euphausiids, decapod crab larvae, copepods, *Oikopleura*, and ostracods. Molluscs form only a minor part of rex sole diet. Euphausiids are principal prey only during summer and cumaceans and *Oikopleura* are more common during the winter (Pearcy and Hancock 1978). In Puget Sound they feed primarily on *Capitella* spp. (Becker and Chew 1987). Rex sole are nocturnal feeders (Becker and Chew 1987).

Stock Status and Trends No formal stock assessment has been completed for Rex sole. Catches of Rex sole have been declining gradually since 1980 averaging about 1,000 mt coastwide, annually. Flatfish trawl surveys conducted off the Oregon coast in the early 1970s estimated total biomass to be in excess of 12,247 mt between the Columbia River and Cape Blanco (Demory *et al.* 1976).

Pacific Sanddab stock status is unknown.

A.1.2.6 Pacific Sanddab (*Citharichthys sordidus*) are found from Cape San Lucas, Baja California, to the Bering Sea. In the past, the Pacific sanddab has been only a minor contributor to the trawl fishery. Since the early 1990s, coastwide landings have increased to about 1,000 mt. The fish is considered a delicacy in the San Francisco region and has enjoyed a strong market there for many years (Barss 1976).



Distribution and Life History Sanddabs occur in depths of 5 to 200 fm (9 to 549 m) but are most abundant in 10 to 50 fm (18 to 91 m) on sandy or sandy-mud bottoms (Barss 1976; Garrison and Miller 1982; Hart 1973). Pacific sanddab inhabit the shallow sublittoral zone of Puget Sound (Hart 1973), and the inner continental shelf along the west coast (Alverson *et al.* 1964; Barss 1976; Kravitz *et al.* 1976). Adults are found in estuaries and coastal waters to as deep as 306 m, but highest abundance is in waters <82 fm (150 m) (Hart 1973). Pearcy and Hancock (1978) found that sanddab were most abundant off Oregon and Washington between 37 and 90 m. In Puget Sound, adults may be found to 150 m, but are common in <20 m of water (Garrison and Miller 1982). Barss (1976) reported adult sanddab occur in San Francisco Bay, and Leos (1991)found adults in Monterey Bay.

Pacific sanddab are oviparous and iteroparous, and eggs are fertilized externally (Garrison and Miller 1982). Spawning occurs from late winter through summer, depending on stock and location. In Puget Sound, spawning begins in February and continues through spring, peaking in March and April (Garrison and Miller 1982; Hart 1973). Off California, spawning takes place July through September, peaking in August (Arora 1951; Garrison and Miller 1982). Female sanddab may spawn twice per season (Arora 1951, Garrison, 1982 #1238; Hart 1973).

Over 50% of three year old fish are mature at about 19cm in length. Eggs and larvae are pelagic and drift with currents. Juveniles and adults are demersal (Garrison and Miller 1982). Larvae may be found as far offshore as 724 km in the upper 200 m of the water column (Sakuma and Larson 1995). Juveniles are primarily found in shallow coastal waters, bays and estuaries (Hart 1973).

Sanddabs grow rapidly during the first 4 years of life and more then more slowly thereafter, attaining 22 cm for males and 26 cm for females at age 7. Sanddabs may live to be 12 years of age.

Sanddabs eat a wide variety of food and show a preference for small fish, squid and octopus. Juveniles and adults are carnivorous. Unlike many sympatric species, Pacific sanddab are mainly pelagic feeders; the only evidence of benthic feeding are annelid worms found in stomachs of some specimens (Pearcy and Hancock 1978). The main food items of large sanddab are crab larvae, squids, octopuses and northern anchovy (Pearcy and Hancock 1978). Smaller sanddab eat euphausiids, amphipods, shrimps and some fish (Kravitz *et al.* 1976; Pearcy and Hancock 1978). The diet of the sanddab is determined mainly by food availability; crab larvae are present only in certain months, and fish consumption is higher in the summer months (Pearcy and Hancock 1978). Sanddabs are also known to feed up in the water column at times (Barss 1976).

Stock Status and Trends Surveys conducted off the Oregon coast in the early 1970s estimated total biomass to be in excess of 10,433 mt on the continental shelf between the Columbia River and Cape Blanco (Demory *et al.* 1976). Catches have increased in recent years but remain constrained by markets.

A.1.4 Other Groundfish

Other groundfish species include rockfish, other flatfish, and other fish (sharks, rays, ratfish, morids, grenadiers) not described above. Life history descriptions of these species may be found in the Appendix to Essential Fish Habitat for West Coast Groundfish which was prepared for Amendment 11 to the FMP. This document may be requested from the Council office and is available at on the web site:

http//www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html. Background descriptions of some of the more significant other groundfish provided below area adapted from the EFH appendix.

A.1.4.1 Leopard Shark (*Triakis semifasciata*)

are sought after by both sport and commercial fishers, principally in nearshore areas off the coast of California.

Distribution and Life History Leopard sharks are found from southern Oregon to Baja California, Mexico including the Gulf of California. A neritic species, the leopard shark is most abundant in California bays and estuaries and along southern California beaches. Although they are common in enclosed, muddy bays, other habitats of the leopard shark are flat, sandy areas, mud flats, and bottoms strewn with rocks near rocky reefs or kelp beds. It is common in littoral waters and around jetties and piers. It is also known to congregate around warm-water outfalls of power plants. The leopard shark occurs in polyhaline-euhaline waters.

Leopard sharks are most common on or near the bottom in waters less than 2.2 fm (4 m) deep, but have been caught as deep as 49.8 fm (91 m). Estuaries and shallow coastal waters appear to be used as pupping and feeding/rearing grounds. Neonate pups occur in and just beyond the surf zone in areas of southern California, such as Santa Monica Bay.

Leopard sharks often enter shallow bays and onto intertidal flats during high tides and retreat on ebb tides. Leopard sharks are active during the day, unlike other nocturnal sharks. They may form large nomadic schools that may be mixed with gray or brown smooth hounds or spiny dogfish.

In Elkhorn Slough, most adult leopard sharks leave by June and return by October whereas juveniles are most abundant there during the summer. Tagging studies in San Francisco Bay show most leopard sharks reside in the bay during March-September, but they also occur both inside and outside the bay from October-February.

Leopard sharks are gonochoristic, ovoviviparous, and iteroparous. Fertilization occurs internally and embryogenesis occurs within the female; there is no yolk-sac placenta. Leopard sharks have a gestation period of 10-12 months. Mating occurs soon after the females give birth, primarily in April and May. Coitus occurs while swimming. Females give birth to 7-36 pups from March-August. Young develop inside the mother but do not receive nourishment from her. Leopard sharks are born as juveniles ranging in size from 18-20 cm at parturition. The maximum recorded length of a leopard shark is 180 cm, but with a average growth rate estimated at 1.4 cm per year, most do not exceed 160 cm in length. Females may take 10-15 years to reach maturity, while males may only take 7-13 years. Maximum age is reported to be 30 years.

The leopard shark utilizes several major food sources without depending upon one, and food preference is dependent upon the size of the shark. Juveniles and adults are carnivorous, opportunistic, benthic and littoral feeders. Small sharks (<90 cm) in Elkhorn Slough are known to feed almost entirely on crabs and in San Francisco Bay, on crabs and shrimp, particularly of the genus *Crangon*. Leopard sharks 90-120 cm in length feed mostly on echiuroid worms *(Urechis caupo)*. Sharks 120-130 cm feed on crabs, clams, fishes, fish eggs, and *Urechis caupo*. Fishes make up the greatest portion of food eaten by 130-140 cm long sharks. Leopard sharks also prey upon polychaete worms and octopuses and feed rapidly on the eggs of herring, topsmelt, jacksmelt, and midshipmen when available.

Presence of mud-burrowing prey in their diet signifies that the leopard shark is feeding very close to or in the mud. The leopard shark must display a sucking or digging behavior to remove clam siphons and *Urecis caupo* from the mud. In Elkhorn Slough, adult leopard sharks seasonally shift their diet preference. During the fall, when fish eggs are not abundant, they feed more on clams and crabs. During the winter and spring, the yellow shore crab decreases in importance whereas cancrid crabs, fish eggs, and *Urechis caupo* increase as prey items. Leopard sharks do not compete for food sources with neighboring shark species because their diets differ.

Stock Status and Trends The leopard shark probably has no major predators except man and possibly other shark species . Leopard sharks can be caught by set lines, rod and reel, trawls, gill nets, and spear fishing. They are caught and sold commercially year-round and have been targeted by small scale commercial line fisheries in San Francisco Bay. From Eureka southward, the commercial fishery takes leopard sharks with gillnets and longlines, and occasionally with trawls Recreational landings are larger than those of the commercial landings.

A.1.4.2 Soupfin Shark (*Galeorhinus zyopterus*) were subjected to an intensive fishery from California to British Columbia during the 1940s. Taken primarily for their livers which were a source of vitamin A, the fishery declined after 1946 due to reduced demand and abundance. Current demand for soupfin sharks is for food.

Distribution and Life History Soupfin sharks are found from northern British Columbia to Abreojos Point, Baja California and the Gulf of California.

Soupfin sharks are an abundant coastal-pelagic species of temperate continental and insular waters. They are often associated with the bottom, inhabiting bays and muddy shallows. Although the soupfin sharks are often found well offshore, they are not oceanic. Although soupfin shark often occur as shallow as 1 fm (2 m), they also occur in submarine canyons up to 257.5 fm (471 m). The population of soupfin sharks along the western Pacific Coast is considered to be homogeneous.

Males and females apparently segregate by sex. Adult males favor deeper waters, whereas females occur closer inshore. The proportion of males is greater in northern waters off California whereas females occur mostly in southern California waters with a mix of sexes in central California waters. Young soupfin are abundant in southern California waters, probably in association with the larger number of females there.

San Francisco Bay, Tomales Bay, and southern California inshore areas (south of Point Conception) are used as pupping grounds.

Soupfin sharks forms dense shoals and has a coastwide movement that is not completely understood. The soupfin migrates north in summer and southward in the winter. They have extensive movements without recognizable patterns of up to 56 km per day with sustained speeds of 16 km per day for 1600 km.

Mating occurs during the spring and fertilization is internal. Eggs grow to a size of 4-6 cm in diameter before they are hatched within the mother. There is no yolk-sac placenta. After a gestation period of approximately 1 year, females move into bays to bear their live young. Litter sizes range from 6-52 young and average 35. The number of young depends on the size of the mother; larger females produce more young.

Newborn soupfin range in size from 30-40 cm in length. Males mature at 120-170 cm while females mature at 130-185 cm in length. Males can reach a maximum length of 155-175 cm and females can grow to 174-195 cm. Estimated age of maturity and maximum age are reported as 12 and 40 years, respectively.

Soupfin sharks are opportunistic, carnivorous feeders. They feed at the bottom, mid-depths, and at the surface. Diversity of pelagic and bottom-living prey indicates soupfin will pursue food where available. Soupfin feed primarily on moderate-sized bony fishes but also readily feed on invertebrates. Young may consume more invertebrate prey than adults.

Prey items include: herring, sardines and other clupeids, anchovies, salmon, smelt, hake, cod, lingcod, midshipmen, flying fish, mackerel and small tuna, barracuda, croakers, wrasses, opaleye, surfperches, damselfishes, gobies, kelp fish, halibut and other flatfishes, rockfishes and scorpionfish, sculpins, sablefish, cephalopods, marine snails, crab, shrimp, annelid worms, echinoderms, and uncommonly other chondrichthyians such as ratfish, sharks, and small stingrays and skates.

Predators include the spotted sevengill shark, the great white shark, marine mammals, and man.

Stock Status and Trends Of the sharks on the west coast, the soupfin shark has been one of the most economically important. The fishery is generally confined to water within 100 miles of the shore and consists of fishing with bottom and pelagic gillnets, longlines, trawls, and with hook-and-line. Because the soupfin is long-lived and reproduces at a comparatively slow rate, it is especially vulnerable to intensive and prolonged fishing pressures.

A.1.4.3 Spiny Dogfish (*Squalus acanthias*) is a smaller species of shark with a more northerly distribution centering off Washington and British Columbia. Although taken in both sport and commercial fisheries, the spiny dogfish has suffered from a bad reputation as a nuisance fish due to its tendency to create havoc with fishing gear. Spiny dogfish mature at the advanced age of 20 years and only produce a few young, thus are vulnerable to overfishing.

Distribution and Life History Spiny dogfish are found in temperate and subarctic latitudes in both the northern and southern hemispheres. In the northern and central Pacific Ocean, they occur from the Bering Sea to Baja California.

For the North Pacific and Bering Sea, spiny dogfish is an inner shelf-mesobenthal species with a depth range of 0-900m. From survey data, they determined that most dogfish inhabit waters ≤350 m. They occur from the surface and intertidal areas to greater depths, and are common in estuaries, such as San Francisco Bay and Puget Sound, and in shallow bays from Alaska to central California.

Adult females move inshore to shallow waters during the spring to release their young. Small juveniles (<10 years old) are neritic while subadults and adults are mostly sublittoral-bathyal. Subadults are found on muddy bottoms when not found in the water column.

Spiny dogfish may occur in waters as deep as 1000 m, but occur more commonly at depths less than 191.4 fm (350 m). They also inhabit the mesobenthal (outer slope) zone. Known physical and chemical requirements are euhaline waters of 3.7-15.6°C, with a preferred range of 6-11°C.

In southern California, spiny dogfish are often found in close association with white croaker.

Dogfish often migrate in large schools which feed actively on their journeys. Seasonal migrations are taken so as to stay in the preferred temperature range. Schooling behavior occurs with inshore populations and with migratory offshore populations. The schools, numbering in the hundreds, exhibit north-south coastal movements and onshore-offshore movements that are not completely understood. The schools tend to divide up according to size and sex although the young, both male and female, tend to stay together.

Spiny dogfish can travel long distances. In one instance a tagged dogfish from Queen Charlotte Sound in 1980 was recovered off the northeast coast of Japan in 1982. They also make diel migrations from near bottom during the day to near surface at night.

Mating with internal fertilization occurs on the ocean bottom between October and January. Spiny dogfish are ovoviviparous. Fecundity is 1-26 eggs per female, per season. Males mate annually and females mate biannually. Their gestation period lasts 18-24 months (usually 23 months), the longest of any vertebrate. Females release their young during the spring in shallow waters.

Small litters (4-7 pups) are common, but litter size may range from 2-20 pups. Newborn pups range in length from 20 to 23 cm. Females reach sexual maturity at 23-35 years and males reach maturity at 11-19 years. The maximum age of females is about 70 years. Females live longer than males, which only live to a maximum of 36 years.

Spiny dogfish seem to be larger at the northern end of their range. Adults usually range in size from 75-103 cm, although they may reach a maximum size of 130 cm (10 kg). Their growth rate is 1.5-3.5 cm per year.

They are carnivorous and occasionally scavengers. They are an opportunistic feeder, taking whatever is available. They are important predators on many commercial fishes and invertebrates. Their diet consists primarily of fish and crustaceans, especially sandlance, herrings, smelts, cods, capelin, hake, ratfish, shrimps, and crabs. Fish become a more important dietary source as they grow larger. Other food items include worms, krill, squid, octopus, jellyfish, algae, and any carrion. Although most of their diet consists of pelagic prey, they also feed on benthic organisms . They are voracious predators that can be quite aggressive in pursuit of prey.

Based on occurrences, 55% of the diet of dogfish off British Columbia was teleosts, 35% crustaceans, and 5% molluscs. The principal food items consisted of herring and euphausids. Pelagic prey consisted of 80% of their diet and they consumed twice as much food in the summer as in the winter.

Spiny dogfish may compete with sablefish, Pacific cod, soupfin shark, and sea lions. They have few natural predators, except blue and tiger sharks and some marine mammals. For defense, it possesses a strong spine in front of its two dorsal fins that is partially sheathed by toxic tissue.

Stock Status and Trends They are the most abundant and economically important shark off North American coasts. In recent years, large numbers of dogfish have been taken in commercial trawl, set net, and longline fisheries, especially in Puget Sound, to supply foreign markets.

Spiny dogfish can be readily caught by rod and reel, longline, trawl or set net. They are fished for biology class dissections and research. Dogfish are often regarded as a menace to fisheries because they cause damage to nets, lines, and rob hooks.

A.1.4.4 Big Skate (*Raja binoculata*) make a small but significant contribution to regional commercial fisheries. Pectoral fins containing a firm white meat are taken for sale on fresh fish markets. No formal stock assessment has been conducted on skates. Due to their low fecundity, they may be vulnerable to overfishing.

Distribution and Life History Big skates are found from Glubokaya Bay and Cape Narvarin in the western Bering Sea to off Cedros Island, central Baja California, Mexico, but are uncommon south of Point Conception.

Big skates are relatively abundant in northern and central California, but are not common south of Point Conception . The big skate occupies inner and outer shelf areas, particularly on soft bottom.

Records show big skates inhabiting water as shallow as 2 fm (3 m), but in survey catches in the North Pacific they are found most frequently on the outer shelf in waters 27-109 fm (50-200 m deep). Over their range, big skates have been taken from waters up to 437 fm (800 m); however, few occur deeper than 191 fm (350 m).

Egg cases of big skates are deposited on the bottom. Off Oregon, skates were taken at depths up to 60 fm (110 m), but were by far most abundant at 35 fm (64 m).

Little is known about the movements of big skates.

Big skates have a low rate of fecundity. They are oviparous; eggs are fertilized internally and deposited on the bottom to develop and hatch. When the eggs are laid, they are covered with a thick leathery membrane, the egg capsule or shell. The shape of the big skate egg capsule is characterized by two prominent dorsal ridges, the rectangular outline with deep notches in the middle portion and short, flattened horns. The egg case is unique among skates because it can measure up to 30 cm in length and can contain up to 7 eggs per case with an average of 3-4.

Some early researchers believe egg cases are laid year round, whereas others indicate a possible seasonal laying. The egg cases in early development are green-brown in color and those in later stages of development are brownish black. It is also speculated that big skates remain in their egg cases for almost a year.

When the young hatch, they are fully developed, although they do have a yolk sac that is gradually absorbed.

The big skate is a long-lived species that grows and matures slowly. They probably live to be 20-30 years of age. Off central California, some males may mature by age 6, but most are mature by age 10-11. Most females were mature by age 12.

The big skate feeds on crustaceans and fishes.

Stock Status and Trends Coastal trawl fleets account for the majority of the catch off the west coast, although some skates are caught by trammel nets in California and longlines in Puget Sound. Only the pectoral fins, or "wings," are bought commercially. Skates are caught incidentally by fisheries for sole and rockfish. In California, the leading areas for skate landings are San Francisco and Monterey. Big skates are also occasionally taken by recreational fishers, particularly in Monterey Bay.

A.1.4.5 California Skate (*Raja inornata*)

contributes to regional commercial fisheries. Pectoral fins containing a firm white meat are taken for sale on fresh fish markets. No formal stock assessment has been conducted on skates. Due to their low fecundity, they may be vulnerable to overfishing.

Distribution and Life History California skates range from the Strait of Juan de Fuca, Canada south to Cedros Island, central Baja California, Mexico.

The California skate is common off most of the California coast, as well as inshore and in shallow bays (10 fm (18 m) of water or less). The California skate has been taken as deep as 367 fm (671 m). California skates typically inhabit inshore muddy bottoms. Egg cases are deposited on the bottom.

Little is known about the movements of skates.

California skates, like other skates, are oviparous, have internal fertilization, and deposit their eggs on the bottom to develop and hatch. When the eggs are laid, they are done so in a distinctive leathery case. The egg case of California skates is smooth with horns. When the eggs hatch, the young are fully developed although they do have a yolk sac that is gradually absorbed.

Skates are long-lived creatures that grow and mature slowly. Their lifespan is estimated at 20-30 years. Females and males reach sexual maturity at approximately 52 cm in length and attain a maximum TL of 76 cm.

The California skate feeds on shrimps and probably other invertebrates.

Stock Status and Trends Coastal trawl fleets account for the majority of the commercial catch off the west coast, although some are caught by trammel nets in California and longlines in Puget Sound. Only the pectoral fins, or "wings," are bought commercially. Skates are caught incidentally in fisheries for sole and rockfish. In California, the leading areas for skate landings are San Francisco and Montere.

A.1.4.6 Longnose Skate (*Raja rhina*) contributes to regional commercial fisheries. Pectoral fins are taken for sale on fresh fish markets but the meat is not as desirable as wing meat of other species. No formal stock assessment has been conducted on skates. Due to their low fecundity, they may be vulnerable to overfishing.

Distribution and Life History Longnose skates are found from Navarin Canyon in the Bering Sea and Unalaska Island in the Aleutian Islands to Cedros Island, Baja California, Mexico.

The longnose skate is one of the more common skates and occurs on the bottom in inner and outer shelf areas from 30-340 fm (55-622 m). Based on survey data for the North Pacific, they are most frequently taken at depths of 100-150 m, with nearly all taken at depths ≤191 fm (350 m). Eggs are deposited on the bottom.

Little is known about their movements.

Longnose skates, like other skates, are oviparous, have internal fertilization, and deposit their eggs on the bottom to develop and hatch. When the eggs are laid, they are enclosed in a rough, leathery shell with a loose covering of fibers and short horns. Their egg cases generally hold one egg each and are 8-12 cm in length. When the eggs hatch, the young are fully developed although they do have a yolk sac that is gradually absorbed .

Skates are long-lived creatures that grow and mature slowly. Their lifespan is estimated at 20-30 years. Male longnose skates are smaller than females. Off central California, males begin maturing at age 5-6, and females at age 8. Males are mature by age 10-12 years.

Stock Status and Trends Coastal trawl fleets account for the majority of the commercial catch off the west coast, although some are caught by trammel nets in California and longlines in Puget Sound. Only the pectoral fins, or "wings," are bought commercially. Skates are caught incidentally by fisheries for sole and rockfish. In California, the leading areas for skate landings are San Francisco and Monterey.

A.1.4.7 Ratfish (*Hydrolagus colliei*) are not sought after by either sport or commercial fishers. This interesting species occupies shallow waters of the continental shelf, but can be found as deep as 500 fm (2,995 ft).

Distribution and Life History Ratfish are found from Cape Spencer in southeast Alaska to Sebastian Vizcaino Bay, Baja California, and in the northern part of the Gulf of California.

In the North Pacific, ratfish are considered a middle-shelf-mesobenthal species and have been reported at depths of 0-499 fm (0-913 m). In survey data, they most frequently occur between 100-150 m, with nearly all taken at depths of 27-219 fm (50-400 m).

Ratfish are a common demersal fish in larger estuaries throughout its range, especially from early winter to late spring. It is believed that ratfish enter estuaries to feed and mate; they do not occur as often in estuaries in summer and fall. In Puget Sound, ratfish often occur in less than 5 fm (10 m) of water, depending on the time of day and season.

All free-swimming life history stages share essentially the same habitat; there is no partitioning by age or size.

Generally, ratfish is a deepwater species that prefers low relief rocky bottoms. Ratfish also prefer exposed gravel and cobble as a habitat and are not common on sand or over boulders.

Eggs are attached by the mother to rocks, or placed upright in the sand in polyhaline to euhaline waters. In the summer and fall, ratfish move offshore into deep waters. It is in these deep waters that egg cases are most often deposited.

Although they are poorly understood, it is known that ratfish make significant seasonal and diel migrations. In the winter, ratfish move into shallow nearshore waters and estuaries, probably for feeding and pre-spawn mate selection. In Puget Sound and other estuaries, ratfish move from deep water by day to much shallower water at night. This diel migration is undertaken mostly by smaller fish, suggesting it is preferred feeding ground for young ratfish, or a means of predator avoidance. Migrations may be completed to regulate ambient light conditions for ratfish because they have an all-rod retina and no means of regulating the amount of light entering their eyes.

Ratfish are oviparous and fertilization is internal. Spawning occurs at all times throughout the year, but seems to peak from late summer to early fall. Ratfish, regardless of size or age, produce only two egg cases per year.

Fertilized egg capsules are elongate, diamond-shaped, and are about 125 mm long at extrusion. The egg case hangs by capsular filaments from the mother's oviducts for 4-6 days before being deposited on rocks or placed in sand where it completes development and hatches. Full development of the egg may take up to a year. Larval stages are completed in the egg, and the hatched ratfish resembles a small adult.

Females grow faster and reach a larger mean size than do males. Female ratfish may reach 97 cm in length.

Ratfish at all life history stages are opportunistic feeders; no one single food item usually makes up more than 25% of a ratfish's diet. Common foods are isopondylous fishes, mollusks, squid, nudibranchs, opisthobranchs, annelids, and small crustaceans. On more than one occasion, a ratfish was found with a stomach full of seaweed. Off southern California, the most important prey were brittle stars, ostracods and amphipods.

Ratfish seek their food by smell and weak electroreception in the pits on their heads.

Ratfish are in turn preyed upon by Pacific halibut, soupfin shark, and spiny dogfish. Ratfish have been recorded as being cannibalistic.

Stock Status and Trends There is no directed fishery for ratfish in the northeast Pacific, but they are taken quite often as bycatch in bottom trawls. Ratfish are not sought by recreational fishers, but are caught occasionally while fishing for other demersal species.

A.1.4.8 Finescale Codling (*Antimora microlepis*)

A.1.4.8 Finescale Codling (*Antimora microlepis*) are a deep-water species, sometimes taken as bycatch in the longline fishery for sablefish.

Distribution and Life History Finescale codling, also known as Pacific flatnose, occur from Shikoku Island, Japan, through the southeastern Bering Sea, to the Gulf of California.

Finescale codling are mesobenthal-bathybenthal, with a reported depth range of 96-1,667 fm(175-3,048 m). In survey data for the North Pacific, they were taken at depths up to 697 fm (1,275 m), most often on the bathybenthal slope between 437-465 fm (800-850 m). Nearly all survey catches were at depths >191 fm (350 m).

There is no biological information available on the biology and life history characteristics of finescale codling.

Status of Stock There is no directed fishery for finescale codling. Finescale codling are taken as incidental catch in the longline fishery for sablefish.

A.1.4.9 Pacific Rattail *(Coryphaenoides acrolepis)* support a growing deepwater commercial trawl fishery. There has been no formal stock assessment on the species.

Distribution and Life History Pacific rattails (also known as Pacific grenadiers) are found in the northeast Pacific from the Bering Sea off Alaska to Baja California.

Stock Status and Trends A commercial fishery is developing for rattails and they are marketed primarily as grenadiers. Most catches are made with trawl gear, but hook and line (longline) is also effective. Incidental catches of rattails in deepwater trawl fisheries are often used in livestock feeds.

Rattails are among the most abundant fishes of the continental slope and abyssal waters worldwide. They are found at depths from 155 to 2,470 m, most commonly below 820 fm (1,500 m) in the Northeast Pacific Ocean.

Spawning depth is not known. Larval stages of the Pacific rattail have been captured in the water column in waters less than 109 fm (200 m) whereas older larvae and juveniles occur deeper. Newly metamorphosed fish off Oregon settle out of the water column in 273 fm (500 m) or less. As they grow, juveniles move to deeper water.

Pacific rattails occur in highest densities on the sandy bottoms of the abyssal plains of the northeast Pacific, but specific habitat associations for any life history stage have not been studied.

Migrations have not been documented and it is assumed that this is a relatively sedentary species. Larger fish are found in deeper water, suggesting a movement to deep water with increasing size.

Pacific rattails are oviparous and fertilization is external. Ripe females were collected in September, October, and April, possibly indicating two spawning seasons per year. Off southern California, spawning occurs mostly from late winter to early spring, although spent females are found throughout the year. Fecundity has been estimated to be between 22,657 and 118,612 eggs per female and as much as 150,000 eggs in a large female off California.

Fertilized eggs are about 2.0 mm in diameter. Larvae hatch at about 2 mm total length and are pelagic, occurring in the upper 109 fm (200 m) of the water column. Metamorphosis occurs at about 10 mm total length.

Female rattails mature at about 650 mm total length; males mature as small as 480 mm total length. Female rattails grow faster and reach a larger average size than do male rattails. Maturity is reached in about 10 years or more, based on estimated size at maturity.

Stomach contents of rattail fishes are usually evacuated between capture and retrieval of the fish, so analysis of stomach contents is difficult. Stomachs have been observed to contain the remnants of cephalopods, other demersal fishes (often other macrourids) and sinking food particles of dead nekton. The food and feeding of larvae and juveniles is not known.

Rattails are, in turn, likely preyed upon by other demersal fishes, including other macrourids. Cannibalism is not uncommon, and may be responsible for high larval and juvenile mortality.

A.2 Other Relevant Fish Stocks (Finfish, Shellfish and Squid)

Relevant fish stocks included in this section are those known to be or likely to be substantively affected by or affect groundfish fisheries, groundfish species or their habitats. Impacts may potentially occur between groundfish species or fisheries and other fish, shellfish, and invertebrates not included in this section, but little is known about them. Some species, such as invertebrates in the deep oxygen minimum zone off the west coast, may be especially vulnerable to fishing impacts, but again, little is known about them.

A.2.1 Pacific Salmon

The distribution and life history of two of the five Pacific salmon species, chinook and coho, are described primarily for the juvenile and adult stages of their life that are spent in the marine environment. Biological information comes primarily from PFMC(1999a).

The generalized life history of salmon includes incubation and hatching of embryos, emergence and initial rearing of juveniles in freshwater; migration to oceanic habitats for extended periods of feeding and growth; and return to natal freshwaters for completion of maturation, spawning, and death.

A.2.1.1 Chinook Salmon (*Oncorhynchus tshawytscha*), also called king salmon, range widely throughout the north Pacific Ocean and the Bering Sea, and as far south as the U.S./Mexico border.

Chinook salmon typically remain at sea for one to six years.

Distribution and Life History After leaving the freshwater and estuarine environment, juvenile chinook disperse to marine feeding areas. Some tend to be coastal-oriented, preferring protected waters and waters along the continental shelf. In contrast, others pass quickly through estuaries, are highly migratory, and may migrate great distances into the open ocean.

Chinook salmon typically remain at sea for one to six years. They have been found in ocean waters. They are most abundant at depths of 30-70m and often associated with bottom topography. However, during their first several months at sea, juveniles are predominantly found at depths less than 37 m and are distributed in the water column.

Along the U.S. west coast, juvenile chinook salmon most commonly occur less than 28 km offshore.

Juvenile chinook are generally found within 55 km of the U.S. west coast, with the vast majority of fish found less than 28 km offshore. Concentrations may be found in areas of intense upwelling. The historic southern edge of their marine distribution appears to be near Point Conception, California.

Throughout their range, adult chinook salmon enter freshwater during almost any month of the year. For example, chinook enter the Columbia River between March and November and the Sacramento River between December and July.

Chinook salmon mature at a wide range of ages, from two to eight years. Most adult females are 65-85 cm in length and males are 50-85 cm, although fish larger than 100cm are not uncommon.

Chinook salmon are the most piscivorous of the Pacific salmon. Fish make up the largest part of their diet, but squids, pelagic amphipods, copepods, and euphausiids are also important.

Many populations of chinook salmon on the U.S. west coast are at very low abundance and several have been listed as "threatened" under the ESA.

Stock Status and Trends Declines in the abundance of chinook salmon have been well documented throughout the southern portion of their range. For example, the Columbia River formerly supported the world's largest chinook salmon run, but currently five ESUs (evolutionarily significant units) in the Columbia Basin are listed as "threatened" under the ESA.

A.2.1.2 Coho Salmon (*Oncorhynchus kisutch*), also called silver salmon, are a commercially and recreationally important species. They are found in small rivers and streams throughout much of the Pacific Rim, from central California to Korea and northern Hokkaido, Japan.

Distribution and Life History Coho salmon spawn in freshwater streams, juveniles rear for at least one year in fresh water and spend about 18 months at sea before reaching maturity as adults. North American populations are widely distributed along the Pacific coast and spawn in tributaries to most major river basins from the San Lorenzo River in Monterey Bay, California, to Point Hope, Alaska.

Juvenile coho spend about 18 months at sea before returning to spawn in natal streams.

Two primary dispersal patterns have been observed in coho salmon after emigrating from freshwater. Some juveniles spend several weeks in coastal waters before migrating northwards into offshore waters of the Pacific Ocean while others remain in coastal water near their natal stream for at least the first summer before migrating north. The latter dispersal pattern is commonly seen in coho salmon from California, Oregon, and Washington.

Coho salmon rarely use areas where sea surface temperature exceeds 15 °C and are generally found within the uppermost 10 m of the water column. While juvenile and maturing coho are found in the open north Pacific, the highest concentrations appear to be found in more productive waters of the continental shelf within 60 km of the coast. Adults enter fresh water during October and November in Washington and Oregon and during December and January in California.

> Coho salmon are generally found within the uppermost 10 m of the water column and within 60 km of shore.

Marine invertebrates, such as copepods, euphausiids, amphipods, and crab larvae, are the primary food when coho first enter salt water. Fish represent an increasing proportion of the diet as coho grow and mature.

Stock Status and Trends Many coho salmon populations in Washington, Oregon, and California are depressed from historical levels with stocks at the southern-most end of the range generally at greatest risk of extinction. Coastal stocks from the Columbia River to the southern extent of their range in Monterey Bay were listed as "threatened" under the ESA, and stocks from the Columbia River Basin, southwest Washington, and Puget Sound are candidates for listing.

> The abundance of many coho populations is very low, and several are listed as "threatened" under the ESA.

A.2.2 Pacific Halibut (*Hippoglossus stenolepis*) ranges from California to the Bering Sea and extends into waters off Russia and Japan. The International Pacific Halibut Commission (IPHC) is responsible for the research and assessment of Pacific halibut in the Northeast Pacific ocean.

Distribution and Life History Pacific halibut is a large flatfish which inhabits the continental shelf of the United States and Canada (IPHC 1998). Pacific halibut are demersal and are most often caught between 90 and 900 feet (27 and 274 meters). Halibut from California through the Bering Sea are considered to form one homogeneous population (Trumble 1991). Halibut off the west coast are at the extreme southern end of their range; the majority of the stock and all major spawning grounds are in

> Halibut off the west coast are a small part of the halibut population off North America.

more northern waters off Canada and Alaska. The halibut that inhabit west coast waters result from the southerly migration of juveniles.

Migration of juveniles southward from waters off Alaska and British Columbia replenishes the stock off the west coast.

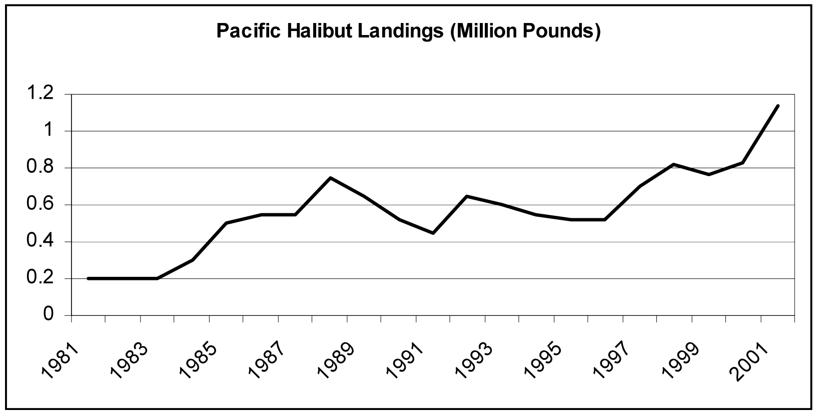
Halibut spawn during the winter in deep water (approximately 1,000 feet or 300 m). Their eggs and larvae rise and drift great distances with the ocean currents in a counter-clockwise direction around the northeast Pacific Ocean. Young fish settle to the bottom in shallow feeding areas. After two or three years in the nursery areas, young halibut tend to counter-migrate and move into more southerly and easterly waters. Juvenile migration is usually completed by the age of six. Adult fish tend to remain on the same grounds year after year, making only a seasonal migration from the more shallow feeding grounds in summer to deeper spawning grounds in the winter (IPHC 1998).

Halibut are large, fast-growing and long-lived.

Pacific halibut are the largest of all flatfish (up to about 500 pounds or 227 kg). Females typically grow faster and live longer than males; nearly all halibut over 100 pounds (45 kg) are females. The oldest halibut on record was 55 years old, but most are less than 25 years old. The growth of Pacific halibut has varied over the years and for the past decade, weight at a given age has been decreasing. The mean age in the commercial halibut catch off the west coast ranged from 9.8 to 11.4 years during 1988-1996 (IPHC 1998).

Pacific halibut prey upon a variety of groundfish, shellfish, and baitfish.

Halibut are carnivorous. Larval halibut feed on plankton. Halibut one to three years old feed on small crustaceans and small fish. As halibut grow, fish become a larger part of their diet. They prey upon cod, sablefish, pollock, rockfishes, sculpins, turbot, and other flatfish. They also leave the bottom to feed on sand lance and herring in the water column. Octopus, crabs, clams, and occasionally small halibut are also eaten. Large juvenile and adult halibut are occasionally eaten by marine mammals but are rarely prey for other fish.



Stock Status and Trends IPHC conducts the stock assessment of halibut throughout its north American range. Methods for assessing the status of halibut off the west coast are provided in Clark (1991a) and Clark and Williams (2001). For assessment purposes, Pacific halibut off the west coast (IPHC Area 2A) and off British Columbia (IPHC Area 2B) have been combined since the early 1980s (Clark and Hare 2001; Clark and Williams 2001). Data from the west coast are weak because only small quantities of fish are involved and only a small number of observations are available. Until 2001, the stock size (exploitable biomass) of halibut off the west coast was estimated as a proportion of the total for the two areas. As a result of a reanalysis and reevaluation of assessment methods for these areas in 2001, the biomass off the west coast was estimated from survey data and a separate assessment of abundance in British Columbia. This change resulted in about a 5% increase in the biomass estimate for west coast halibut (Clark and Hare 2001).

Although assessment methods have varied, catch limits generally reflect trends in estimated abundance. Catch limits have typically been based on a constant exploitation yield, calculated by applying a fixed harvest rate to estimated biomass. West coast catch limits set by IPHC for the combined commercial setline, tribal, and sport fisheries have increased significantly since the late 1990s.

A.2.3 California Halibut (*Paralichthys californicus*) range from the Quillayute River, Washington to Almejas, Baja California, but their abundance and commercial fishery in U.S. waters are concentrated from Bodega Bay to San Diego, California.

Although they range from Washington to Baja California, California halibut are most abundant off central and southern California.

Information on life history and stock status is from Kramer, et al, (2001), Wang(1986), and Kucas and Hassler (1986). California Dept. of Fish and Game (CDFG) manages fisheries for California halibut off its coast; little fishing and catch occurs off Oregon and Washington.

Distribution and Life History Adults live on soft bottom habitats in coastal water generally less than 300 feet (91 m) deep, with greatest abundance at depths less than 100 feet (30 m).

Adults may live more than 30 years, reach 60 inches, and are usually found on soft bottoms less than 100 feet deep.

California halibut live up to 30 years and reach 60 inches (153 cm). Male halibut mature at one to three years of age and eight to twelve inches (20 - 30 cm), whereas females mature at four to five years and 15 to 17 inches (38 - 43 cm).

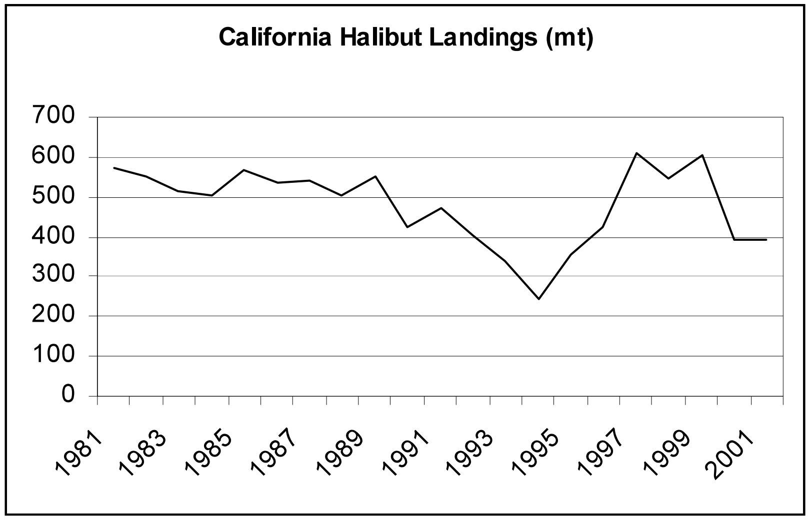
Adults spawn throughout the year with peak spawning in winter and spring. Pelagic eggs and larvae drift over the shelf but are in greatest densities within four miles of shore. Larvae apparently move toward shore as they metamorphose into a bottom-dwelling life.

Newly settled and larger juvenile halibut are usually found in unvegetated shallow-water embayments, and infrequently on the open coast, suggesting that embayments are important nursery habitats. Juveniles emigrate from the bays to the coast at about one year of age and 6.9 to 8.7 inches (17.5 - 22 cm).

Current abundance of California halibut is not known, but in the early 1990s, an estimated 4.6 million fish inhabited southern and central California waters.

Tagging studies show that California halibut do not move long distances. Most sublegal (under 22 inches or 56 cm) halibut were recovered within five miles from their tag sites in southern California. Larger halibut tend to travel the greatest distances; one large halibut was recovered 64 miles (103 km) away 39 days after release.

Adult California halibut primarily prey upon Pacific sardine, northern anchovies, squid, and white croaker. Small juvenile halibut eat primarily crustaceans, including copepods and amphipods until they reach about 2.5 inches (6.4 cm). As they grow, juvenile halibut increasingly prey upon fish, beginning with gobies, which are common in bays.



Stock Status and Trends Estimates of the current abundance of California halibut are not available. In the early 1990s, a fishery-independent trawl survey produced a biomass and population estimate for halibut in southern and central California. That survey indicated a biomass of 6.9 million pounds (3,129 mt) for southern California and 2.3 million pounds (1,043 mt) for central California. Population numbers were estimated to be 3.9 million halibut in southern California and 700,000 halibut for central California. Coastwide commercial landings have generally been between 400 and 600 mt per year during the 1980s and 1990s.

Abundance of larval halibut in plankton surveys is correlated with commercial landings of halibut, suggesting that this species has a cycle of abundance of about 20 years. However, the maximum size of the halibut population may be limited by the amount of available nursery habitat, because juvenile halibut appear to be dependent on shallow-water embayments as nursery areas.

Ocean shrimp occur over the continental shelf from the Aleutian Islands to southern California.

A.2.4 Ocean Shrimp (*Pandalus jordani*), also called pink shrimp, occur from the Aleutian Islands to San Diego, California. State agencies plus the Washington treaty tribes manage the ocean shrimp resource and fisheries off their respective coasts.

Ocean shrimp concentrate in well-defined areas, often associated with green mud and muddy-sand bottoms.

Environmental conditions determine ocean shrimp recruitment and subsequently population size.

Distribution and Life History Ocean shrimp occur at depths from 150 to 1,200 feet (46 - 366 m) but are generally found at depths from 240 to 750 feet (73 - 229 m). Concentrations of shrimp remain in well-defined areas or beds from year to year. These areas are associated with green mud and muddy-sand bottoms. Adults from different beds probably intermix rarely, but the planktonic larvae undoubtedly intermingle. Genetic studies for stock identification have not shown any genetic differences between ocean shrimp off the coasts of California, Oregon, Washington, and British Columbia (Collier and Hannah 2001).

Most ocean shrimp begin life as males and change to females after their first year.

Most ocean shrimp spend the first year and a half of life as males, then pass through a transitional phase to become females. In some years, as much as 60% of the one-year-old shrimp become females and never mate as males (Collier and Hannah 2001). Ocean shrimp adjust their sex ratio to fluctuating age distributions (Charnov and Hannah 2002).

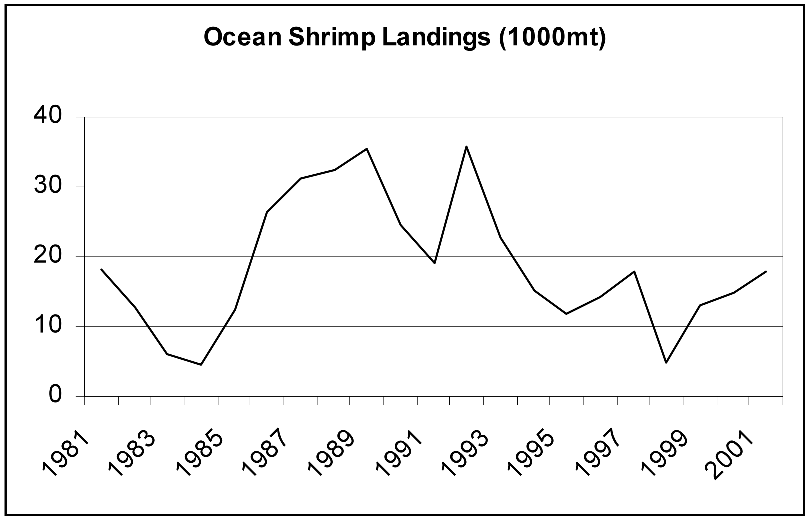
Mating takes place during September and October. Fertilization takes place when the females begin extruding eggs in October. Females usually carry between 1,000 and 2,000 eggs until the larvae hatch in March and April. The larval period lasts 2.5 to three months. Developing juvenile shrimp occupy successively deeper depths, and often begin to show in commercial catches by late summer.

Ocean shrimp grow in steps by molting or shedding their shells and growth rates vary by region, season, sex and year class. They may reach 5.5 inches (14 cm) in total length, but the average size in the catch is about four inches. Ocean shrimp grow rapidly during spring and summer but have slower growth during the winter.

Many groundfish species prey upon ocean shrimp, and predation by Pacific whiting may affect the abundance of ocean shrimp.

Ocean shrimp feed mainly at night on planktonic animals, such as euphausiids and copepods. Likely in association with feeding, they migrate toward the surface during periods of darkness.

Many species of fish prey on ocean shrimp, including Pacific whiting, arrowtooth flounder, sablefish, petrale sole and several species of rockfish (Collier and Hannah 2001). Predation by whiting may affect the abundance of ocean shrimp. An analysis of data on ocean shrimp from commercial catches and logbooks during the 1980s and data on whiting abundance showed that natural mortality rates were positively correlated with the abundance of Pacific whiting, age 2-7 (Hannah 1995).



Stock Status and Trends Estimates of ocean shrimp abundance are not available for the west coast. Population abundance is determined by environmental conditions, which cause natural fluctuations in recruitment that bear little relation to fishing effort (Collier and Hannah 2001). Off Oregon, annual recruitment success is linked to the strength and timing of the spring transition in coastal currents immediately following larval release. An early, strong transition produces large year classes. Consequently, ocean shrimp may be inherently resistant to overfishing (Collier and Hannah 2001). Abundance of ocean shrimp off the Washington coast is unknown, but is assumed to be stable (WDFW 2002).

Ocean shrimp catches (PacFIN annual reports, PSFMC) by commercial trawl and pot fisheries may indicate past trends in abundance. Since 1982, commercial landings have ranged from 4,500 to 36,000 mt, and were about 18,000 mt in 2001.

A.2.5 Prawns

Although several species of prawns occur along the west coast, two species have substantive interactions with groundfish. These species are spot and ridgeback prawns. Prawns are managed by the respective west coast states and Washington treaty tribes. Information on the biology and status of spot prawns is drawn primarily from Mormorunni (2001) with additional information as cited below. Information on the biology and status of ridgeback prawns is from Sunada, *et al*.(2001).

Annual commercial landings of spot and ridgeback prawns off the west coast during 1981-2001 are taken from annual PacFIN reports (PSMFC).

A.2.5.1 Spot Prawn (*Pandalus platyceros*)

ranges from the Aleutian Islands to San Diego, California, and extends to the Sea of Japan and the Korea Strait.

Spot prawns range from the Aleutian Islands to San Diego, California, and to the Sea of Japan and Korea Strait.

Distribution and Life History Spot prawns commonly occur at depths from the intertidal zone to 1,600 feet (487 m) and are typically found at depths between 653 and 772 feet (198-234 m). Juvenile shrimp concentrate in shallower, inshore areas (<297 feet or 90m) and migrate offshore as they mature.

Spot prawns occur on rocky or hard bottoms, such as reefs and canyon edges.

Spot prawn distribution is very patchy and related to water temperature, salinity and physical habitat. Spot prawns typically inhabit rocky or hard bottoms, including reefs, coral or glass-sponge beds, and the edges of marine canyons. Research conducted in Monterey Bay, California, showed that spot prawns appeared to actively select habitat. They were more commonly associated with complex habitats of mixed sediment and smaller rock types such as gravel and cobble.

The spot prawn is the largest of the pandalid shrimp, measuring about 2.5 inches (61 mm) in carapace length. They can live up to six years off California but longevity decreases in more northerly areas; the average age off Canada is only four years.

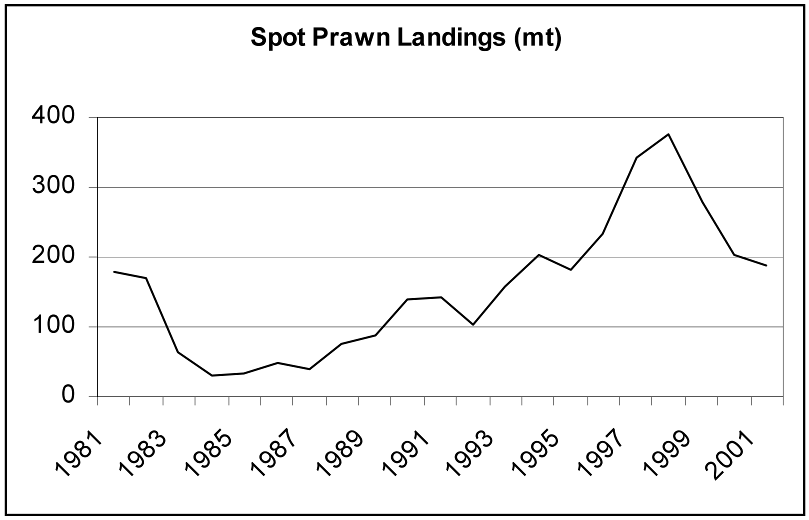
Spot prawns begin life as males and change to females during their fourth year.

Spot prawns change sex in midlife. They mature first as males, mate, and then change to females after a transition phase. Sexual maturity is reached during the third year (about 1.5 inches or 38 mm carapace length). By the fourth year (about 1.75 inches or 44 mm carapace length), many males begin to change sex to the transitional stage. By the end of the fourth year, the transitionals become females. Each individual mates once as a male and once or twice as a female.

Spawning occurs once each year, typically in late summer or early autumn. Spawning takes place at depths of 500 to 700 feet (151-212 m). Females carry eggs for a period of four to five months before they hatch. Depending on size of the female, spot prawns produce from 1,400 to 5,000 eggs for the first spawning down to 1,000 eggs for the second spawning. Eggs hatch over a 10-day period , and most hatching is completed by April. The larvae are free-swimming in the water column for up to three months. As they develop into juveniles, they begin to settle out at shallow depths.

Very little is known about the stock status of spot prawns off the west coast.

Spot prawns typically feed on other shrimp, plankton, small mollusks, worms, sponges and fish carcasses. They usually forage on the bottom throughout the day and night (Larson 2001).



Stock Status and Trends There is little information on spot prawn abundance or relationships among stocks (Lowry 2001; McCrae 1994a; Mormorunni 2001). Landing statistics and fishers' local knowledge are the primary source of information about the status of spot prawns. Commercial landings of spot prawns on the west coast rose during the late 1980s through the late 1990s but have declined since 1999.

Ridgeback prawns occur only from Monterey, CA south to Baja California.

Unlike spot prawns, ridgeback prawns do not change sex and females do not carry eggs till hatching.

The abundance of ridgeback prawns is not known, although fishery data suggest that abundance may have increased steadily during the 1990s.

A.2.5.2 Ridgeback Prawn (*Sicyonia ingentis*)

occurs from Monterey, California, to Cedros Island, Baja California.

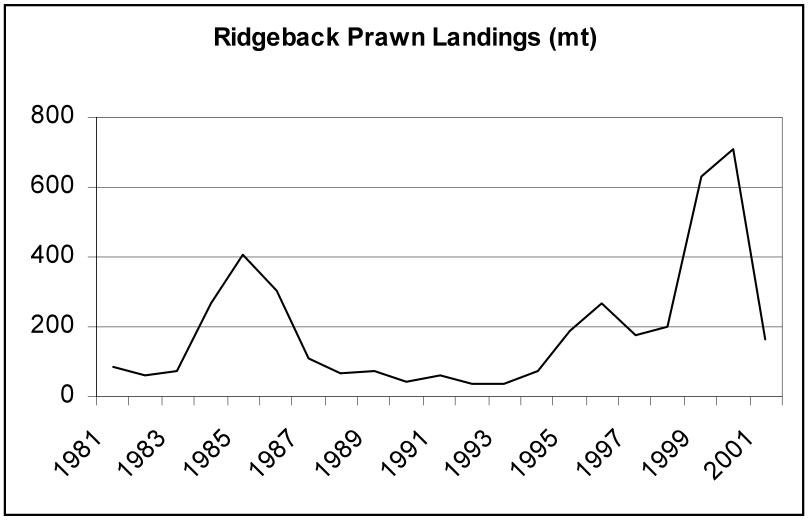
Distribution and Life History They inhabit depths ranging from less than 145 feet to 525 feet (44 - 160 m). Major concentrations occur in the Ventura-Santa Barbara Channel area, Santa Monica Bay, and off Oceanside. Other pockets of abundance occur off Baja California.

Ridgeback prawns inhabit substrates of sand, shell and green mud. Because they are relatively sessile, little or no intermixing occurs.

Their maximum life span is five years and sexes are separate. Females reach a maximum carapace length of 1.8 inches (46 mm) and males 1.5 inches (38 mm).

Ridgeback prawns are free spawners; as opposed to other shrimps which carry eggs. Both sexes spawn as early as the first year, but most spawn during the second year at a size of 1.2 inches (30 mm). Studies suggest that this species undergoes multiple spawning from June through October. On average, females produce 86,000 eggs. Following spawning, both sexes undergo molting and continue molting throughout winter and spring.

The food habits of the ridgeback prawn are unknown, but it may feed on detritus like closely related species. Likely predators include rockfish, lingcod, octopus, sharks, halibut, and bat rays.



Stock Status and Trends No population estimates are available for any of the major fishing grounds. However, fishery data suggest that their abundance increased substantially during the 1990s. Ridgeback prawn trawl logs, mandatory since 1986, show that catch rates rose steadily from a low of 32 pounds (14.5 kg) per tow/hour in 1992 to 213 pounds (96.6 kg) per tow/hour in 1999. This increase is in addition to increased fishing effort during this period. Commercial landings on the west coast rose from 75 mt in 1994 to 711 mt in 2000, but fell sharply to 165 mt in 2001.

Dungeness crab live in coastal and estuarine areas from Alaska to Mexico, usually over sandy or muddy bottoms.

A.2.6 Dungeness Crab (*Cancer magister*) occur in coastal waters along North America from Unalaska Island to Magdalena Bay, Mexico (ADFG 1994). State agencies and Washington treaty tribes manage the Dungeness crab resource and fisheries off their respective coasts. Information on the distribution and life history is taken from several sources (Pauley *et al.* 1986; Pauley 1989; ADFG 1994) and information on stock status and trends is from WDFW (2001).

Distribution and Life History Dungeness crabs are widely distributed subtidally and prefer a sandy or muddy bottom in salt water. However, they are tolerant of salinity changes and can be found in estuarine environments. Subadults and adults are common offshore. They generally inhabit waters shallower than 90 feet (27.4 m), but they have been found as deep as 600 feet (183 m).

> Crabs grow each time they shed their old carapace (molt) and males can only mate with females that have just molted.

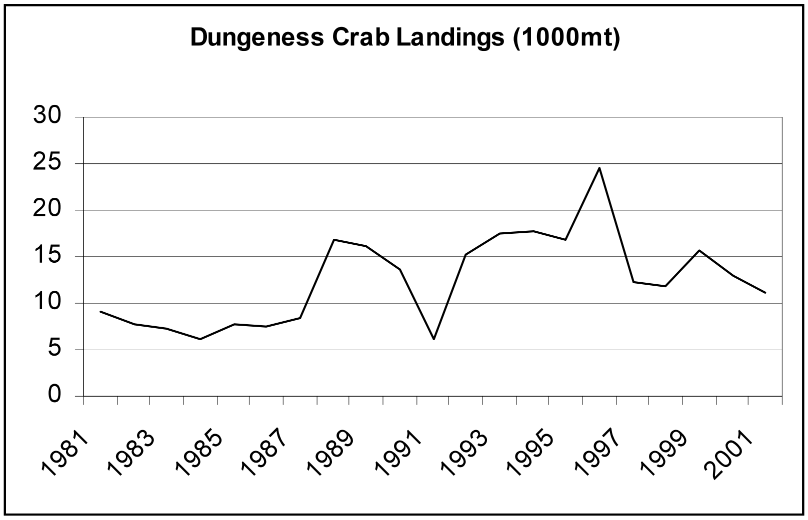
Crabs grow each time they molt (shed their old carapace). After two years, Dungeness males grow faster than females. Juveniles molt 11 or 12 times prior to sexual maturity, which may be reached at three years. At four to five years, a Dungeness crab can be over 6.5 inches (16.5 cm) in carapace width and weigh between 2 and 3 pounds (0.9 - 1.4 kg). A large male can exceed 10 inches (25.4 cm) in carapace width. The estimated maximum life span is between 8 and 13 years.

Dungeness crabs mate from spring through the fall. Males mate only with female crabs that have just molted. A large female crab can carry 2.5 million eggs under her abdomen until hatching. After hatching, the young crabs swim freely. Young planktonic crabs go through six developmental stages before they molt into their first juvenile stage. After molting, the juveniles inhabit shallow coastal waters and estuaries with large numbers living among eelgrass or other habitats with aquatic vegetation. Shell hash, a large deposit of dead clam shells, is also important habitat for young Dungeness crabs.

> Although estimates of abundance are not available, the coastal Dungeness crab resource is considered to be healthy.

Dungeness crabs scavenge along the sea floor for animals that live partly or completely buried in the sand. They are carnivores and their diet includes shrimp, mussels, small crabs, clams, and worms. Cannibalism is common.

Young planktonic crabs are important prey for salmon and other fishes. Juveniles are eaten by a variety of fishes in the nearshore area, especially starry flounder, English sole, rock sole, lingcod, cabezon, skates and wolf eels. Octopus may also be an important predator.



Stock Status and Trends "The coastal Dungeness crab resource is healthy despite large fluctuations in harvest from season to season." Variation in oceanographic conditions will likely continue to cause seasonal abundance to fluctuate as it has in the past, but barring the onset or persistent adverse environmental conditions, the resource is expected to remain healthy (WDFW 2001).

Annual commercial landings of Dungeness crab on the west coast have fluctuated between 6,900 and 26,800 mt since 1981. Data on annual commercial landings of Dungeness crab off the west coast (excluding Puget Sound, Washington) were provided by PSFMC (Daspit 2002).

A.2.7 Market Squid (*Loligo opalescens*) occur throughout the California and Alaska current systems from the southern tip of Baja California, Mexico, to southeastern Alaska.

The Pacific Fishery Management Council (PFMC) manages market squid off the west coast. Information on the biology and status of market squid is from PFMC's coastal pelagic species fishery management (PFMC 1998b)and from CDFG (2002).

Market squid occur from southeastern Alaska through Baja California, although they are most abundant south of Monterey Bay, California.

Distribution and Life History Market squid are most abundant from Punta Eugenio, Baja California and Monterey Bay, California. Although generally considered pelagic, they are found over the continental shelf from the surface to depths of at least 2,625 feet (800 m). Adults and juveniles are most abundant between temperatures of 10 °C and 16° C. They prefer oceanic salinities and are rarely found in bays, estuaries, or near river mouths.

Market squid are small, short-lived molluscs reaching a maximum size of 12 inches (30 cm) total length, including arms. Some individuals may live up to two years, but most mature and spawn when about one year old, then die.

Most market squid mature and spawn when about one year old, then die.

Spawning along the west coast occurs year-round. Peak spawning usually begins in southern California during the fall-spring. Off central California, spawning normally begins in the spring-fall. Squid spawning off Oregon has been observed during May to July. Off Washington and Canada, spawning normally begins in late summer.

Spawning occurs year-round.

Spawning squid concentrate in dense schools near spawning grounds, but habitat requirements for spawning are not well understood. Known major spawning areas are shallow semi-protected nearshore areas with sandy or mud bottoms adjacent to submarine canyons. In these locations, egg deposition occurs between 1.5 and 17 feet (5-55 m).

Males on spawning grounds are larger than females. Males reach 7.5 inches (19 cm) dorsal mantle length and a maximum weight of 130 g (4.6 oz). Females reach 6.7 inches (17 cm) dorsal mantle length and a maximum weight of 90 g (3 oz). Mating has been observed on spawning grounds just prior to spawning, but may also occur before squid move to the spawning grounds. Males deposit spermatophores into the mantle cavity of females and eggs are fertilized as they are extruded. Females produce 20 to 30 capsules and each capsule contains 200 to 300 eggs. Females attach each egg capsule individually to the substrate. As spawning continues, mounds of egg capsules covering more than 100 square meters (1076 sq. ft.) may be formed.

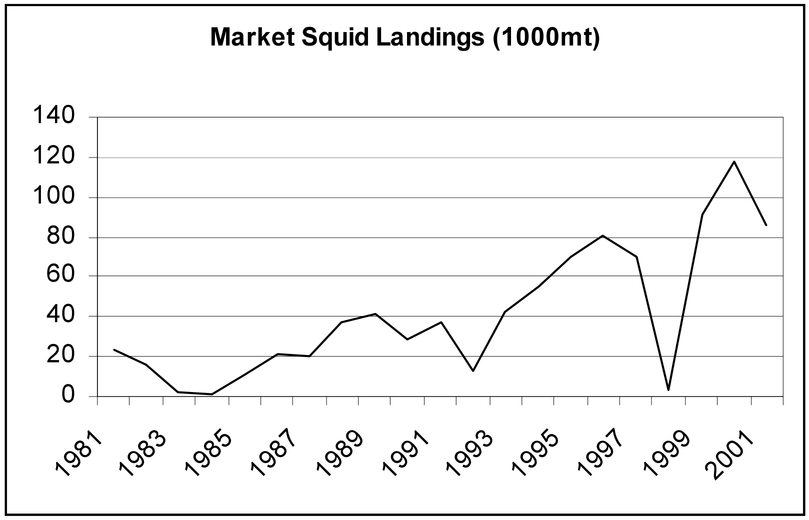
Each female produces egg capsules and deposits them on sandy or mud bottoms.

Spawning is continuous and eggs of varying developmental stages may be present at one site. Temperature affects the time eggs take to hatch: 3 months at 7 to 8 °C; one month at 13 °C; and 12 to 23 days at 10 °C. Newly hatched squid are about 0.10 to 0.12 inches (2.5 to 3 mm) in length. Hatchlings are dispersed by currents, and their distribution after leaving the spawning areas is largely unknown.

Squid are important prey for many marine fish, birds and mammals.

Little is known about market squid abundance.

Squid feed on copepods as juveniles, gradually changing to euphausiids, other small crustaceans, small fish, and other squid as they grow. Market squid are important forage to a long list of fish, birds, and mammals. Some of the more important squid predators are king salmon, coho salmon, lingcod, rockfish, harbor seals, California sea lions, sea otters, elephant seals, Dall's porpoise, sooty shearwater, Brandt's cormorant, rhinoceros auklet and common murre. Few organisms eat squid eggs although bat stars and sea urchins have been observed doing so.

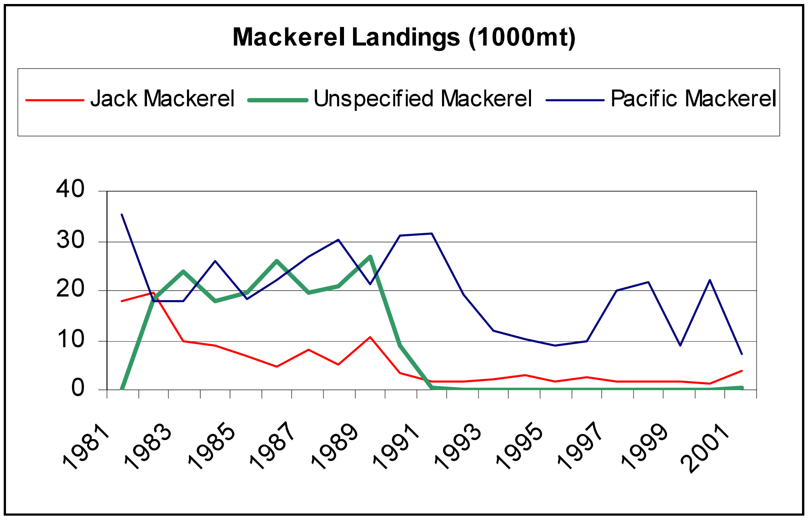


Stock Status and Trends The population dynamics of market squid are poorly understood and no reliable estimates of abundance are available (CDFG 2002; PFMC 2001). Commercial squid landings (PSMFC PacFIN reports) have fluctuated widely and have been solely determined by market demand. Recent high landings may only reflect the coincidental needs of the market and favorable environmental conditions. Similarly, very low landings may reflect unfavorable environmental conditions (PFMC 2001).

The best available information indicates squid have a very high natural mortality, approaching 100% per year, and that the adult population is composed almost entirely of new recruits. No spawner-recruit relationship has been demonstrated. Implications of these ideas are that the entire stock is replaced annually, even in the absence of fishing. Thus, the stock may be dependent on successful spawning each year coupled with good survival of recruits to adulthood (CDFG 2002).

A.2.8 Mackerels

PFMC manages mackerels off the west coast and information on the biology and status of jack mackerel and Pacific (chub) mackerel are primarily from PFMC's coastal pelagic species management plan (PFMC 1998b) and from Mason and Bishop (2001).



A.2.8.1 Jack Mackerel (*Trachurus symmetricus*)

is a pelagic schooling fish, widely distributed throughout the northeastern Pacific Ocean.

> Jack mackerel are pelagic schooling fish, widely distributed throughout the northeastern Pacific Ocean.

Distribution and Life History Jack mackerel ranges from the Pacific coast westward to an offshore limit approximated by a line running from Cabo San Lucas, Baja California, to the eastern Aleutian Islands, Alaska. Much of their range lies outside the 200-mile US exclusive economic zone (EEZ).

> Young jack mackerel (up to 6 years) school over shallow rocky banks off the Southern California Bight. Older, larger fish occur offshore in deep water and along the coastline in northern areas.

Young fish, up to six years old and 12 inches (30.5 cm) in fork length, are most abundant in the Southern California Bight and school over shallow rocky banks. Older fish, 16 to 30 years old and 20 to 24 inches (50 - 60 cm) fork length, are generally found offshore in deep water and along the coastline to the north of Point Conception. Large fish rarely appear in southern inshore waters. Fish of intermediate lengths and ages were found in considerable numbers during the spring of 1991 around the EEZ limit off southern California. Jack mackerel sampled over several years by trawl surveys off Oregon and Washington ranged from 30 to 62 cm (12 - 25 inches) and more than half were older than 20 years.

> Jack mackerel can grow to two feet in length and live to 35 years or more.

Jack mackerel off southern California move inshore and offshore as well as north and south. They are more available on offshore banks in late spring, summer, and early fall than during the remainder of the year. They remain near the bottom or under kelp canopies during daylight and move into deeper nearby areas at night. Young juveniles sometimes are found in small schools beneath floating kelp and debris in the open ocean.

Jack mackerel live 35 years or more. Estimates of natural mortality are uncertain, but information suggests that approximately 20% of the stock dies each year of natural causes if no fishing occurred.

Half or more of females mature during their first year and older females may spawn every five days.

Half or more of all females reach sexual maturity during their first year of life and they are batch spawners. Older jack mackerel spawn about every five days and the average female may spawn as many as 36 times per year.

The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July. Young spawners off southern California begin spawning later in the year than older spawners. Little is known of the maturity cycle of large fish offshore, but peak spawning appears to occur later in more northerly areas and far offshore.

Larval jack mackerel feed almost entirely on copepods. Small jack mackerel off southern California eat large zooplankton, juvenile squid, and anchovy. Large mackerel offshore primarily prey upon euphausiids, but also on small fishes.

Large predators like tuna and billfish and some marine mammals like seals and sea lions prey upon jack mackerel. Smaller fish and marine birds are unlikely to feed on jack mackerel, except young-of-the-year and yearlings.

Reliable estimates of jack mackerel abundance are not available.

Stock Status and Trends "The best current estimate of average spawning biomass for jack mackerel, based on California Cooperative Oceanic Fisheries Investigations (CalCOFI data), is about 1.2 million mt to 2.6 million mt, with roughly 50% of the total spawning biomass found off California and Mexico. This estimate, which is based on scanty information about the distribution and reproductive biology of jack mackerel, is little more than an educated guess"(PFMC 1998b). Beginning in 1991, in response to increased interest in fishing for jack mackerel, PFMC adopted a coastwide quota of 46,500 mt (102.5 million pounds).

Maximum sustainable yield has not been estimated but crude estimates of potential yield have been developed. These estimates for the total stock range from 130,000 to 275,000 mt (286.7 to 606.4 million pounds). Commercial landings on the U.S. west coast have been less than 5,000 mt since 1991 (see figure for mackerels above).

Pacific mackerel is a coastal pelagic species, most common south of Monterey Bay within 20 miles of shore.

A.2.8.2 Pacific (Chub) Mackerel (*Scomber japonicus*)

Pacific (Chub) Mackerel (*Scomber japonicus*) in the northeastern Pacific ranges from Banderas Bay, Mexico to southeastern Alaska and are common from Monterey Bay to Cabo San Lucas.

Distribution and Life History Pacific mackerel usually occur within 20 miles of shore, but have been taken as far offshore as 250 miles.

Of the three spawning stocks along the Pacific coasts of the US and Mexico, only the northeastern Pacific stock extending northward from Punta Abreojos, Baja California is harvested by US fishers and managed by PFMC.

Adults inhabit water ranging from 10°C to 22.2°C and they may move north in summer and south in winter between Tillamook, Oregon and Magdalena Bay, Baja California. They are found from the surface to depths of 300 meters and commonly occur near shallow banks. Juveniles are found off sandy beaches, around kelp beds, and in open bays. Larvae are found in water around 14°C. Pacific mackerel often school with other pelagic species, particularly jack mackerel and Pacific sardine.

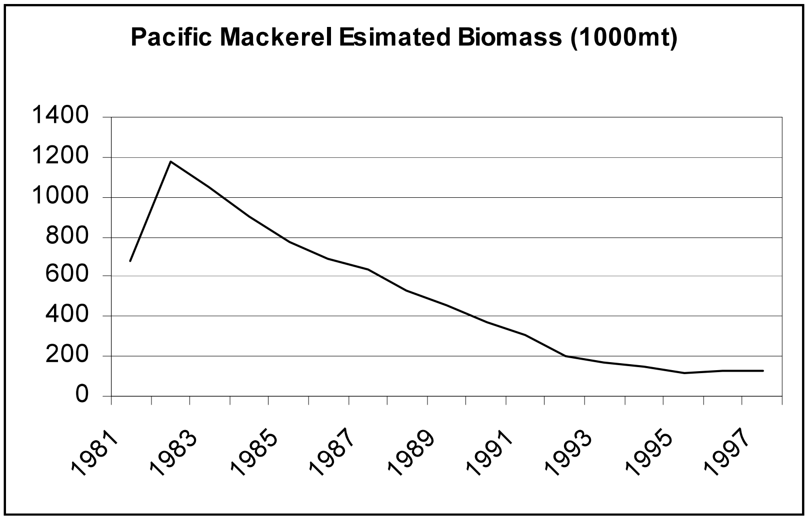
Pacific mackerel can grow to 63 cm and live to 11 years of age.

Pacific mackerel may reach 63 cm in length and 11 years in age, but most taken in commercial fisheries are less than 40 cm and four years old. Some mature as one-year-olds and all are mature by age four.

Like most coastal pelagic species, Pacific mackerel have indeterminate fecundity and seem to spawn whenever sufficient food is available and appropriate environmental conditions prevail. Spawning peaks from late April to July.

They are important prey for some groundfish, as well as marine mammals and seabirds.

Juvenile and adult Pacific mackerel prey upon small fish, fish larvae, squid and pelagic crustaceans. As larvae, they eat copepods and other zooplankton including fish larvae. Juveniles and adults are eaten by larger fish, marine mammals, and seabirds. Pacific mackerel larvae are preyed upon by a number of invertebrate and vertebrate planktivores.



Stock Status and Trends During the 1970s and 1980s, estimated biomass of Pacific mackerel rose from less than 1,000 mt in 1970 to a high of 1,176,000 mt in 1982. Biomass subsequently declined to about 125,000 mt by the late 1990s. Scale-deposition studies indicated that the period of high biomass levels was an unusual event that might be expected to occur, on average, about once every 60 years (see Soutar and Isaacs (1974) and MacCall *et al*.(1985)).

Recruitment success is highly variable and somewhat cyclic and it is estimated that mackerel might sustain average yields of 26,000 to 29,000 mt per year under current management conditions (see MacCall *et al*. (1985)).

Walleye pollock are most abundant in waters off Canada and Alaska, and only occasionally occur in sufficient numbers off the U.S. west coast to attract commercial fishing.

A.2.9 Walleye Pollock (*Theragra chalcogramma*)

are found in the waters of the Northeastern Pacific Ocean from the Sea of Japan, north to the Sea of Okhotsk, east in the Bering Sea and Gulf of Alaska, and south along the Canadian and U.S. west coast to Carmel, California. Information about walleye pollock is taken primarily from Gustafson *et al*.(2000).

Distribution and Life History Adult walleye pollock are generally a semi-demersal species that inhabit the continental shelf and slope. Adults occur as deep as 366m, but the vast majority occur between 100 and 300m. Spawning takes place at depths of 50 to 300m. Eggs are pelagic and are found throughout the water column. Larvae and juveniles are pelagic, and are generally found in the upper water column to depths of 60m. Postlarvae and small juveniles occupy a wider depth range, generally rising to the surface at night to feed and sinking down in schools during the day. Juvenile pollock have been found in a variety of habitat types, including eelgrass (over sand and mud), gravel and cobble.

Walleye pollock are not considered to be a migratory species, but prespawning adults do make relatively short migrations to regional spawning grounds. These grounds are generally in sea valleys, canyons, indentations in the outer margin of the continental shelf, and in fjords. A variety of environmental factors, including hydrographic fronts, temperature, light intensity, prey availability, and depth determine the distribution of juveniles and adults.

Walleye pollock are oviparous and females spawn several batches of eggs, usually in deep water over a short period of time. Although age of maturity varies by area, many pollock are mature by age three.

Adults are carnivorous and feed primarily on euphausiids, small fishes, copepods, and amphipods. They tend to be opportunistic feeders, preying upon whatever food items are available. In some areas, cannibalism can be an important food source for adults.

The abundance of walleye pollock off the U.S. west coast is not known.

Stock Status and Trends Little is known about the stock status and trends of walleye pollock abundance off Washington, Oregon and California. In comparison to abundance in northern waters, the numbers of walleye pollock off the west coast is low. However, in years with very favorable environmental conditions, numbers sufficient to attract attention by commercial fishers apparently move southward from waters off British Columbia.

A.2.10 Sharks

Of the more than two dozen shark species off the west coast, four species are included in this section. Three are offshore species and one is a nearshore species. Little is known about most of them, especially their population status. Information is primarily taken from the NMFS Southwest Fisheries Science Center website (SWFSC 2002) and from Leet *et al.* (1992). Three shark species, spiny dogfish, leopard shark and soupfin shark, are classified as groundfish in the FMP and are described earlier in this Appendix.

The common thresher shark is a large, pelagic species usually occurring within 40 miles of the west coast.

Annual landings data for the common thresher shark, blue shark, shortfin mako shark and Pacific angel shark are taken from the PacFIN report series.

A.2.10.1 Common Thresher Shark (*Alopias vulpinus*) is a large pelagic shark with a circumglobal distribution.

Distribution and Life History In the northeastern Pacific, it occurs from Goose Bay, British Columbia south to off Baja California. Genetic analyses indicate that the Pacific U.S.-Mexico common thresher shark is a single homogenous population. Abundance is thought to decrease rapidly beyond 40 miles from the coast, although catches off California and Oregon do occur as far as 100 miles offshore. This species is often associated with areas of high biological productivity, strong frontal zones separating regions of upwelling and adjacent waters, and strong horizontal and vertical mixing of surface and subsurface waters.

> They likely seasonally migrate between San Diego/Baja California and Oregon and Washington.

Tagging and other data suggest a seasonal north-south migration between San Diego/Baja Mexico and Oregon and Washington. Large adults may pass through southern California waters in early spring of the year, remaining in offshore waters from one to two months for pupping. Pups are then thought to move into shallow coastal waters. The adults then continue to follow warming water and perhaps prey northward, and by late summer, arrive off Oregon and Washington. Subadults appear to arrive in southern California waters during the early summer, and as summer progresses move up the coast as far north as San Francisco, with some moving as far as the Columbia River. In the fall, these subadults are thought to move south again. Little is known about the presumed southward migration of the large adults, which do not appear along the coast until the following spring.

> Off the west coast, the common thresher shark grows to 18 feet in length and females mature at about 8.5-9 feet and 4-5 years of age.

Off the U.S. west coast, the largest reported is 18 feet (550 cm). Size and age of first maturity for females is likely between 8.5-9 feet (260-270 cm) and about 4 or 5 years old. For males, size and age of first maturity is between 8-11 feet (246-333 cm) and 3 to 6 years. This species has been variously reported to reach a maximum age of from 19 to 50 years old.

The common thresher shark bears live young, with a typical litter size of 2-4 pups. Mating presumably takes place in midsummer along the U.S. west coast with a gestation period of about 9 months. Birth is believed to occur in the spring months off California.

> Local thresher shark stocks may be rebuilding, following relatively heavy exploitation during the 1980s.

Primary prey items in the diet of the common thresher shark taken in the California-Oregon drift gillnet fishery included anchovy, sardine, Pacific whiting, mackerels, shortbelly rockfish, and market squid.

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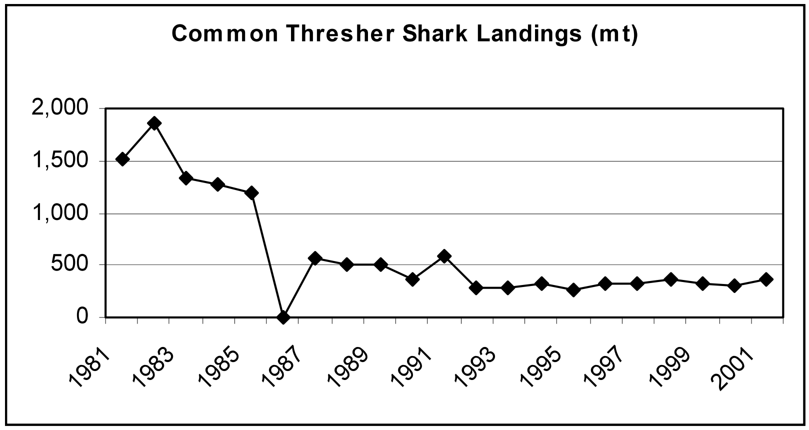


atus of Stocks and Trends According to preliminary analyses of trends in relative abundance in the California-based drift net fishery and fishery-independent survey data, local thresher shark stocks may be rebuilding, following the disappearance of the most heavily exploited size classes from catches during the 1980s (SWFSC 2002).

Blue sharks are oceanic and epipelagic, but may also occur at shelf narrows and near submarine canyons along the coast.

A.2.10.2 Blue Shark (*Prionace glauca*) is thought to be the most wide-ranging shark species. It is an oceanic-epipelagic species with a circumglobal distribution.

Distribution and Life History Blue sharks also occur near the coast where the shelf narrows or is cut by submarine canyons close to shore. They are most commonly found in water temperatures between 45°F and 61°F. In temperate waters, blue sharks are caught within the mixed layer and generally range between the surface and the top of the thermocline, but have been documented as deep as 2,145 feet.

Blue sharks off the west coast can grow to 8.5 feet in length and reach 20 years of age.

In the Pacific, blue shark show strong fluctuations in seasonal abundance related to population shifts northward in summer and southward in winter. There is considerable sexual segregation in populations with females more abundant at higher latitudes than males. Local abundance off California undergoes major seasonal fluctuations with juveniles to three-year-olds most abundant in the coastal waters from early spring to early winter. Mature adults are uncommon in coastal waters.

Blue sharks reportedly grow to 13 feet (396 cm) in length, but seldom exceed 8.5 feet (260 cm) off the U.S. west coast. Maximum age is reported to be at least 20 years. The size and age of 50% maturity for males is 6.5 feet (203 cm) and 4-5 years, and for females is 6 feet (186 cm) and 5-6 years.

Nursery habitat for blue sharks may extend from the Southern California Bight to the Columbia River.

Blue shark are viviparous and bear fully-formed, live young. Litters average about 30 pups, with maximum litter size reported at 135. The gestation period is about 9-12 months. Off California, parturition occurs in early spring, and mating occurs during late spring to early winter. Catch observations in the drift-net fishery suggest that the nursery habitat may extend northward to off the Columbia River mouth and primarily offshore of the 100 fm isobath.

In coastal waters off the U.S. west coast, blue sharks reportedly feed on anchovy, mackerel, whiting, dogfish, squid and pelagic crustaceans, including euphausiids. They may feed more actively at night, with highest activity in the early evening.

The status of the blue shark population is not known, but may have decreased slightly since the 1980s.

Stock Status and Trends The size of the blue shark stock off the west coast is not known. Recent analyses of trends in relative abundance in the California-based drift net fishery and fishery-independent survey data show that abundance of blue sharks has slightly decreased and fish size in the catch has also decreased since the 1980s (SWFSC 2002). The extent to which this has been influenced by shifts in environmental conditions and fish distributions is not known. Commercial landings of blue shark off the west coast have usually been less than10 mt per year.

A.2.10.3 Shortfin Mako Shark (*Isurus oxyrinchus*)

A.2.10.3 Shortfin Mako Shark (*Isurus oxyrinchus*) is an oceanic, epipelagic species distributed in temperate and tropical seas worldwide.

The shortfin mako shark is an oceanic, epipelagic species. Off the west coast, they are most common off California.

Distribution and Life History Juveniles are also common in neritic waters. In the eastern Pacific, the mako shark occurs from Chile to the Columbia River and in U.S. west coast waters is most common off California.

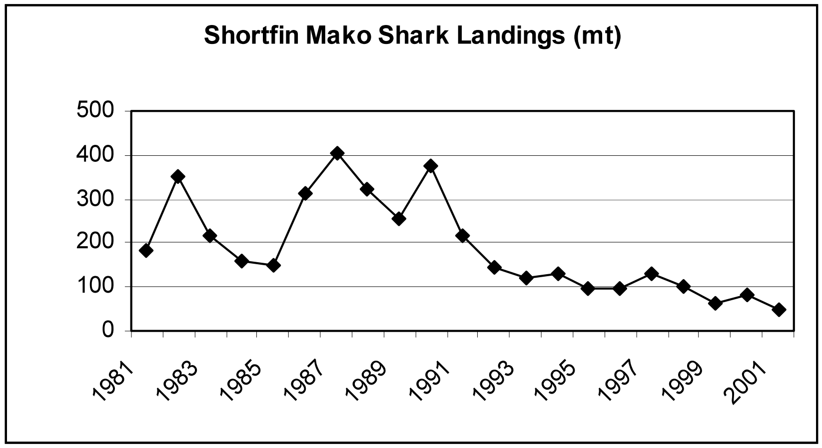
Off the west coast, shortfin mako sharks grow up to 11.5 feet (351 cm); those caught are typically between 6-7 feet (213-244 cm) in length. Determining the age of shortfin mako sharks is difficult, but the maximum age may be as old as 40 years. They bear live young, with an average brood size of about 12 pups, but litters from 4 to 30 have been reported. At birth, pups are about 2.0 to 2.5 feet in length. The gestation period is estimated to last from 12 to 19 months.

The Southern California Bight is an important pupping and nursery area for shortfin mako sharks.

The present status of the shortfin mako shark is not known, but is of concern.

Tagging data suggest that the Southern California Bight is an important pupping and nursery area. Newly born juveniles apparently remain in these waters for about two year, then move offshore or to the south.

Shortfin mako sharks may feed predominantly during the day and important prey includes mackerel, bonito, anchovy, tuna, marine mammals, marlin, other sharks and squid off California (SWFSC 2002).



Stock Status and Trends The present status of the shortfin mako shark in state and federal waters off California is not known but is of concern. Over-development of fisheries in the coastal nursery poses the greatest risk to the mako population in the eastern Pacific. Recent analyses of trends in relative abundance in the California-based drift net fishery and fishery-independent survey data show that abundance of shortfin mako sharks has slightly decreased and fish size in the catch has also decreased since the 1980s (SWFSC 2002). The extent to which this has been influenced by shifts in environmental conditions and fish distributions is not known.

Pacific angel sharks live on sandy bottoms along the west coast, commonly at depths between 30 and 240 feet off California.

A.2.10.4 Pacific Angel Shark (*Squatina californica*) in the northeastern Pacific Ocean occurs from southeastern Alaska to the Gulf of California, although they are uncommon north of California.

Distribution and Life History The angel shark is a relatively small, bottom-dwelling shark, living on the sandy bottom of the ocean, commonly at depths between 30 and 240 feet. It lives offshore to depths of over 600 feet, in bays, and along the fringe of kelp forests. It is often found laying partially buried on sandy bottoms in sand channels between rocky reefs during the day, and appears to move little away from its home territory. Research strongly indicates that genetically isolated populations of angel sharks exist in California.

Genetic studies suggest that isolated populations of angel sharks exist in California waters.

Pacific angel sharks reach a maximum length of five feet and a weight of 60 pounds. To date, attempts to determine the age of angel sharks have been unsuccessful. Sexual maturity in both males and females occurs between 35 and 39 inches in length. An average of six pups are produced annually from March to June. A 10-month gestation period is estimated for this species.

The angel shark's diet varies seasonally. Major prey items include queenfish and blacksmith in the summer and market squid in the winter. They also reportedly prey upon mackerel and sardines during the fall and early winter.

The current status of the population is not known.

Stock Status and Trends No population studies have been conducted on angel shark since the commercial nearshore fishery off California ended in 1994. Commercial fishing for angel shark rose during the 1980s to a peak of 1,132 mt in1985. Reduced catches subsequently resulted from changing fishing practices and a series of management actions implemented out of concern for the status of the population during the late 1980s. Annual commercial landings reported in the PacFIN data series have remained below 60 mt since 1993.

Many herring stocks occur along the Pacific coast from Mexico to Alaska.

A.2.11 Pacific Herring (*Clupea pallasi*) range from Baja California to Alaska and across the Pacific Ocean to Japan, China, and Russia. Information on the distribution and life history of Pacific herring was drawn from the following sources: Watters *et al* (2001), Lassuy (1989), Barnhart(1988), and McCrae (1994b).

Distribution and Life History Juvenile herring form schools and inhabit inshore waters until summer or early fall when they migrate to the open ocean. There is little information on the life history of herring in the ocean.

Herring consistently spawn in the same areas from year to year and each spawning area is typically managed as a separate stock.

There may be numerous herring stocks although individual ones have not been clearly defined. Many differences have been found between stocks at different latitudes, such as timing of spawning, age at maturity, and size. Locations of spawning grounds are consistent from year to year and each spawning area is typically managed as a separate stock. It is likely that stocks intermingle extensively on summer offshore feeding grounds.

Herring spawn on marine vegetation or rocky substrate in protected inlets, bays, and estuaries.

Some herring reach sexual maturity at age two and all are sexually mature by age three. Pacific herring off California may live to be nine or 10 years old and reach a maximum length of about 11 inches (28 cm), although fish older than seven are rare (Watters *et al.* 2001).

Spawning habitats are typically marine vegetated or rocky substrate in protected inlets, bays, and estuaries, from intertidal to about 30 feet (9 m) in depth. Very little spawning occurs on the open coast.

Spawning times vary with latitude and apparently coincide with increasing plankton productivity. Spawning can begin as early as October in California, and as late as July in Alaska. Spawning peaks in February and March off Oregon. In the late winter and early spring, large schools of herring enter shallow bays and estuaries, where they remain up to three weeks before spawning. Spawning occurs in "waves" of 1-3 days, separated by 1-2 weeks between waves. Larger, older fish tend to spawn first, then smaller, younger fish.

A large spawning run can result in 20 miles or more of the shoreline being covered by a 30-foot-wide band of herring eggs.

A large female may lay 40,000-50,000 eggs in one year. Eggs are laid in thin layers or up to 20 layers thick on vegetation or solid substrates. The highest egg densities are in the lower intertidal and upper subtidal zones. A large spawning run may last a week and can result in 20 miles (32.2 km) or more of the shoreline being covered by a 30-foot-wide (9.1-m-wide) band of herring eggs.

Pacific herring is one of the most important prey species for other marine fish, birds, mammals, and invertebrates.

Eggs are vulnerable to predation by marine birds, fishes, and invertebrates and to desiccation or freezing during low tide cycles. Between 50-99 % of herring eggs die during the 2 to 3 weeks till hatching.

Copepods, euphausiids, and decapod larvae are major food items for herring. Herring are an important forage fish for numerous species of marine fishes, birds, invertebrates, and mammals.

Stock Status and Trends Coastwide estimates of herring abundance are not available, but the size of herring spawning populations in Tomales and San Francisco Bays is estimated annually. During 2000, spawning biomass was estimated at 27,400 tons (60.4 million pounds) in San Francisco Bay and 2,011 tons (4.4 million pounds) in Tomales Bay.

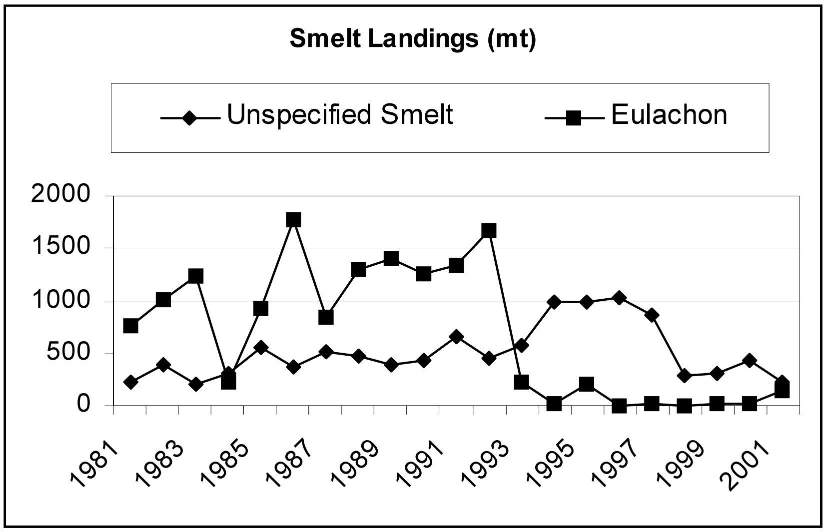
Annual abundance fluctuates widely due to variations in recruitment caused by environmental factors, especially El Niño events. The lack of upwelling and associated warm water conditions that occur during El Niño events reduces the production of food for herring, which can affect their condition and survival. It also may displace herring to areas of colder water.

A.2.12 Smelts

Little is known about smelt abundance on the west coast.

Smelts off the west coast are managed by the respective state agencies and Washington treaty tribes. Information about true smelts is taken from: Sweetnam *et al*.(2001), Wang(1986), and McCrae (1994c). Four species are summarized in this section: longfin smelt, night smelt, surf smelt, and eulachon, also known as Columbia River smelt.

Little is known about the abundance of smelts along the west coast. Annual commercial landings of smelt, primarily eulachon, are from the annual reports of the PacFIN data series.



A.2.12.1 Eulachon (*Thaleichthys pacificus)* range from central California to Alaska.

Eulachon are pelagic, schooling fish and spend most of their life in the open ocean.

Distribution and Life History Eulachon are anadromous, spending most of their life in the open ocean, schooling at depths of 150 to 750 feet (46 - 229 m). They migrate to lower reaches of coastal rivers and streams to spawn in fresh water; occasionally they travel over 100 miles up the Columbia River. They spawn in gravelly riffles close to the stream mouths.

They travel to the lower reaches of rivers and streams to spawn in freshwater.

Eulachon may live up to five years and reach 12 inches (30.5 cm) in length. Most eulachon reach maturity in two to three years and die after spawning. Each female lays about 25,000 eggs which stick to the gravel and hatch in two to three weeks. Upon hatching, larvae begin migrating to the sea.

Eulachon feed mainly on euphasiids, copepods and othe curstaceans, and they are a very important food for predatory marine animals, including salmon, halibut, cod and sturgeon.

Eulachon abundance coastwide declined drastically during the late 1990s.

Stock Status and Trends In recent years, eulachon numbers have declined drastically. Although coastwide commercial landings of eulachon usually exceeded 1,000 mt during the 1980s and early 1990s, they were less than 26 mt each year between 1996 and 2000 (see figure for smelts above). In 2001, the Columbia River spawning run increased and may be a harbinger of larger stock sizes in the future (WDFW 2002).

Eulachon numbers in California rivers also declined drastically in recent years. They are now rare or absent from the Mad River and Redwood Creek and scarce in the Klamath River (Sweetnam *et al.* 2001).

Longfin smelt are pelagic and primarily inhabit estuaries.

A.2.12.2 Longfin Smelt (*Spirinchus thaleichthys*) is a pelagic, estuarine fish, which ranges from Monterey Bay, California to Prince William Sound, Alaska.

Distribution and Life History Longfin smelt are anadromous and live up to three years. They reach lengths of six inches (15 cm). Longfin smelt reach maturity at the end of their second year. Most die after spawning, but a few females may survive and spawn a second time. Females produce between 5,000 and 24,000 eggs, which are adhesive and attach to the substrate. Hatching takes place within 40 days depending on water temperature.

At age two, they migrate to freshwater to spawn, then most die.

In the Sacramento-San Joaquin Estuary, adults feed mainly on mysids, while juveniles prefer copepods. Potential predators include striped bass, inland silversides, marine birds and some marine mammals.

Stock Status and Trends Abundance of longfin smelt severely declined in California during the early 1990s. However, the populations in California are not considered genetically distinct from abundant and stable populations found in Washington (Sweetnam *et al.* 2001).

Unlike longfin smelt, night smelt are uncommon in estuaries and occupy coastal areas.

Night smelt congregate to spawn on shallow beaches with coarse sand and gravel and become completely buried in the surf zone.

A.2.12.3 Night Smelt (*Spirinchus starksi*) are found from Point Arguello, California to Shelikof Bay, Alaska.

Distribution and Life History Night smelt are schooling, plankton-feeding fish. Apparently, the bulk of the population remains along the Pacific coast, and only a few occasionally enter bays and estuaries (Wang 1986).

Night smelt rarely exceed 3 inches (7.6 cm) in length or three years in age. Spawning has been recorded from January through

September on the same beaches as those used by surf smelt. During spawning, schools of fish congregate on shallow beaches with coarse sand and gravel. The adhesive eggs sink to the bottom, become encrusted by sand and gravel, and eventually become completely buried in the substrate in the surf zone. Adults may spawn more than once during the season. Eggs take about two weeks to hatch. Life history details from the egg to the juvenile stages are not well known.

Their diet consists of small crustaceans, similar to that of other smelt. Night smelt are also important prey for other fishes as well as marine mammals and birds.

Stock Status and Trends Little is known about the status of the night smelt population, although commercial landings in California averaged over 800,000 pounds (363 mt) per year during the 1990s (Sweetnam *et al.* 2001). Its population status off Oregon and Washington is not known.

A.2.12.4 Surf Smelt (*Hypomesus pretiosus*) have been reported to occur from Prince William Sound and Chignik Lagoon, Alaska to Long Beach, California, although they are only common north of San Francisco Bay.

Surf smelt are most common north of San Francisco Bay and generally stay within ten miles of shore.

Distribution and Life History Surf smelt are a schooling, plankton-feeding fish that can reach 10 inches (25.4 cm) in length. Females typically grow the largest and live the longest, up to five years. Males rarely live longer than three years. Females are mature in one to two years, and produce 1,300 to 37,000 eggs.

Surf smelt spawn on selected beaches at predictable times of the year, especially during high tides.

Surf smelt spawn on selected beaches at predictable times of the day and year. In California, most spawning occurs in June through September, especially during high tides. The fertilized eggs stick to sand and pebbles and they appear to prefer beaches made up largely of coarse sand and gravel, with some freshwater seepage. During periods of heavy spawning, some beaches are coated with eggs. Juveniles commonly inhabit estuaries during spring through fall.

Eggs hatch in two to three weeks. Little is known about their life history as larvae, juveniles or adults in the ocean environment. They generally stay within ten miles of shore.

Surf smelt are important prey for many marine birds, mammals and fishes.

Stock Status and Trends Little information is available about the population status of surf smelt on the west coast.

Marine Mammals, Turtles, and Seabirds

A.3 Marine Mammals, Turtles and Seabirds

A.3.1 Introduction

This section examines interactions between protected species and groundfish fisheries under consideration in this Fishery Management Plan (FMP). As a point of clarification, interactions and incidental catches are different than bycatch. Interactions and incidental catches involve fishing gears and marine mammals, turtles and birds, while bycatch consists of regulatory or economic discards of fish. Turtles, although defined as fish in the Magnuson-Stevens Act and thus technically are bycatch, are included in this section because of their protected status (NMFS 1998). The marine mammal species accounts presented here are taken primarily from the most recent Stock Assessment Reports (Carretta *et al.* 2001) prepared by NMFS as required by the Marine Mammal Protection Act (MMPA). The sea turtle species accounts are taken from the species accounts of the Environmental Assessment for the issuance of a marine mammal permit to the California/Oregon drift gillnet fishery (NMFS 2001a).

The following marine mammal species occur off the west coast that are or could be of concern with respect to potential interactions with groundfish fisheries.

	Scientific Name	ESA Status
Pinnipeds		
California sea lion	*Zalophus californianus*	
Pacific harbor seal	*Phoca vitulina richardsi*	
Northern elephant seal	*Mirounga angustirostris*	
Guadalupe fur seal	*Arctocephalus townsendi*	T
Northern fur seal	*Callorhinus ursinus*	
Northern or Steller sea lion	*Eumetopias jubatus*	T
Sea otters		
Southern	*Enhydra lutris nereis*	T
Washington	*Enhydra lutris kenyoni*	
Cetaceans		
Minke whale	*Balaenoptera acutorostrata*	
Short-finned pilot whale	*Globicephala macrorhyncus*	

Gray Whale	*Eschrichtius robustus*
Harbor porpoise	*Phocoena phocoena*
Dall's porpoise	*Phocoenoides dalli*
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
Short-beaked common dolphin	*Delphinus delphis*
Long-beaked common dolphin	*Delphinus capensis*

The following cetaceans are present within the area managed by this FMP but not likely to interact with groundfish fisheries or have not been documented having had interactions in observed groundfish fisheries:

Bottlenose dolphin	*Tursiops truncatus*	
Striped Dolphin	*Stenella coeruleoalba*	
Sei whale	*Balaenoptera borealis*	E
Blue whale	*Balaenoptera musculus*	E
Fin whale	*Balaenoptera physalus*	E
Sperm whale	*Physeter macrocephalus*	E
Humpback whale	*Megaptera novaeangliae*	E
Bryde's whale	*Balaenoptera edeni*	
Sei whale	*Balaenoptera*	E
Killer whale	*Orcinus orca*	
Baird's beaked whale	*Berardius bairdii*	
Cuvier's beaked whale	*Ziphius cavirostris*	
Pygmy sperm whale	*Kogia breviceps*	
Risso's dolphin	*Grampus griseus*	
Striped dolphin	*Stenella coeruleoalba*	
Northern right-whale dolphin	*Lissodelphis borealis*	

The following sea turtle species occur off the west coast that are or could be of concern with respect to potential interactions with groundfish fisheries.

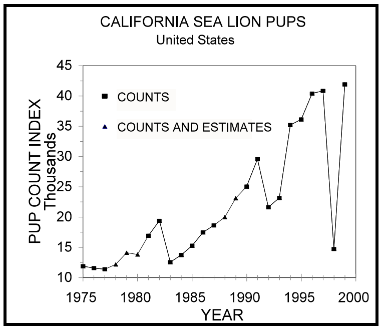
	Scientific Name	ESA Status
Loggerhead	*Caretta caretta*	T
Green	*Chelonia mydas*	T
Leatherback	*Dermochelys coriacea*	E
Olive (Pacific) ridley	*Lepidochelys olivacea*	T

The following seabirds occur off the west coast that are or could be of concern with respect to potential interactions with groundfish fisheries.

	Scientific Name	ESA Status
Short-tailed albatross	*Phoebastria albatrus*	E
Black-footed albatross	*Phoebastria nigripes*	
California brown pelican	*Pelecanus occidentalis californicus*	E
Northern fulmar	*Fulmarus glacialis*	

Cormorants	*Phalacrocorax* species
Puffins	*Fratercula* species
Shearwaters	*Puffinus* species
Gulls	*Larus* species

A.3.2 Marine Mammals



The US pup counts continue to increase (From Lowry, 1999; Carretta, 2001).

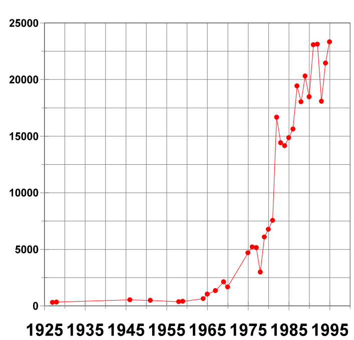
A.3.2.1 California Sea Lion *(Zalophus californianus)*

(Zalophus californianus) range from British Columbia south to Tres Marias Islands off Mexico. Breeding grounds are mainly on offshore islands from the Channel Islands south into Mexico. Breeding takes place in June and early July within a few days after the females give birth. NMFS conducts annual pup censuses at established rookeries (Lowry 1999) and uses a correction factor to obtain a total estimated population of 214,000 sea lions (Carretta *et al.* 2001). The stock appears to be increasing at about 6.2% per year while fishery mortality also is increasing (Lowry *et al.* 1992). California sea lions are not endangered or threatened under the Endangered Species Act (ESA) nor depleted under the MMPA. This stock is also not listed as a strategic under the MMPA and total human-caused mortality (1352 sea lions) is less than the 6,591 sea lions allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

> California sea lions are killed incidentally in the California set gillnet and CPFV fisheries and also the WOC groundfish trawl fishery.

During the summer breeding season, most adults are present near rookeries principally located on the southern California Channel Islands and Año Nuevo Island near Monterey Bay. Males migrate northward in the fall, going as far north as Alaska and returning to their rookeries in the spring. Adult females generally do not migrate far away from rookery areas. Juveniles remain near rookery areas or move into waters off central California. Diet studies indicate that California sea lions feed on squid, octopus, and a variety of fishes: anchovies, sardine, mackerel, herring, rockfish, hake, and salmon (Antonelis *et al.* 1984; Lowry *et al.* 1990; NMFS 1997).

Incidental mortalities of California sea lions have been documented in set and drift gillnet fisheries (Carretta *et al.* 2001; Hanan *et al.* 1993). Skippers logs and at-sea observations have shown that California sea lions have been incidentally killed in Washington, Oregon, and California groundfish trawls and during Washington, Oregon, and California commercial passenger fishing vessel fishing activities (Carretta *et al.* 2001).



Increases in CA Harbor Seals (Hanan, 1996)

A.3.2.2 Harbor Seal *(Phoca vitulina richardsi)*

inhabit nearshore and estuarine areas ranging from Baja

California, Mexico, to the Pribilof Islands, Alaska. MMPA stock assessment reports recognize six stocks along the U.S. west coast: California, Oregon/ Washington outer coastal waters, Washington inland waters, and three stocks in Alaska coastal and inland waters (Carretta *et al.* 2001). Using the latest complete aerial survey (Hanan 1996) and appropriate corrections for counting bias, Carretta, *et al.* (2001) estimates the California stock at 30,293 seals; the Oregon/ Washington Coast stock at 26,180 seals; and the Washington inland-water stock at 16,056 seals. These estimates combine for a west coast, lower three-state total of 72,529 seals. The population appears to be growing and fishery mortality is declining. Harbor seals are not endangered or threatened under the ESA nor depleted under the MMPA. This stock is also not listed as a strategic under the MMPA and total human-caused mortality (666 seals) is less than the 1,678 harbor seals allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Harbor seals do not migrate extensively, but have been documented to move along the coast between feeding and breeding locations (Brown 1988; Herder 1986; Jeffries 1985). The harbor seal diet includes herring, flounder, sculpin, cephalopods, whelks, shrimp, and amphipods (Bigg 1981; NMFS 1997).

No mortalities of harbor seals have been observed in west coast groundfish fisheries.

Combining mortality estimates from California set net, northern Washington marine set gillnet, and groundfish trawl results in an estimated mean mortality rate in observed groundfish fisheries of 667 harbor seals per year along Washington, Oregon, and California (Carretta *et al.* 2001).

A.3.2.3 Northern Elephant Seal *(Mirounga angustirostris*) range from Mexico to the Gulf of Alaska. Breeding and whelping occurs in California and Baja California, during winter and early spring (Stewart and Huber 1993)on islands and recently at some mainland sites. Stewart *et al.*(1994) estimated the population at 127,000 elephant seals in the U.S. and Mexico during 1991. The population is growing and fishery mortality may be declining, and the number of pups born may be leveling off in California during the last five years (Carretta *et al.* 2001). Northern elephant seals are not endangered or threatened under the ESA nor depleted under the MMPA. This stock is also not listed as a strategic under the MMPA and total human-caused mortality (33 seals) is less than the 2,142 elephant seals allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

The northern elephant seal is not ESA of MMPA listed, and population is growing.

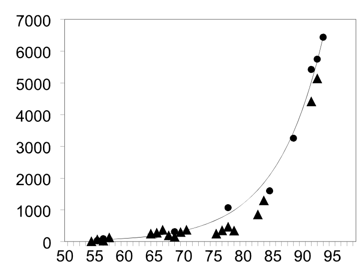
Northern elephant seals are polygynous breeders with males forming harems and defending them against other mature males in spectacular battles on the beach. Female give birth in December and January, mate about three weeks later, after which the pups are weaned (Reeves *et al.* 2002). They were hunted for their oil to near extinction and the current population is composed of the decedents of a few hundred seals that survived off Mexico (Stewart *et al.* 1994). They feed mainly at night in very deep water to consume whiting, hake, skates, rays, sharks, cephalopods, shrimp, euphasiids, and pelagic red crab (Antonelis *et al.* 1987). Males feed in waters off Alaska, and females off Oregon and California (Le Boeuf *et al.* 1993; Stewart and Huber 1993).

Elephant seals eat whiting, skates, rays, sharks, and other species.

There are no recent estimated incidental kills of Northern elephant seals in groundfish fisheries along Washington, Oregon, and California, however they have been caught in setnet fisheries (Carretta *et al.* 2001).

A.3.2.4 Guadalupe Fur Seal *(Arctocephalus townsendi)*

historical distribution and abundance are uncertain because commercial sealers and other observers failed to distinguish between this species and the northern fur seals. However, the species likely ranged from Islas Revillagigedo, Mexico (18° N) to Point Conception, California (34° N) and possibly as far north as the Farallon Islands, California (37° N). At the present time, this species ranges from Cedros Island, Mexico to the northern Channel Islands. Remains have been found in Indian trash middens through out the southern California bight and individual seals frequent Channel Island sea lion colonies (Stewart *et al.* 1987). This species was once thought to be extinct, however Gallo(1994)estimated a total of about 7,408 animals in 1993, and a growth rate of about 13.7% per year (Carretta *et al.* 2001). Guadalupe fur seals are protected under Mexican law (Guadalupe Island is a marine sanctuary), the U.S. MMPA (depleted and strategic), U.S. ESA (threatened), the California Fish and Game Code (fully protected), and the California Fish and Game Commission (threatened).



Counts of Guadalupe fur seals have increased dramatically (from Carretta, 2001 #25)

There have been no U.S. reports of fishing-related mortalities or injuries for Guadalupe fur seals.

In 1892, only 7 of these seals could be found; they were presumed extinct until 1926, when a group of 60 animals was discovered on Isla de Guadalupe, Mexico (Hubbs and Wick 1951). Although the primary breeding colony is on Guadalupe Island, Mexico, a pup was born at San Miguel Island, California (Melin and DeLong 1999). Males defend territories during May through July and mate with the females approximately one week after the birth of single pups. Guadalupe fur seals are reported to feed on fish including hake, rockfish, and cephalopods (Fleischer 1987) and probably require about 10% of their own body weight in fish per day.

There have been no U.S. reports of mortalities or injuries for Guadalupe fur seals (Cameron and Forney 1999; Julian 1997; Julian and Beeson 1998), although there have been reports of stranded animals with net abrasions and imbedded fish hooks (Hanni *et al.* 1997).

A.3.2.5 Northern Fur Seal *(Callorhinus ursinus)*

range in the eastern north Pacific Ocean, from southern California to the Bering Sea. Two separate stocks of northern are recognized within U.S. waters: an Eastern Pacific stock and a San Miguel Island stock. Nearly hunted to extinction for its fur, the San Miguel Island stock is estimated at 4,336 seals (Carretta *et al.* 2001) and the Eastern Pacific stock at 941,756 seals (Angliss and Lodge 2002). The San Miguel Island stock is not endangered or threatened under the ESA nor depleted under the MMPA. This stock is also not listed as a strategic under the MMPA and total human-caused mortality (0 seals) is less than the 100 fur seals allowed under the Potential Biological Removal formula (Carretta *et al.* 2001). "The Eastern Pacific stock is classified as a strategic because it is designated as depleted under the MMPA" (Angliss and Lodge 2002).

Prior to harvesting, Northen fur seal populations were mainly located on the Pribilof Islands of Alaska, and were estimated at two million animals. Northern fur seals were harvested commercially from the 1700s to 1984. San Miguel Island is the only place in California where northern fur seals breed and pup. Offshore, they dive to depths of 20 - 130 m, usually at night, to feed opportunistically on pollock, herring, lantern fish, cod, rockfish, squid, loons, and petrels (Fiscus 1978; Gentry 1981; Kajimura 1984; Kooyman *et al.* 1976).

Fur seals are a pelagic species spending many months at sea migrating throughout the eastern North Pacific Ocean including off Oregon and California (Roppel 1984). There were no reported mortalities of northern fur seals in any observed fishery along the west coast of the continental U.S. during the period 1994-1998 (Carretta *et al.* 2001), although there were incidental mortalities in trawl and gillnet fisheries off Alaska (Angliss and Lodge 2002).

Steller sea lions are listed as threatened under the ESA.

A.3.2.6 Northern or Steller sea lion *(Eumetopias jubatus)*

range along the North Pacific

Ocean from Japan to California (Loughlin *et al.* 1984). Two stocks are designated in U.S. waters with the eastern stock extending from Cape Suckling, Alaska to southern California (Loughlin 1997) with a total of 6,555 animals off Washington, Oregon and California. The eastern stock of Steller sea lion has a threatened listing under the ESA, depleted under the MMPA, and therefore is classified as a strategic stock (Angliss and Lodge 2002).

They do not make large migrations, but disperse after the breeding season (late May-early July), feeding on rockfish, sculpin, capelin, flatfish, squid, octopus, shrimp, crabs, and northern fur seals (Fiscus and Baines 1966).

Eastern stock Steller sea lions were observed taken incidentally in WA/OR/CA groundfish trawls and marine set gillnet fisheries (Angliss and Lodge 2002). Total estimated mortalities of this stock (44) is less than the 1,396 Steller sea lions allowed under the Potential Biological Removal formula (Angliss and Lodge 2002).

Harvest of sea otters during the 1700s and 1800s reduced the species to near extinction throughout its range.

A.3.2.7 Southern Sea Otter *(Enhydra lutris nereis*) range along the mainland coast from Half Moon Bay, San Mateo County south to Gaviota, Santa Barbara County; an experimental population currently exists at San Nicolas Island, Ventura County (VanBlaricom and Ames 2001). Prior to the harvest that drove the population to near extinction, sea otters ranged from Oregon to Punta Abreojos, Baja California (Wilson *et al.* 1991). The 2002 spring survey of 2,139 California sea otters reflects an overall decrease of 1.0 percent from the 2001 spring survey of 2,161 individuals, according to scientists at the U.S. Geological Survey. Observers recorded 1,846 independents in 2002 (adults and subadults), down 0.9 percent from the 2001 count of 1,863 independents; 293 pups were counted in 2002, down by 1.7 percent from the 2001 count of 298 pups (USGS 2002). The U.S. Fish and Wildlife Service declared the southern sea otter a threatened species in 1977 under the ESA and therefore the stock is also designated as depleted under the MMPA (VanBlaricom and Ames 2001).

The California population of southern sea otters is listed as threatened.

Harvest for their fur reduced the sea otter population to very few animals and presumed extinction until California Department of Fish and Game biologists and wardens discovered a remnant group near Point Sur. In 1914, the total California population was estimated to be about 50 animals (CDFG 1976). Sea otters eat large-bodied bottom dwelling invertebrates such as: sea urchins, crabs, clams, mussels, abalone, other shellfish, as well as, market squid. Otters can dive up to 320 feet to forage (VanBlaricom and Ames 2001).

During the 1970s and 1980s considerable numbers of sea otters were observed caught in gill and trammel entangling nets in central California. This was projected as a significant source of mortality for the stock until gill nets were prohibited within their feeding range. During 1982 to 1984 an average of 80 sea otters were estimated to drown in gill and trammel nets (Wendell *et al.* 1986). More recent mortality data (Pattison *et al.* 1997) suggest similar patterns during a period of increasing trap and pot fishing for groundfish and crabs (Estes *et al.* In Press). This elevated mortality appears to be the main reason for both sluggish population growth and periods of decline in the California sea otter population (Estes *et al.* In Press).

Sea otters were reintroduced off Washington in 1969-1970.

A.3.2.8 Sea Otter *(Enhydra lutris kenyoni*, Washington stock) range from Pillar Point south to Destruction Island. In an effort to return the extirpated sea otters to Washington state waters, otters were transplanted from Amchitka Island, Alaska in 1969 and 1970; 59 otters were introduced (Jameson *et al.* 1982). The experiment worked, sea otter numbers increased, and they are re-occupying former range (Richardson and Allen 2000). The highest count for the 2001 survey was 555 sea otters, an increase of 10% from 2000 (USGS 2002). The rate of increase for this population since 1989 is about 8.8%. The Washington sea otter has no formal Federal listing under ESA or MMPA but is designated as endangered by the State of Washington.

The Washington sea otter stock ranges from Neah Bay south to Destruction Island.

Sea otters eat bottom dwelling invertebrates such as: sea urchins, crabs, sea cucumbers, clams, mussels, abalone, other shellfish, as well as, market squid. Otters can dive up to 320 feet to forage (VanBlaricom and Ames 2001).

Gillnet and trammel net entanglements were a significant source of mortality for southern sea otters (Wendell *et al.* 1986) and some sea otters were taken incidentally in setnets off Washington (Kajimura 1990). Evidence from California and Alaska suggests that incidental take of sea otter in crab pots and tribal set-net fisheries may also occur. Sea otters are also quite vulnerable to oil spills due to oiled fur interfering with thermoregulation, ingested oil disintegrating the intestinal track, and inhaled fumes eroding the lungs (Richardson and Allen 2000).

Harbor porpoise are not listed under the ESA or MMPA.

A.3.2.9 Harbor Porpoise *(Phocoena phocoena*) are small and inconspicuous. They range in nearshore waters from Point Conception, California into Alaska and do not make large scale migrations (Gaskin 1984). Harbor porpoise in California are split into two separate stocks based on fisheries interactions: the central California stock, Point Conception to the Russian River, and the northern California stock in the remainder of northen California (Barlow and Hanan 1995). Oregon and Washington harbor porpoise are combined into a coastal stock and there is designated an inland Washington stock for inland waterways. The most recent abundance estimates, based on aerial surveys are: central California 7,579; northern California 15,198; Oregon/ Washington coastal 44, 644; and inland Washington 3,509 harbor porpoise. There are no clear trends in abundance for these stocks (Carretta *et al.* 2001). Harbor porpoise are not listed as threatened or endangered under the ESA nor as depleted under the MMPA. "The average annual mortality for 1996-99 (80 harbor porpoise) is greater than the calculated PBR (56) for central California harbor porpoise; therefore, the central California harbor porpoise population is strategic under the MMPA" (Carretta *et al.* 2001).

Although usually found in nearshore waters, "distinct seasonal changes in abundance along the west coast have been noted, and attributed to possible shifts in distribution to deeper offshore waters during late winter" (Barlow 1988; Carretta *et al.* 2001; Dohl *et al.* 1983). The harbor porpoise diet is comprised mainly of cephalopods and fishes and they prefer schooling non-spiny fishes, such as herrings, mackerels, and sardines (Reeves *et al.* 2002).

Harbor porpoise are very susceptible to incidental capture and mortalities in setnet fisheries (Julian and Beeson 1998). Off Oregon and Washington, fishery mortalities of harbor porpoise have been recorded in the northern Washington marine set and drift gillnet fisheries (Carretta *et al.* 2001).

A.3.2.10 Dall's Porpoise *(Phocoenoides dalli)*

are common in shelf, slope and offshore waters in the north eastern Pacific Ocean down to southern California (Morejohn 1979). As a deep water oceanic porpoise, they are often sighted nearshore over deep-water canyons. These porpoise are abundant and widely distributed with at least 50,000 off California, Oregon, and Washington; however because of their behavior of approaching vessels at sea, it may be difficult to obtain an unbiased estimate of abundance (Reeves *et al.* 2002). They are not endangered or threatened under the ESA nor depleted under the MMPA. This stock is also not listed as strategic under the MMPA and total human-caused mortality (12) is less than the

Dall's porpoises have not been listed under the ESA or MMPA.

Low levels of mortality for Dall's porpoise have also been documented in the California/Oregon/ Washington domestic groundfish trawl fisheries.

737 porpoise allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Dall's porpoise calf between spring and fall after a 10-11 month gestation period (Reeves *et al.* 2002). Carretta, *et al*. (2001)observe "that north-south movement between California, Oregon and Washington occurs as oceanographic conditions change, both on seasonal and inter-annual time scales." Dall's porpoise feed on squid, crustaceans, and many kinds of fish including jack mackerel (Leatherwood *et al.* 1982; Scheffer 1953).

There is a harpoon fishery for Dall's porpoise in Japan where large numbers are killed (Reeves *et al.* 2002). Observers document that Dall's porpoise have been caught in the California, Oregon and Washington domestic groundfish trawl fisheries (Perez and Loughlin 1991) but the estimated annual take is less than two porpoise per year.

A.3.2.11 Pacific White-sided Dolphin

(Lagenorhynchus obliquidens) are abundant, gregarious and found in the cold temperate waters of the North Pacific Ocean. Along the west coast of north America they are rarely observed south of Baja California, Mexico. Aerial surveys have exceeded 100,000 white-sided dolphins over the California continental shelf and slope waters (Reeves *et al.* 2002). These dolphins are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (7) is less than the 157 dolphins allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

> Low levels of white-sided dolphin mortality have been documented in the Pacific whiting fishery.

Little is know of their reproductive biology although a 29 year old pregnant female is reported indicating a relatively long reproductive span (Reeves *et al.* 2002). White-sided dolphins inhabit California waters during winter months moving northward into Oregon and Washington during spring and summer (Green *et al.* 1992). Shifts in abundance likely represent changes in prey abundance or migration of prey species. They are opportunistic feeders and often work collectively to concentrate and feed small schooling fish including anchovies, hakes, herrings, sardines, and octopus.

Observers have documented mortalities in the California, Oregon, and Washington groundfish trawl fisheries for whiting (Perez and Loughlin 1991). The total estimated kill of white-sided dolphins in these fisheries averages less than one dolphin per year (Carretta *et al.* 2001).

Risso's dolphins have not been listed under ESA or MMPA.

A.3.2.12 Risso's Dolphin (*Grampus griseus*) have world-wide distribution in warm-temperate waters of the upper continental slope in waters depths averaging 1,000 feet. They commonly move into shallow areas in pursuit of squid (Reeves *et al.* 2002). Reeves *et al*.(2002) also report up to 30,000 Risso's dolphins off the U.S. west coast. They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (6) is less than the 105 dolphins allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Sighting records of Risso's dolphins appear to have increased during the last two decades in some areas off the U.S. West coast.

The reproductive biology of this species is not well known. Risso's dolphins feed at night on fish, octopus and squid, but they concentrate on squid. They are usually observed in groups of 10-40 animals and may form loose aggregations of 100-200 animals (Reeves *et al.* 2002). It has been speculated that changes in ecological conditions and an El Niño event off southern California may have resulted in this species filling a niche previously occupied by pilot whales (Reeves *et al.* 2002).

There have been no recent Risso's dolphin moralities in west coast groundfish fisheries (Carretta *et al.* 2001), although Reeves *et al*.(2002) report that Risso's are a bycatch in some longline and trawl fisheries.

Short-beaked common dolphins have not been listed under the ESA or MMPA.

A.3.2.13 Short-beaked Common Dolphin *(Delphinus delphis)* commonly inhabit tropical and warm temperate oceans. Their distribution along the U.S. west coast extends from southern California to Chile and westward to 135° West longitude (Reeves *et al.* 2002). "The 1991-96 weighted average abundance estimate for California, Oregon and Washington waters based on the three ship surveys is 373,573 short-beaked common dolphins"(Barlow 1997; Carretta *et al.* 2001). They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (79) is less than the 3,188 dolphins allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Mortalities of common dolphins may occur in set gillnets in California and in some trawl fisheries.

Reproductive activity is non-seasonal in tropical waters with peaked calving in spring and summer in more temperate waters (Reeves *et al.* 2002). Short-beaked common dolphins feed nearshore on squid, octopus and schooling fish like anchovies, hake, lantern fish, deep-sea smelt or herring. These dolphins are often seen in very large schools of hundreds or thousands and are active bow riders.

Common dolphin mortality has been estimated for set gillnets in California (Julian and Beeson 1998); however, the two species (short-beaked and long-beaked) were not reported separately. Reeves *et al*.(2002) relate that short-beaked common dolphins are also a bycatch in some trawl fisheries.

> Long-beaked common dolphins have not been listed under the ESA or MMPA.

A.3.2.14 Long-beaked Common Dolphin *(Delphinus capensis)*

(Delphinus capensis) were recognized as a distinct species in 1994 (Heyning and Perrin 1994; Rosel *et al.* 1995). Their distribution overlaps with the short-beaked common dolphin, although they are more typically observed in nearshore waters. "The 1991-96 weighted average abundance estimate for California, Oregon and Washington waters based on the three ship surveys is 32,239 long-beaked common dolphins" (Barlow 1997; Carretta *et al.* 2001). They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (14) is less than the 250 dolphins allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

> Mortalities of common dolphins may occur in set gillnets in California and in some trawl fisheries.

Reproductive activity is similar to short-beaked: non-seasonal in tropical waters with peaked calving in spring and summer in more temperate waters (Reeves *et al.* 2002). Long-beaked common dolphins feed nearshore on squid, octopus and schooling fish like anchovies or herring. They are also active bow riders and break the water surface frequently when swimming in groups averaging 200 animals..

Common dolphin mortality has been estimated for set gillnets in California (Julian and Beeson 1998); however, the two species (short-beaked and long-beaked) were not reported separately. Reeves *et al*.(2002) relate that long-beaked common dolphins are also a bycatch in some trawl fisheries.

> Short-finned pilot whales are not endangered or threatened under the ESA nor depleted under the MMPA.

A.3.2.15 Short-finned Pilot Whale *(Globicephala macrorhynchus)*

favor a tropical and warm temperate distribution and are considered abundant (Reeves *et al.* 2002). They were common to Southern California, especially the isthmus of Santa Catalina Island during the winter (Dohl *et al.* 1980). However, following the 1982-83 El Niño they have been rarely observed (Barlow 1997). "The 1991-96 weighted average abundance estimate for California, Oregon and Washington waters based on three ship surveys is 970 short-finned pilot whales" (Barlow 1997; Carretta *et al.* 2001). They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (3) is less than the 6 short-finned pilot whales allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

They form social groups of 15- 50 individuals often traveling in long lines two to three animals wide. A typical sex ratio is one mature male to eight mature females; mating occurs in August through January with a 15 month gestation period (Reeves *et al.* 2002).

Short-finned pilot whales feed somewhat exclusively on market squid, *Loligo opalescens,* and were believed by fishermen to significantly compete with squid purse seine operations off Southern California. There were many records and observations of short-finned pilot whale shootings by fishermen (Heyning *et al.* 1994; Miller *et al.* 1983). Although the squid fishery has become the largest fishery in California since 1992 (Vojkovich 1998) coinciding with reduced short-finned pilot whales numbers, there have been no recent reports of mortalities in this fishery (Carretta *et al.* 2001).

Gray whales are no longer listed under the ESA or MMPA.

A.3.2.16 Gray Whale *(Eschrichtius robustus)*

is represented as the Eastern Pacific stock along the west coast of North America. Currently, the population is estimated at about 26,000 whales (Reeves *et al.* 2002) with rates of increase just above two per cent (Angliss and Lodge 2002). They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (48) is less than the 432 gray whales allowed under the Potential Biological Removal formula (Angliss and Lodge 2002).

Gray whales breed as they migrate through warmer waters; gestation lasts 12-13 months with females calving every 2-3 years (Reeves *et al.* 2002). At 5,000 miles, their migration from summer feeding grounds in the waters of Alaska to calving areas in bays and estuaries of Baja California, Mexico is one of the longest for any mammal. The Eastern North Pacific stock feeds by filtering from the bottom sediments small, bottom-dwelling amphipods, crustaceans, and polychaete worms off Alaska during summer months (Rice and Wolman 1971).

The Eastern Pacific gray whale stock was removed from the ESA List of Endangered and Threatened Wildlife in 1994. They have been an incidental catch in set net fisheries, but there have been no recent takes in groundfish fisheries (Angliss and Lodge 2002).

Minke whales are not listed under the ESA or MMPA.

A.3.2.17 Minke Whale *(Balaenoptera acutorostrata*) are one of the most widely distributed of baleen whales, ranging from South America to Alaska. For management, NMFS recognizes a California , Oregon, and Washington stock within the EEZ. "The number of minke whales is estimated as 631 (CV = 0.45) based on ship surveys in 1991, 1993, and 1996 off California and in 1996 off Oregon and Washington" (Barlow 1997; Carretta *et al.* 2001). They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (0) is less than the 4 minke whales allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Little is know of their reproductive biology, presumably they calve in winter in tropical waters after about a ten-month gestation (Reeves *et al.* 2002). They are the smallest of the rorqual whales and only the pygmy right whale is smaller. Some migrate as far north as the ice edge in summer. The diet of Minke whales consists of plankton, krill, small fish including schools of sardines, anchovies and herring.

They have occasionally been caught in coastal gillnets off California (Hanan *et al.* 1993), in salmon drift gillnet in Puget Sound, Washington, and in drift gillnets off California and Oregon (Carretta *et al.* 2001). There have been no recent takes in groundfish fisheries off California , Oregon, or Washington (Carretta *et al.* 2001).

A.3.2.18 Sperm Whale *(Physeter macrocephalus*) occur throughout the oceans and seas of the world near canyons and the continental slope. They are observed along the coasts of Oregon, and Washington (Carretta *et al.* 2001; Dohl *et al.* 1983). "Recently, a combined visual and acoustic line-transect survey conducted in the eastern temperate North Pacific in spring 1997 resulted in estimates of 24,000 (CV=0.46) sperm whales based on visual sightings, and 39,200 (CV=0.60) based acoustic detections and visual group size estimates" (Carretta *et al.* 2001). Sperm whales are ESA listed as endangered, therefore this stock is automatically considered as depleted and strategic under the MMPA. Annual human-caused mortality (1.7 whales) is less than the 2.1 sperm whales allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Sperm whales are listed as endangered under the ESA.

Mating centers on spring, calving interval is a minimum of four to six years, and a gestation period of 18 months results in extremely low population growth rates (Reeves *et al.* 2002). All age classes and both sexes move throughout tropical waters while males range farther and farther from the equator. Sperm whales feed near the ocean bottom, diving as deep as one mile to eat large squid (including giant squid), octopuses, rays, sharks, and fish (Reeves *et al.* 2002).

There are no recent observations of sperm whale incidental catches in west coast groundfish fisheries.

Humpback whales are listed as endangered under the ESA.

A.3.2.19 Humpback Whale *(Megaptera novaeangliae)* have a world wide distribution and along Washington, Oregon, and California. NMFS recognizes the eastern North Pacific stock which is observed frequently along coastal areas. "The North Pacific total now almost certainly exceeds 6,000 humpback whales" (Calambokidis *et al.* 1997; Carretta *et al.* 2001). Humpback whales are ESA listed as endangered, therefore this stock is automatically considered as depleted and strategic under the MMPA. Annual human-caused mortality (>0.2 whales) is less than the 1.9 whales allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

One of the most famous breeding behaviors of all the marine mammals is the songs of male humpback whales. They breed during winter with a two to three year gestation and calving in the tropics (Reeves *et al.* 2002). Their migrations can be as long as 5,000 miles (one way) from the higher latitude feeding grounds to the tropics for breeding and calving. They feed on krill and pelagic schooling fish.

There are no recent observations of humpback whale incidental catches in west coast groundfish fisheries.

Blue whales are listed as endangered under the ESA.

A.3.2.20 Blue Whale *(Balaenoptera musculus)* is the largest animal ever to exist on this planet. They inhabit most oceans and seas of the world. The eastern north Pacific stock summers off California to feed and migrates as far south as the Costa Rica Dome. "The best estimate of blue whale abundance is the average of the line transect and mark-recapture estimates, weighted by their variances, or 1,940" (Carretta *et al.* 2001) whales in this stock. Blue whales are ESA listed as endangered, therefore this stock is automatically considered as depleted and strategic under the MMPA. Annual human-caused mortality (0 whales) is less than the 1.7 whales allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Blue whale mating is unknown but calving takes place in winter after an eleven-month gestation. Calving interval is about two to three years. They feed on krill and possibly pelagic crabs (Reeves *et al.* 2002).

There are no recent observations of blue whale incidental catches in west coast groundfish fisheries.

Fin whales are listed as endangered under the ESA.

A.3.2.21 Fin Whale *(Balaenoptera physalus)* occur in the major oceans of the world and tend to be more prominent in temperate and polar waters. The California, Oregon, and Washington Stock was estimated at 1,851 fin whales based on ship surveys in summer/autumn of 1993 and 1996 (Barlow and Taylor 2001). Fin whales are ESA listed as endangered, therefore this stock is automatically considered as depleted and strategic under the MMPA. Annual human-caused mortality (1.5 whales) is less than the 3.2 whales allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Little is known of their reproductive behavior, breeding, or calving areas. Females calving cycle is two to three years with an eleven or twelve-month gestation period following winter breeding. They probably don't make large scale migrations and feed on krill and small pelagic fish such as herring (Reeves *et al.* 2002).

There are no recent observations of fin whale incidental catches in west coast groundfish fisheries.

A.3.2.22 Killer Whale *(Orcinus orca*) inhabit most oceans and seas without respect to water temperature or depth but are more prevalent in the higher colder latitudes (Reeves *et al.* 2002). Off Washington, Oregon, and California three stocks are recognized based on behavior, photographic identification, and genetics differences. Those stocks are: Eastern North Pacific Offshore Stock, Eastern North Pacific Transient Stock, and Eastern North Pacific Southern Transient Stock (Carretta *et al.* 2001). "Based on summer/fall shipboard line-transect surveys in 1991, 1993 and 1996 (Barlow 1997), the total number of killer whales within 300 nm of the coasts of California, Oregon and Washington was recently estimated to be 819 animals. There is currently no way to reliably distinguish the different stocks of killer whales from sightings at sea..." (Carretta *et al.* 2001). Killer whales are not listed as endangered or threatened under the ESA nor depleted under the MMPA. None of the three stocks is listed as strategic under the MMPA and total human-caused mortality is less than that allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

However, a coalition of environmental groups recently filed a petition to protect the southern population of resident killer whales under the ESA. (This population lives in both U.S. and Canadian waters.) In June 2002, NMFS ruled this population of killer whales does not merit protection under the ESA. NMFS said the stock met two criteria – that it was a separate group and that it was in danger of extinction. But the third criteria – that of being a "significant" group – was not met because the southern population is considered part of the general killer whale population in the North Pacific, which is considered healthy. NMFS favors "depleted" status, with some protections under the MMPA. In December 2002, environmental groups filed a lawsuit on agency's ruling.

Killer whales give birth in all months with the peak in calving during winter. Movement seems to track prey items; along the U.S. west coast, movements from Southeast Alaska to central California are documented (Goley and Straley 1994). Resident killer whales feed on fish including salmon, and other large bodied fish; transient killer whales feed on other marine mammals including sea otters, seals, porpoise, and baleen whales (Baird 2000); and offshore killer whales probably feed on squid and fish.

The only incidental take recorded by groundfish fishery observers was in the Bering Sea/Aleutian Islands (BSAI) groundfish trawl (Carretta *et al.* 2001). There are also reports of interactions between killer whales and longline vessels (Perez and Loughlin 1991). (Longline fishers in the Aleutian Islands reported several cases where orcas removed sablefish from longlines as the gear was retrieved.) There are no other reports of killer whale takes in west coast groundfish fisheries (Carretta *et al.* 2001).

Sei whales in the eastern North Pacific are listed as endangered under the ESA.

A.3.2.23 Sei Whale *(Balaenoptera borealis)* occur in subtropical and tropical waters into the higher latitudes and occupy oceanic, as well as, coastal waters. "Seis are known worldwide for their unpredictable occurrences, with a sudden influx into an area followed by disappearance and subsequent absence for years or even decades" (Reeves *et al.* 2002). They are rare off Washington, Oregon, and California and there are no estimates of abundance or population trends for this stock. Sei whales in the eastern North Pacific (east of longitude 180°) are considered a separate stock and listed as endangered under the ESA. Consequently, the eastern North Pacific stock is automatically considered as a depleted and strategic stock under the MMPA.(Carretta *et al.* 2001).

Sei whales usually travel alone or in small groups and little is known of their behavior. They breed and calve in winter after a 11-12 month gestation. They forage on small fish, squid, krill, and copepods.

There are no observations of sei whale incidental catches in west coast fisheries, therefore no estimated groundfish fishery related losses.

A.3.2.24 Common Bottlenose Dolphin *(Tursiops truncatus)* are distributed worldwide in tropical and warm-temperate waters. For the MMPA stock assessment reports, bottlenose dolphins within the Pacific U.S. EEZ are divided into three stocks: 1) California coastal stock, 2) California, Oregon and Washington offshore stock, and 3) Hawaiian stock.

Coastal bottlenose dolphins are not listed under the ESA or MMPA.

<u>California coastal bottlenose dolphins</u> are found within about one kilometer of shore, primarily from Point Conception south into Mexican waters. El Niño events appear to influence the distribution of animals along the California coast; since the 1982-83 El Niño they have been consistently sighted in central California as far north as San Francisco. Studies have documented north-south movements of coastal bottlenose dolphins (Hansen 1990; Defray *et al*. 1999) . Coastal bottlenose dolphins spend an unknown amount of time in Mexican waters, where they are subject to mortality in Mexican fisheries. The best estimate of the average number of coastal bottlenose dolphins in U.S. waters is 169, based on two surveys conducted in 1994 and 1999 that covered virtually the entire U.S. range of this species. The minimum population size estimate for U.S. waters is 154 coastal bottlenose dolphins. The PBR level for this stock is 1.5 coastal bottlenose dolphins per year (the minimum population size times one half the default maximum net growth rate for cetaceans (half of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997)).

Due to its exclusive use of coastal habitats, this bottlenose dolphin population is susceptible to fishery-related mortality in coastal set net fisheries. However, from 1991-94 observers saw no bottlenose dolphins taken in this fishery, and in 1994 the state of California banned coastal set gillnet fishing within 3 nm of the southern California coast. In central California, set gillnets have been restricted to waters deeper than 30 fathoms (56m) since

1991 in all areas except between Point Sal and Point Arguello. These closures greatly reduced the potential for mortality of coastal bottlenose dolphins in the California set gillnet fishery. Coastal gillnet fisheries are still conducted in Mexico and probably take animals from this population, but no details are available.

Coastal bottlenose dolphins are not listed as threatened or endangered under the ESA nor as depleted under the MMPA. Because no recent fishery takes have been documented, coastal bottlenose dolphins are not classified as a strategic stock under the MMPA, and the total fishery mortality and serious injury for this stock can be considered to be insignificant and approaching zero.

Offshore bottlenose dolphins are not listed under the ESA or MMPA.

California/Oregon/Washington Offshore Stock: On surveys conducted off California, offshore bottlenose dolphins have been found at distances greater than a few kilometers from the mainland and throughout the Southern California Bight. They have also been documented in offshore waters as far north as about 41°N latitude, and they may range into Oregon and Washington waters during warm water periods. Sighting records off California and Baja California (Lee 1993; Mangels and Gerrodette 1994) suggest that offshore bottlenose dolphins have a continuous distribution in these two regions. The most comprehensive multi-year average abundance for California, Oregon and Washington waters, based on the 1991-96 ship surveys, is 956 offshore bottlenose dolphins (Barlow 1997). The minimum population size estimate of offshore bottlenose dolphins is 850. The PBR level for this stock is 8.5 offshore bottlenose dolphins per year.

In 1997, a Take Reduction Plan for the California drift gillnet (non-groundfish) fishery was implemented, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders. Overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 1999). Based on 1997-98 data, the estimate of offshore bottlenose dolphins taken annually in the U.S. fishery is zero. Drift gillnet fisheries for swordfish and sharks are also conducted along the entire Pacific coast of Baja California and may take animals from the same population.

Offshore bottlenose dolphins are not listed as threatened or endangered under the ESA nor as depleted under the MMPA. Because no recent fishery takes have been documented, offshore bottlenose dolphins are not classified as a strategic stock under the MMPA, and the total fishery mortality and serious injury for this stock can be considered to be insignificant and approaching zero.

Striped dolphins are not listed under the ESA or MMPA.

A.3.2.25 Striped Dolphin *(Stenella coeruleoalba)* are distributed world-wide in tropical and warm-temperate pelagic waters. For the MMPA stock assessment reports, striped dolphins within the Pacific U.S. EEZ are divided into two discrete, noncontiguous areas: 1) waters off California, Oregon and Washington and 2) waters around Hawaii.

California/Oregon/Washington Stock: On recent shipboard surveys extending about 300 nmi offshore of California, striped dolphins were sighted within about 100-300 nmi from the coast. No sightings have been reported for Oregon and Washington waters, but striped dolphins have stranded in both states (Oregon Department of Fish and Wildlife, unpublished data; Washington Department of Fish and Wildlife, unpublished data). Striped dolphins are also commonly found in the central North Pacific, but sampling between this region and California has been insufficient to determine whether the distribution is continuous. Based on sighting records off California and Mexico, striped dolphins appear to have a continuous distribution in offshore waters of these two regions (Perrin *et al*. 1985; Mangels and Gerrodette 1994).

The abundance estimate for California, Oregon and Washington waters is 20,235 striped dolphins (Barlow 1997). The minimum population size estimate is 17,995. The PBR level for this stock is 180 striped dolphins per year, calculated as the minimum population size (17,995) times one half the default maximum net growth rate for cetaceans (half of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997).

Drift gillnet fisheries for swordfish and sharks conducted along the Pacific coast of Baja California may take animals from this population.

Striped dolphins are not listed as threatened or endangered under the ESA nor as depleted under the MMPA. Including U.S. driftnet information only for years after implementation of the Take Reduction Plan (1997-98), the average annual human-caused mortality in 1994-98 is zero. Because recent mortality is zero, striped dolphins are not classified as a strategic stock under the MMPA, and the total fishery mortality and serious injury for this stock can be considered to be insignificant and approaching zero.

A.3.3 Sea Turtles

Numerous human-induced factors have adversely affected sea turtle populations in the North Pacific and resulted in their threatened or endangered status (Eckert 1993; Wetherall *et al.* 1993). Documented incidental capture and mortality by purse seines, gillnets, trawls, longline fisheries, and other types of fishing gear adversely affect sea turtles, however the relative effect of each of these sources of impact on sea turtles is difficult to assess (NMFS and USFWS 1998a; 1998b; 1998c; 1998d). Each of the sea turtle species that might interact with groundfish fisheries are listed. Little data are available estimating total annual mortalities except in the drift gillnet fishery which is not part of the groundfish FMP.

A.3.3.1 Loggerhead Sea Turtle (*Caretta caretta)*

are a widespread species inhabiting shallower continental areas in the subtropical and temperate waters (Eckert 1993; MMS 1992). Population estimates are about 300,000 loggerheads (NMFS and USFWS 1998c; Pitman 1990) and with peak abundance summer and fall off southern California (NMFS and USFWS 1998c). Throughout its range, the loggerhead turtle is listed as a threatened species under the ESA.

Juvenile and subadult loggerheads are omnivorous, foraging on pelagic crabs, molluscs, jellyfish, and vegetation captured at or near the surface. The maximum recorded diving depth for loggerhead is 233 meters (Eckert 1993).

The primary fishery threats to the loggerheads in the Pacific are longline and gillnet fisheries (NMFS and USFWS 1998c).

A.3.3.2 Green Sea Turtle *(Chelonia mydas)* are a

cosmopolitan, highly migratory species, nesting mainly in tropical and subtropical regions. Green turtles have declining throughout the Pacific Ocean, probably due to overexploitation and habitat loss (Eckert 1993) and are listed as threatened, except for breeding populations found in Florida and the Pacific coast of Mexico listed as endangered.

The green sea turtle was listed as endangered/ threatened on July 28, 1978.

The maximum recorded dive depth for an adult green turtle was 110 meters, while subadults routinely dive 20 meters for 9-23 minutes, with a maximum recorded dive of 66 minutes (Eckert

1993). Additionally, it is presumed that drift lines or surface current convergences are preferential zones due to increased densities of likely food items.

The primary green turtle nesting grounds in the eastern Pacific are located in Michoacán, Mexico, and the Galapagos Islands, Ecuador. More than 165,000 turtles were harvested from 1965 to 1977 in the Mexican Pacific. The nesting population at the two main nesting beaches in Michoacán decreased from 5,585 females in 1982 to 940 in 1984 (NMFS and USFWS 1998a).

A.3.3.3 Leatherback Sea Turtle *(Dermochelys coriacea)*

A.3.3.3 Leatherback Sea Turtle *(Dermochelys coriacea)* are distributed in most open ocean waters and range into higher latitudes than other sea turtles, as far north as Alaska (NMFS and USFWS 1998b), possibly associated with El Niño events. Leatherbacks were commonly sighted near Monterey Bay, mainly in August (Starbird *et al.* 1993). The leatherback turtle is listed as an endangered species under the ESA throughout its range.

> The leatherback is the largest living turtle.

Leatherbacks are the largest of the sea turtles possibly due to their ability to maintain warmer body temperature over longer time periods and distribution of prey: jellyfish, siphonophores, and tunicates (Eckert 1993). Leatherbacks are reported diving to depths exceeding 1000 meters (Lutz and Musick 1997).

Primary threats to leatherbacks in the Pacific are the killing of nesting females and eggs at the nesting beaches and the incidental take in coastal and high seas fisheries (NMFS and USFWS 1998b).

A.3.3.4 Olive Ridley Sea turtle *(Lepidochelys olivacea)*

are the most abundant sea turtle in the Pacific basin. However, although these turtles remain relatively widespread and abundant, most nest sites support only small or moderate-scale nesting, and most populations are known or thought to be depleted. The olive ridley populations on the Pacific coast of Mexico are listed as endangered; all other populations are listed as threatened.

> This population continues to be threatened by nearshore trawl fisheries.

This sea turtle species appears to forage throughout the eastern tropical Pacific Ocean, often in large groups, or flotillas. Occasionally they are found entangled in scraps of net or other floating debris. Despite its abundance, there are surprisingly few data relating to the feeding habits of the olive ridley. However, those reports that do exist suggest that the diet in the western Atlantic and eastern Pacific includes crabs, shrimp, rock lobsters, jellyfish, and tunicates. In some parts of the world, it has been reported that the principal food is algae. Although they are generally thought to be surface feeders, olive ridleys have been caught in trawls at depths of 80-110 meters (NMFS and USFWS 1998d).

A.3.4 Seabirds

Seabird species accounts are primarily taken from the online resource NatureServe, jointly established by the Nature Conservancy and the Natural Heritage Network in July 1999 to advance the application of biodiversity information to conservation, unless otherwise noted (NatureServe Explorer 2002).

The highly productive California Current System, an eastern boundary current that stretches from Baja Mexico to southern British Columbia, supports more than two million breeding seabirds and at least twice that number of migrant visitors. Over 100 species have been recorded within the EEZ including: albatross, shearwaters, petrels, storm-petrels, cormorants, pelicans, gulls, terns, and alcids (murres, murrelets, guillemots, auklets, and puffins). In addition to these "classic" seabird species, millions of other birds are seasonally abundant in this oceanic habitat including: waterfowl, waterbirds (loons and grebes), and shorebirds (phalaropes)(Tyler *et al.* 1993). Not surprisingly, there is considerable overlap of fishing areas and areas of high bird density in this highly productive upwelling system.

The species composition and abundance of birds varies spatially and temporally. The highest seabird biomass is found over the continental shelf and bird density is highest during the spring and fall when local breeding species and migrants predominate. Sooty shearwaters are the most numerous species during summer. During the winter, local breeding species and migrants from inland breeding areas, such as California gulls, predominate. In addition to local breeders and nonbreeding migrants, the rich waters of the California Current System also attract breeders from distant locations (Tyler *et al.*1993). Radio telemetry data from black-footed albatross breeding in the Hawaiian Islands document that breeding birds feeding chicks undertake long distance foraging trips to the waters off Washington, Oregon and California to feed before returning to Hawaii to feed their chicks (Fernandez *et al.* 2001).

The U.S. Fish and Wildlife Service (USFWS) is the primary federal agency responsible for seabird conservation and management. Under the Magnuson-Stevens Act, NMFS is required to ensure that fishery management actions comply with other laws designed to protect seabirds. NMFS is also required to consult with FWS if fishery management plan actions may affect seabird species that are listed as endangered or threatened.

The short-tailed albatross was listed as endangered under the ESA in July 2000.

A.3.4.1 Albatross range extensively throughout waters off the Pacific Coast. In particular, three albatross species, the short-tailed albatross (*Phoebastria albatrus*), the black-footed albatross (*Phoebastria nigripes*), and the Laysan albatross (*Phoebastria immutabilis*) occur in the waters off Washington, Oregon, and California.

Once considered the most common albatross ranging over the continental shelf, the short-tailed albatross was hunted to near extinction in the early 1900s and is now thought to be one of the rarest birds in the world.

Sought after for its feathers and eggs, the short-tailed albatross population was decimated by hunting in the early 1900s.

Short-tailed albatross range widely in the North Pacific, breeding occurs off Japan and sightings extend from the Aleutian Islands to southern California (West Coast Groundfish Observer Program, NMFS, unpublished data, 2002). There are two known short-tailed albatross breeding colonies, one on Torishima Island and one on Minami-kojima Island, in the waters off Japan. Historical records indicate that there were over 100,000 individuals at the Torishima Island colony at the turn of the century and during 1998 - 1999 just over 400 breeding adults were found at the colony. The population on Torishima Island is now growing at an annual rate of 7.8%. The current estimate of the short-tailed albatross world population is ~1700 individuals (Hasegawa 2002; START 2002).

The short-tailed albatross population is increasing, but still vulnerable because of low numbers and low reproductive potential.

The short-tailed albatross feeds at the water's surface on squid, crustaceans, and various fish species. They sometimes follow fishing vessels and feed on offal. Chicks are fed a mixture of stomach oil and partially digested food that is regurgitated; nestlings are often fed squid, flying fishes, and crustaceans. Threats to short-tailed albatross include volcanic eruptions on the primary nesting island, Torishima, incidental take in commercial fisheries, ingestion of plastic, and the potential threat of oil spills.

Much like the short-tailed albatross, the black-footed albatross ranges throughout the North Pacific. Breeding occurs on northwestern Hawaiian Islands and Torishima Island and the species disperses from the Bering Sea south along the Pacific Coast to California.

Black-footed albatross mortality due to interactions with US-based longline fisheries is estimated to be at least 3,000 individuals per year.

Black-footed albatross is the most numerous albatross species along the Pacific Coast and is present throughout the year (Briggs *et al.* 1987). The global black-footed albatross population is estimated at about 56,500 breeding pairs and thought to be decreasing (Naughton 2003). This species is classified as vulnerable by the IUCN (International Union for the Conservation of Nature and Natural Resources) based on a 19% population decrease during 1995 - 2000 and a projected future decline of more than 20% over the next 60 years owing to interactions with longline fisheries for tuna, billfish, and groundfish in the North Pacific (Birdlife International 2001).

Black-footed albatross fed on fish, sea urchins, amphipods, and squid; foraging is done at night and prey is caught at the ocean's surface. This species will also follow fishing vessels and feed on discard. Besides interactions with longline fisheries, other threats to black-footed albatross include nest loss due to waves, pollution, introduced predators, oiling, ingestion of plastic, and volcanic eruptions on Torishima (Birdlife International 2001).

The most abundant North Pacific albatross species is the Laysan albatross. The vast majority of the Laysan albatross population breeds on the northwestern Hawaiian Islands, fewer numbers breed on the Japanese Ogasawara Islands, and still fewer pairs breed on islands off Baja California, Mexico (Guadalupe Island, Alijos Rocks, and in the Revillagigedo Islands). When at sea, the Laysan albatross ranges from the Bering Sea, to California, to Japan.

An estimated 2,000 Laysan albatross were killed each year between 1996 - 1998 in longline fisheries around Hawaii.

The USFWS counts this species at Midway Atoll once every four years and counts or samples density at French Frigate Shoals and Laysan Island every year. These monitoring sites account for 93% of the world population of ~393,000 breeding pairs. At the three sites listed above breeding populations have declined at an average rate of 3.2% per year since 1992. This represents a 32% decline in annual breeding attempts over a 10-year period (Naughton 2003).

Similar to the other North Pacific albatross species, Laysan albatross feed on schooling fish and squid at the ocean's surface and the primary threat to their population is interactions with fisheries.

The California brown pelican was listed as endangered under the ESA in 1970.

Brown pelican nesting habitats are especially sensitive to human disturbance.

A.3.4.2 California brown pelican *(Pelecanus occidentalis californicus)* range along the Pacific Coast from British Columbia south to central America. Historically, breeding colonies were found at Point Lobos, California and from the Channel Islands south to Baja California, Mexico. They are found in coastal areas, on rocky shores and cliffs, in sloughs, and may also be found on breakwaters, jetties, pilings, and sandbars in harbors. While the California brown pelican still occurs throughout its original range, the breeding colonies in California, located in the Channel Islands National Park, West Anacapa Island, and the Santa Barbara Islands, are in decline (CDFG 2000).
In the 1970s, California brown pelicans were threatened with extinction by the widespread use of the pesticide DDT (dichlorodiphenyltrichloroethane). This chemical is transmitted via the food chain and becomes concentrated in top predators. DDT affects the pelican's ability to metabolize calcium, resulting in thin-shelled eggs that break during incubation. The use of DDT was banned in 1972 and the California brown pelican population subsequently began its recovery (CDFG 2000).

In the early 2000s, it was estimated that the brown pelican breeding population in California was about 9,000 adults (CDFG 2001). While the brown pelican population is thought stable, food availability is a cause for concern. Pacific mackerel, Pacific sardine, and the northern anchovy are important prey for brown pelicans, especially during the breeding season. However, commercial over-harvesting of these coastal pelagic species has reduced the quantity of prey that is available to pelicans (CDFG 2000).

The primary threats to California brown pelicans are human development in coastal regions, entanglement in abandon recreational fishing gear, and oil spills (CDFG 2000).

The California least tern was listed as endangered under the ESA in June 1970.

In 2002, the gull-billed tern, elegant tern, Caspian tern, and arctic tern were considered "birds of conservation concern" by the USFWS.

A.3.4.3 Terns - Nine species of terns occur along the Pacific coast, they are the arctic tern (*Sterna paradisaea*), common tern (*Sterna hirundo*), black tern (*Chlidonias niger*), California least tern (*Sterna antillarum browni*), Caspian tern (*Sterna caspia*), Forster's tern (*Sterna forsteri*), gull-billed tern (*Sterna nilotica*), royal tern (*Sterna maxima*), and elegant tern (*Sterna elegans*).

The populations of most tern species found along the Pacific Coast are stable, however, some tern species are listed under the ESA or are considered "birds of conservation concern" by the USFWS.

The range of the California least tern is limited to California and Baja California. During 1988 - 1989 in California, the population was estimated to be about 1,250 pairs. As with most species of terns, California least tern are found along seacoasts, beaches, bays, estuaries, lagoons, lakes, and rivers. Terns usually nest on open, flat beaches along lagoons or estuary margins. California least terns usually nest in the same area during successive years and tend to return to the natal site to nest.

Terns obtain their prey by diving from the air into shallow water and their diet is predominately small fishes (e.g., anchovy, surf-perch).

Primary threats to the California least tern population and possible threats to other tern populations, include human development of nesting habitat and predation of adults, eggs, and young by birds and introduced mammals.

A.3.4.4 Murrelets - Four species of murrelets occur along the Pacific coast, they are the marbled murrelet (*Brachyramphus marmoratus*), Craveri's murrelet (*Synthliboramphus craveri*), Xantus's murrelet (*Synthliboramphus hypoleucus*), and the ancient murrelet (*Synthliboramphus antiquus*).

> The marbled murrelet was listed as threatened under the ESA in October 1992 .

The marbled murrelet has an extensive range along the Pacific Coast, extending from Alaska to California and breeding occurs throughout their range. These birds are found in coastal areas, mainly in salt water, often in bays and sounds. They are also found up to 5 km offshore and are occasionally sighted on lakes and rivers within 20 km of the coast. Most populations are dependent upon large coniferous trees in old-growth forests as suitable nesting habitat.

> In the Pacific Northwest, approximately 90% - 95% of old-growth, marbled murrelet habitat has been removed by large-scale logging since the mid-1800s.

The marbled murrelet population has probably declined substantially throughout the region and it is estimated that 10,000 - 20,000 individuals remain(Carter *et al.* 1995).

The diet of marbled murrelets includes fishes (e.g., sandlance, capelin, herring), crustaceans, and mollusks. Birds may also feed exclusively on freshwater prey for several weeks. Marbled murrelets typically forage in waters up to 80 m in depth and 2 km from shore. Birds dive to capture prey; dives may extend down 30 m below the water's surface.

The continued harvest of old-growth and mature coastal coniferous forest threatens critical nesting habitat throughout the marbled murrelet range. Additional threats to this population are interactions with gillnet fisheries and oil spills.

The ancient murrelet ranges along the Pacific Coast from Alaska to California. The estimated global population is on the order of half a million breeding pairs, with just over half found on the Queen Charlotte Islands of British Columbia. This species nests in rocky offshore islands in crevices, under rocks, at the base of trees, and in burrows. Declines in the ancient murrelet population are often attributed to the introduction of predators onto offshore islands used for breeding. Rats, raccoons, and foxes have reduced what was once the world's the largest colony (Langara Island, British Columbia) from about 200,000 pairs in 1969 to 15,000 pairs in 1994. Ancient murrelets are also threatened by food availability, which is subject to pesticide pollution, and changes in marine currents controlling local productivity.

> In 2002, the Pacific Seabird Group submitted federal and state petitions to list the Xantus's murrelet as threatened under the ESA. Additionally, this species is considered a "bird of conservation concern" by the USFWS.

Xantus's and Craveri's murrelets have relatively restricted ranges, when compared to other Pacific Coast murrelets, and are primarily found in California. Both species breed on islands; the Craveri's breeds in the Gulf of California and along the western coast of Baja California while the Xantus's breeds on islands off central California and western Baja California.

> Both the Craveri's and Xantus's murrelets are classified as vulnerable by the IUCN.

The population of the Craveri's murrelets is estimated to be between 6,000 and 10,000 individuals. Xantus's murrelets persist in very low numbers and the breeding population is estimated to be between 2,000 and 5,000 individuals. Both species are threatened by introduced predations on breeding islands, specifically rats and feral cats, and oil spills, specifically spills from offshore platforms in Santa Barbara Channel and oil tanker traffic in Los Angeles harbor (Carter *et al.* 1995).

A.3.4.5 Northern fulmars *(Fulmarus glacialis)*

range along the Pacific Coast from Alaska to Oregon and they are primarily pelagic.

> Northern fulmars exhibit a strong fidelity to their mates and nest sites, with changes to either only occurring on the order of less than 1% per year.

The estimated total population of northern fulmars in the North Pacific is between 3 and 3.5 million individuals (Hatch 1993). This species primarily breeds in Alaska at colonies on sea cliffs and, less frequently, on low, flat rocky islands. Northern fulmars show strong mate and nest site fidelity (Shallenberger 1984). Nests are often raided by weasels and gulls.

Northern fulmars are surface feeders, they swim or float upon the ocean's surface while feeding on organisms found just below the surface. The diet of this species includes fishes, mollusks, crustaceans, and cephalopods. Northern fulmars have also been observed following fishing vessels, presumably to feed on offal.

Primary threats to northern fulmars are oil pollution, plastic debris, entanglement in fishing gear, and introduced predators and human disturbance on breeding islands (Hatch 1993).

A.3.4.6 Storm-petrels - Seven species of storm-petrels occur along the Pacific Coast, they include the black storm-petrel (*Oceanodroma melania*), fork-tailed storm-petrel (*Oceanodroma furcata*), ashy storm-petrel (*Oceanodroma homochroa*), least storm-petrel (*Oceanodroma microsoma*), Galapagos storm-petrel (*Oceanodroma tethys*), Wilson's storm-petrel (*Oceanites oceanicus*), and Leach's storm-petrel (*Oceanodroma leucorhoa*).

In 2002, the ashy storm-petrel was considered a "bird of conservation concern" by the USFWS.

Populations of storm-petrel species found along the Pacific Coast, along with the amount of information known about different populations, varies considerably. In the North Pacific, Leach's storm-petrel is the most abundant species (a conservative total population estimate is between 10 and 15 million individuals) followed by the fork-tailed storm-petrel (total population estimate is between 5 and 10 million individuals). Conversely, the populations of ashy storm-petrels (total population estimated at fewer than 10,000 individuals), black storm-petrels (population estimate ranges between 10, 000 and 100,000 individuals), and least storm-petrels (population estimate ranges between 10,000 and 50,000 individuals) may be at risk (Boersma and Groom 1993).

Storm-petrel chicks are fed a regurgitated fish oil, rather than the prey items themselves, enabling adults to make longer foraging trip.

Storm-petrels are pelagic, spending the majority of their lives at sea and returning to land only to breed. When at the breeding colonies, storm-petrels are nocturnal, an adaptation that reduces their susceptibility to diurnal predators (e.g., gulls)(Speich and Wahl 1989). Nests are often located in burrows, rocky crevices, or grassy slopes on small coastal islands. Some species of storm-petrels nest in the same burrow in successive years (Spendelow and Patton 1988).

Storm-petrels have a well developed olfactory system and use their keen sense of smell to locate prey and burrow and nest sites.

Storm-petrels feed at the water's surface, rarely diving beneath the surface in pursuit of food. They catch prey by "dipping and pattering," that is they hover on outstreched wings, paddle the water with their webbed feet, and dip their bills into the water (Ainley 1984a). The diet of storm-petrels includes such things as plankton, small fishes, crustaceans, and small squid.

Primary threats to storm-petrels include introduced predators on breeding islands, pesticides and contaminants, pollution, and oil spills.

A.3.4.7 Shearwaters - Eight species of shearwaters range along the Pacific Coast, they include Townsend's shearwater (*Puffinus auricularis*), black-vented shearwater (*Puffinus opisthomelas*), wedge-tailed shearwaters (*Puffinus pacificus*), sooty shearwater (*Puffinus griseus*), short-tailed shearwater (*Puffinus tenuirostris*), pink-footed shearwater (*Puffinus creatopus*), flesh-footed shearwater (*Puffinus carneipes*), and Buller's shearwater (*Puffinus bulleri*).

> Townsend's shearwater is classified as critically endangered by the IUCN.

The populations of most shearwater species found along the Pacific Coast are stable, however, some shearwater populations are considered at risk by the IUCN. Many species of shearwaters move between hemispheres to take advantage of the best feeding conditions (Shallenberger 1984).

> The black-vented, pink-footed, and Buller's shearwaters are classified as vulnerable by the IUCN.

The black-vented shearwater breeds on a handful of small islands off the coast of Baja California; the wedge-tailed and Townsend's shearwater breed on islands off the coasts of Mexico and Hawaii. The five remaining species of shearwater breed in the southern hemisphere on islands off the coast of Chile, Australia, and New Zealand. Much like storm-petrels, shearwaters nest in burrows and rocky crevices and their activities at breeding colonies are largely nocturnal.

When foraging, shearwaters may feed at the water's surface, plunge from just above the water's surface, or dive to depths of 50 m. Their diet includes small fishes (e.g., northern anchovies, Pacific sardines), squid, plankton, and crustaceans.

> By moving between hemispheres, many species of shearwaters live in perpetual "summer" taking advantage of the best feeding conditions.

Shearwater populations are primarily threatened by predation by feral mammals (e.g., cats, pigs, mongoose, rats) and loss of habitat on breeding islands. Other threats associated with urbanization include collisions with power lines and attraction to lights.

A.3.4.8 Cormorants - Three species of cormorants occur along the Pacific Coast: Brandt's cormorant (*Phalacrocorax penicillatus*), double-crested cormorant (*Phalacrocorax auritus*), and pelagic cormorant (*Phalacrocorax pelagius*).

> The populations of the Brandt's, the double-crested, and the pelagic cormorant are either stable or increasing along the Pacific Coast.

Brandt's cormorants are by far the most abundant cormorant species nesting along the coast of Oregon and California. In Washington, however, they have never been numerous or widespread (Spendelow and Patton 1988). Brant's cormorants are typically found in inshore, coastal areas, especially in areas having kelp beds, brackish bays, sheltered inlets, and quiet bays. Large numbers of birds breed in California and Oregon with fewer numbers breeding in Washington. Brandt's cormorant usually nests on offshore islands or, less frequently, on inaccessible mainland bluffs and wide cliff ledges near the water (Speich and Wahl 1989). Resident throughout the year near nesting areas, birds range more widely during non-breeding periods.

Because cormorant feathers are not water-proof, birds are usually found within a few hours of their roosting or breeding sites.

Double-crested cormorants are widespread and breeding populations along the Pacific Coast seem to be increasing in number (Carter *et al.* 1995; Spendelow and Patton 1988). They can be found along seacoasts, marine islands, coastal bays, swamps, lagoons, rivers, and lakes. Double-crested cormorants nest in variety of habitats. Along the coast, they nest on offshore rocks and islands, exposed dunes, abandoned wharf timbers, and power poles. Birds nesting inland often use trees or snags (Sowls *et al.* 1980; Speich and Wahl 1989). Birds are usually found within a few hours of their roosting or breeding sites (Ainley 1984b).

Breeding populations of pelagic cormorants are relatively evenly distributed from Washington to California (Spendelow and Patton 1988) and in recent years, populations have been increasing in number. Pelagic cormorants occur in outer coastal habitats, bays, and inlets, especially in rock-bottom habitats and often in water less than 100 m and within 1 - 2 km of shore. These birds will often nest with other pelagic cormorants or near other species of seabirds. Nesting occurs on island cliff ledges, crevices, and in sea caves by building nests out of seaweed (Sowls *et al.* 1980).

In California, reproductive success of cormorants was decrease by eggshell thinning due to pesticide contamination.

Cormorants are classified as diving birds, their strong swimming ability enables them to pursue and capture their prey underwater. Their diet includes small fishes, squid, crabs, marine worms, and amphipods.

Cormorant populations are threatened by pesticides, human disturbance at nesting sites, oiling, and interactions with fisheries.

A.3.4.9 Jaegers - Three species of jaegers occur along the Pacific Coast: the pomarine jaeger (*Stercorarius pomarinus*), parasitic jaeger (*Stercorarius parasiticus*), and long-tailed jaeger (*Stercorarius longicaudus*).

Jaegers are considered the birds of prey of the marine world and are commonly referred to as the "sea falcon".

All three species of jaegers are primarily pelagic, but may be found in bays and harbors. Jaegers breed in the arctic and sub-arctic. Non-breeding birds and breeders during the non-breeding season can be found off Washington, Oregon, and California.

The diet of jaegers includes small mammals, birds, bird eggs, fishes, invertebrates, and offal from fishing vessels. Jaegers are well known for their habit of pursing other seabirds on the wing (Maher 1984), forcing the other birds to disgorge their food, and then stealing the food before it hits the ground.

A.3.4.10 Gulls - Eleven species of gulls occur along the Pacific Coast, these include the glaucous gull (*Larus hyperboreus*), glaucous-winged gull (*Larus glaucescens*), western gull (*Larus accidentalis*), herring gull (*Larus argentatus*), California gull (*Larus californicus*), Thayer's gull (*Larus thayeri*), ring-billed gull (*Larus delawarensis*), mew gull (*Larus canus*), Heermann's gull (*Larus heermanni*), Bonaparte's gull (*Larus philadelphia*), and Sabine's gull (*Larus sabini*).

> The glaucous-winged gull is the most numerous and widely distributed gull in the eastern North Pacific.

> The western gull colony on Southeast Farallon Island is the largest gull colony along the Pacific Coast.

For most marine-nesting species in the North Pacific, only rough estimates of nesting populations exist and reproductive success has only been investigated for one to two years (Vermeer *et al.* 1993). However, it is thought that most gull populations along the Pacific Coast are stable and not considered to be at risk.

Most gulls along the Pacific Coast occur during the non-breeding season or are non-breeding individuals. Birds can be found at sea, along the coast, on rocky shores or cliffs, bays, estuaries, beaches, and garbage dumps. Only two species of gulls breed along the Pacific Coast. The glaucous-winged gull has breeding colonies in British Columbia and Washington and the western gull has breeding colonies in California (most are located on the Farallon Islands), Oregon, and Washington (Drury 1984). Breeding habitat for these gulls includes coastal cliffs, rocks, grassy slopes or offshore rock or sandbar islands.

Pacific Coast gulls feed at the ocean's surface and their diet typically includes fishes, mollusks, crustaceans, carrion, and garbage.

Primary threats to gulls include human disturbance at nesting locations.

> Kittiwakes, named for their shrill cries, are among the most oceanic of the gull family.

A.3.4.11 Black-legged kittiwakes *(Rissa tridactyla)* range along the Pacific Coast from Alaska to Mexico (Drury 1984). While they are primarily pelagic, black-legged kittiwakes can also be found along sea coasts, bays, and estuaries.

It is estimated that there are approximately 2.6 million black-legged kittiwakes at colonies in the North Pacific. This species breeds on mainland and island sites in the Arctic and along the Aleutian islands.

Black-legged kittiwakes feed at the ocean's surface and their diet typically includes small fishes, mollusks, crustaceans, and plankton (Hatch *et al.* 1993).

Primary threats to black-legged kittiwakes are unknown.

In the mid-1800s, over 14 million murre eggs were harvested from Southeast Farallon Island to feed residents of the San Francisco Bay area.

A.3.4.12 Common murres *(Uria aalge)* range along the Pacific Coast from Alaska to central California. While they are primarily pelagic, common murres can also be found along rocky sea coasts.

Common murres are the dominant member of the breeding seabird community along the Pacific Coast, but numbers have declined substantially in central California and Washington. In the mid-1800s, over 14 million murre eggs were harvested from Southeast Farallon Island to feed residents of the San Francisco Bay area (Manuwal 1984). The Washington population has been almost extirpated over the last decade, due to a combination of oceanographic conditions, gillnets, low-flying aircrafts, and oil spills, and has not recovered. In contrast, the population of common murres in Oregon and California has been stable or increasing despite human disturbance(Carter *et al.* 1995). In the late 1980s, the Pacific Coast population was estimated to be greater than 600,000 individuals. Nesting typically occurs in large, dense colonies on mainland and island cliff ledges or on rocky, low-lying islands. Common murres do not build nests but lay their eggs directly on the bare soil or rock (Spendelow and Patton 1988).

Common murres are diving birds, capturing their prey underwater, and can descend to depths of 180 m. Their diet includes fishes, squid, mysids, and shrimp.

Primary threats to common murres include predators on breeding islands, increasing sea surface temperature, oil spills, gill-net mortality, and military practice bombing activity.

The pigeon guillemot engages in spectacular aerial courtship chases, during which their bright orange feet and legs are prominently displayed.

A.3.4.13 Pigeon guillemots *(Cepphus columba)* range along the Pacific Coast from Alaska to southern California.

While these birds are primarily pelagic, they can be found along rocky coasts and in bays and inlets.

In the late 1980s, the pigeon guillemot breeding population along the Pacific Coast was estimated to be greater than 20,000 individuals. Breeding occurs along coasts, on islands, on cliffs, in rock crevices, in abandon burrows, or they may dig their own burrows. Pigeon guillemots have a spectacular courtship behavior (Manuwal 1984) and may use the same nest in successive years (Spendelow and Patton 1988).

Pigeon guillemots forage underwater; their diet includes small fishes, generally inshore benthic species, mollusks, crustaceans, and marine worms.

Primary threats to pigeon guillemots include introduced predators on breeding islands, inshore gillnet fisheries, and oil spills (Erwins *et al.* 1993).

A.3.4.14 Auklets - Three species of auklets occur along the Pacific Coast: the parakeet auklet (*Aethia psittacula*), the rhinoceros auklet (*Cerorhinca monocerata*), and the Cassin's auklet (*Ptychoramphus aleuticus*).

In the eastern North Pacific, the estimated population of Cassin's auklets is over 3 million and the estimated population of parakeet auklets is approximately 200,000 (Springer *et al.* 1993). The estimated breeding population of rhinoceros auklets along the Pacific Coast is just over 60,000 (Spendelow and Patton 1988).

In 2002, the Cassin's auklet was considered a "bird of conservation concern" by the USFWS.

Auklets are primarily pelagic, however, they are also found along rocky coasts. The parakeet auklet only breeds in Alaska, while the rhinorceros and Cassin's auklets breed on offshore islands between Alaska and Baja California. Nesting generally occurs in areas with low vegetation, in burrows, or under rocks. Some nesting sites are used in successive years. Auklets may be diurnal as well as nocturnal.

Auklets dive from the water's surface when foraging. Their diet generally includes small fishes, crustaceans, and squid.

Primary threats to auklets include introduced predators on nesting islands, long-term oceanographic changes in the California Current System which caused a decline in zooplankton populations, and oil spills.

In their breeding plumage of black, orange, white, and red, puffins are some of the most colorful of marine birds.

A.3.4.15 Puffins - Two species of puffins occur along the Pacific Coast, these include the horned puffin (*Fratercula corniculata*) and the tufted puffin (*Fratercula cirrhata*). These colorful puffins (Manuwal 1984) are primarily pelagic but they can also be found along the coast.

In the North Pacific, the estimated breeding population of tufted puffins and horned puffins is 3.5 million and 1.5 million, respectively (Byrd et al. 1993). Puffins breed on offshore islands or along the coast; nesting occurs in ground burrows, under and among rocks, and occasionally under dense vegetation. Horned puffins only nest in Alaska, while tufted puffins nest all along the Pacific Coast from Alaska to California.

Puffins are diving birds and capture their prey underwater. Their diet includes fish, cephalopods, crustaceans, and polychatetes.

Primary threats to puffins include introduced predators on breeding islands, oil spills, and gillnet fisheries. Low numbers of tufted puffins in California may be due to oil pollution and/or declines in the sardine population.

A.3.4.16 South polar skuas *(Stercorarius maccormicki)* range along the Pacific Coast from Alaska to Mexico. While these birds are primarily pelagic and solitary, they can sometimes be found in small, loose groupings in and around harbors.

South polar skuas breed in and around Antarctica. Non-breeders can be found spring through fall along the Pacific Coast.

> Like jaegers, south polar skuas are also considered the birds of prey of the marine world and known as the "sea hawk".

The diet of south polar skuas is diverse (Maher 1984). At sea, they pursue foraging seabirds until the other birds relinquish their prey, as well as following fishing vessels to forage on offal. On the breeding grounds, their diet includes fish, seabirds, small mammals, krill, penguin eggs and young, and carrion.

Because south polar skuas breed in such remote locations, there are relatively few threats to the breeding population. Additionally, they are relatively immune to threats during the non-breeding season because they spend the majority of their time at sea.

A.3.4.17 Black skimmers (*Rynchops niger*) can be found in California. This species is primarily found nearshore in coastal waters including bays, estuaries, lagoons, and mudflats.

In the late 1970s - early 1980s, the estimated breeding population of black skimmers throughout the United States was about 65,000 individuals and increasing. In California, however, less than 100 breeding individuals were found (Spendelow and Patton 1988).

Nesting generally occurs near coasts on sandy beaches, shell banks, coastal and estuary islands, salt pond levees, and on dredged material sites. Black skimmers are often nesting in association with or near terns.

In 2002, the black skimmer was considered a "bird of conservation concern" by the USFWS.

As their name suggests, black skimmers forage by flying low over the water and skimming food off the surface with their lower mandible. The diet primarily includes small fish and crustaceans.

Primary threats to black skimmers include predation and human disturbance on nesting islands.

Appendix B Impacts of Alternatives on Groundfish

4.2.1 Impacts of Alternative 1: *Status quo*

Summary of Alternative 1 The policy goal of alternative 1 is to continue current fishery management provided by the FMP in a manner consistent with Council objectives of maintaining a year-round groundfish fishery, preventing overfishing, and rebuilding overfished stocks at current levels of effort. In this alternative, bycatch and bycatch mortality is controlled in part through modifying effort and gear efficiency. Trip limits are used to discourage fishing in certain areas based on species encounter rates of overfished species. Gear restrictions are used where possible to reduce expected bycatch rates. Area closures are also used to reduce or prohibit fishing within Rockfish Conservation Areas (RCAs) on the continental shelf. Management relies on logbooks, port sampling, and partial observer coverage of the groundfish fleet.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 1:

- **Harvest Levels** Ratios of overfished species to other groundfish are used to set total catch caps for the overfished species. Unlike some of the alternatives, these are 'soft' caps allocated to various fishery sectors. Other groundfish harvest is constrained to maintain expected catch ratios, thus lowering overall OY and reducing harvest opportunities on healthy stocks. The GMT's quota species monitoring(QSM) program is used to track soft caps and the Council recommends appropriate in-season adjustments to ensure overall catch remains at or below recommended OY. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.1).

- **Vessel trip limits** Trip limits are the most restrictive with this alternative due to the need to keep catch and bycatch of overfished species within OY at current levels of effort, and to maintain a year-round season. This tool is ranked 4th out of a range of 1-4 scored for the alternatives (Table 4.3.1).
- **Vessel catch limits** Vessel catch limits not explicitly used as a tool in this alternative. This tool ranks last or 4th out of a range of 1-4 scored for the alternatives (Table 4.3.1).
- **Gear regulations** Gear restrictions are used to minimize take of undersized fish and overfished species, reduce bycatch and bycatch mortality. Survival rates of bycatch escaping gear is unknown. Experimental Fishing Permits (EFPs) are used allowing fishers the opportunity to experiment with various gear modifications in an effort to reduce bycatch and bycatch mortality of overfished species in particular This tool is ranked 2nd out of a range of 1-3 scored for the alternatives (Table 4.3.1).
- **Time/area closures** Extensive use of Rockfish Conservation Areas (RCAs) are used under *status quo* to keep catch of overfished species from exceeding OYs, thus reducing bycatch and bycatch mortality. Large areas of the shelf are off limits to directed groundfish fishing. Some open access and recreational fishing still occurs within RCAs This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.1).

- **Capacity reduction** Capacity reduction is not explicitly considered under this alternative. ***(It should be noted that Congress has authorized a capacity reduction program and bids are being solicited in order to reduce groundfish fleet size. If the program is successful, Alternative 2 would be more closely aligned with a status quo management program.)***
- **Data reporting, record-keeping, and monitoring** Under *status quo* management, 100% of the at-sea catcher/processor whiting fleet and approximately 10% of the remaining commercial groundfish fleet are monitored with on-board observers. Data are used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish. Under status quo management, these data are updated annually and used to change forecast of OY and trip limit impacts by fishery sector for the annual specifications process This tool is ranked 5th out of a range of 1-5 scored for the alternatives (Table 4.3.1).

Impacts on Groundfish
The *status quo* alternative ranking of effects on reducing groundfish bycatch, bycatch mortality, and increasing accountability are summarized in Table 4.3.1. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Harvest levels establish limits on the harvest of groundfish by through annual specification of ABCs and OYs. Overfished species constrain access to other healthier stocks of groundfish. When OY is effectively managed as a harvest cap, as it is for overfished species, it may limit or mitigate bycatch and bycatch mortality when used in combination with other tools, such as time/area closures. Under *status quo*, a soft 'scorecard' is used to track estimated mortality by fishery. Performance of the different fishery sectors is measured against this scorecard during the fishing season using the best estimates of in-season landed catch and anticipated bycatch. No portion of OY is held in reserve and fishery sectors are not held accountable of exceeding soft scorecard limits. In-season management action may be applied to fishery sectors in order to keep catches close to pre-season estimates of fishing mortality. *Status quo* ranks the same as or lower than other alternatives with respect to effective performance standards, use of OY reserve, and application of sector limits (Table 4.3.1). Observer data gathered in-season along with other fishery information such as logbook data are used to update estimated mortality on an annual basis. See Table 4.2.0 for 2002 and 2003 OYs and estimated total removals for 2002.

<u>Overfished Groundfish</u>
Most of the overfished species live on the continental shelf. Under the *status quo* alternative, rebuilding of groundfish within Northern and Southern Shelf Environments would take place in less than Tmax with a probability greater than 60%. Rebuilding most rockfish stocks is expected to take decades to achieve. In the Northern Shelf Environment, canary and yelloweye rockfish will constrain catches of other species for many years as they rebuild. Likewise, canary rockfish, cowcod, and boccacio will constrain harvest of other groundfish within the Southern Shelf Environment. Lingcod, also caught on the shelf, co-occurs with overfished and other rockfish species. OY for lingcod is high enough as not to be constraining and catches are currently well below OY.

Current management allocates OY among users to accommodate bycatch needs while allowing limited access to healthier species of groundfish exceeding OYs of species under rebuilding plans. Most overfished species allocations are 'soft' allocations, in the sense that management measures for each fishery sector are adjusted to try and target the soft allocation. Flexibility between allocated amounts is allowed, however, if overall catches are projected to be below OY.

Analysis of different allocation options between recreational and commercial fisheries indicate a greater impact on some species if more are allocated to the recreational fishery because it takes a higher percentage of juvenile fish. For canary rockfish, a higher proportion of younger fish in the recreational catch results in a higher "per-ton" impact on rebuilding (PFMC 2003b).

Pacific whiting and widow rockfish are two species within the pelagic environment that have been determined to be overfished. In the years preceding this determination, OY levels were high enough to allow directed fishing towards widow rockfish by the whiting midwater trawl fleet, and trip limits were structured to allow a significant portion of the OY to be taken in such a manner. OY under rebuilding for widow rockfish is much lower than catches in the last decade.

Emphasis Species

Under the *status quo* alternative, some species of groundfish have annual landed catch levels that are well below OY specifications due to OYs for constraining overfished species or species under precautionary management. These constraints have a significant and direct impact on fishing opportunities. Yellowtail rockfish catches are constrained will below OY due to low OYs for co-occurring canary rockfish and boccacio. Chilipepper rockfish is largely constrained by market conditions. Regulations also constrain the harvest of the slope Dover sole, thornyhead, and sablefish (DTS) complex to prevent shortspine thornyhead from being overfished. DTS trip limits based on expected catch ratios of this complex allow access to healthier Dover sole and longspine thornyhead stocks (see discussion on trip limits below). Ratio management may lead to regulatory discard of sablefish and shortspine thornyhead in particular as fishers pursue attainment of Dover sole and longspine thornyhead OYS. Current catches of Dover sole and sablefish are close to but less than OY. Shortspine thornyhead OY is low and annual catches attain OY, while catches of longspine thornyhead are well below OY. Undersized and lower priced sablefish may be discarded in favor of larger more valuable fish - a practice known as 'high-grading'. The fishing strategy reduces the chance of early attainment of sablefish OY and increases the value of the catch.

In other cases, OY is underachieved due to existing market limits not linked to regulatory limits. For example, English sole OY is set at the ABC level of 3,100 mt, coastwide. Current catch levels are well below ABC (Table 4.2.0). Some level of bycatch and bycatch mortality is likely to occur in either of these cases. Forgone catch may indirectly reduce bycatch and bycatch mortality if limiting OYs for overfished species results in reduced catch of other groundfish.

Trip limits for the trawl and non-trawl fisheries are described in the Federal Register (NMFS, 2003). Under status quo, trip limits are designed to spread OY out to maintain a year-round season and to provide an incidental catch allowance for overfished species caught with co-occurring groundfish. Some trip limits for overfished species are very small to discourage any targeting on restricted species. Most contemporary trip limits are cumulative 2 month period limits. Cumulative limits have the effect of minimizing regulatory related discard of groundfish in excess of the limit until the last trip of the period.

Recent analysis of 2002 observer data suggests significant bycatch in the form of regulatory and non-regulatory discard associated with cumulative trip limits based on ratios of anticipated bycatch (PFMC 2003d). The *status quo* alternative application of trip limits ranks 4^{th} out of a range of 1-4 as a tool to reduce bycatch and bycatch mortality for most species, compared to other alternatives that reduce the need to use landing limits (Table 4.3.1).

Overfished Groundfish

Over time, trip limits for individual species have been modified to reflect species associations Knowledge of species depth distributions and associations allowed application of trip limits to sub-groups of species. For example, groups of species were broken out of the Sebastes complex with separate trip limits to discourage targeting on overfished species. Separate sub-groups were developed for nearshore, shelf and slope environments, along with some sub-group and individual species trip limits. See Table 2.1-12 of the 2003 Groundfish Annual SEIS (PFMC 2003b). Lower limits for these subgroups to protect overfished species resulted in a high percentage of OY for the subgroup left unharvested. Yellowtail rockfish is an example of a shelf rockfish species with a harvest well below OY due to recent trip limit constraints applied to shelf rockfish in order to protect canary rockfish (currently, area closures have the same consequence).

In 2000, NMFS reduced trip limits for shelf rockfish were coupled with restrictions on the size of roller gear that could be used on the continental shelf. A study by Hannah (2003, In Press) showed that reductions in trip limits prior to 2000 already began reducing fishing effort in areas of 'prime trawlable rockfish habitat'. The same study also demonstrated that fishing continued adjacent to the harder bottomed high relief rockfish habitat areas. OY reductions and catch ratio management led to more restrictive measures in 2003.

In 2003, depth based management of RCAs affected all gear types to some degree. Canary rockfish trawl limits were only 100 lb per month for the year, with the exception of 300 lb per month during the May-August period when canary rockfish are seasonally more abundant shoreward of the Rockfish Conservation Area (RCA) inner depth limits. Likewise, trip limits for bocaccio are contained within the 300 lb per month limit for minor nearshore rockfish which may be taken shoreward of the RCA. Limits for other species of groundfish are therefore constrained to limit the take of overfished species and species under precautionary management.

Currently, logbook and observer data are used to project expected catch ratios of overfished species to other target species. Individual trip limits are adjusted to keep overfished species OY from being exceeded. Under *status quo*, if actual ratios of overfished species to target species differ from those projected, bycatch and bycatch mortality may occur. Discarding of overfished species may occur if the actual proportion of overfished species is higher than expected. Likewise, if the actual proportion of overfished species is lower than expected, discarding of the target species may occur.

In a study of West Coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch *et al.* 1988). *Status quo* trip limits may therefore result in a higher catch and bycatch mortality of overfished species compared to alternatives that allow larger trip limits, or alternatives that utilize a different set of management tools. Vessel trip limits for overfished species are very restrictive under current effort levels and OYs, and are designed to provide for non-target incidental catch, although some target fishing is allowed for lingcod. Generally, restrictive landing limits can lead to higher bycatch and bycatch mortality due to regulation induced discarding. Cumulative 1 or 2 month limits are used to help minimize discard. Under status quo, regulatory induced discard of overfished species may be higher in comparison with other alternatives which use other approaches to maintain catch within OY, encourage landing of more of the catch, or avoid take of overfished groundfish.

Emphasis Species

As noted earlier (See discussion above in Overfished Groundfish) regulatory induced discard may be high if managers place constraints on other groundfish to protect co-occurring overfished species. Much of the success using ratios to manage trip limits depends on the how well ratios reflect actual catch proportions. In addition, the target 'mixture' sought by fishers is sensitive to prices of various components of the catch. Currently, catch ratios are applied to species making up the DTS complex in order to prevent over harvest of shortspine thornyhead. While most of the Dover sole harvest is close to OY, a significant proportion of longspine thornyhead and sablefish OY is un-attained. Previous discard rates for Dover sole are thought to be related to undersized fish and are estimated to be 5% (Sampson and Wood 2002). Recent analysis of the 2002 observer data show that Dover sole discard may be a high as 17% (PFMC 2003d). However, discard of shortspine thornyhead is thought to as high as 30% and there is some evidence that sablefish discard rates may be as high as 40%, suggesting that catch ratios may not be accurate, high-grading may be occurring, or that their application does not take into account the degree of variability seen under actual fishing practices. Discard of small sablefish may be taking place as they typically are priced lower than medium to large fish, and the most recent assessment suggests a strong incoming year-class. Discard of shortspine thornyheads (due to regulatory limits) may be taking place in order to attain Dover or sablefish limits.

While regulatory discard of species such as English sole and other shelf and nearshore flatfish species may be low or absent , there may be economic reasons to discard. Trip limits for English sole are liberal under current effort levels and OY. Analysis of trip frequencies show that few trips attain the regulatory induced limit (Table 4-2). Market limits on the quantity landed may induce an unknown amount of economic discard. Undersized English sole are also a major component of discarded catch (See **Gear restrictions**, below).

A new cumulative limit approximating an IQ program and an extended season for fixed gear sablefish fishers reduces the need for a 'derby' style fishery. The new program implemented in 2002 (?) removes the need to race for fixed gear limited entry OY share. This program may reduce the need to discard fish compared to other sectors without IQs, as fishers have more time to move to areas with higher concentrations of marketable fish (see discussion of handling below under **Gear restrictions**).

Gear restrictions modify selectivity and placement of fishing gear. Some restrictions such as trawl mesh size may allow undersized fish an opportunity to escape. Trawl roller gear size coupled with a depth restriction may minimize the risk that trawl gear will be used on habitats with high concentrations of rockfish. Gear restrictions under *status quo* are similar to those found in three other alternatives, and rank 2nd in a range of effect scores from 1-3 (Table 4.3.1).

Overfished Groundfish

Gear restrictions, modifications, and deployment practices can reduce bycatch and bycatch mortality of overfished species. The minimum 4.5" mesh size aids in the escapement of juvenile rockfish. Rates of survival of escaping fish are not known, however. Due to the lack of a swim bladder, lingcod would have a greater chance of survival than rockfish, when caught with trawl gear. To protect overfished rockfish, the Council initially recommended very small trip limits for those using trawls with large roller gear when fishing on the continental shelf. Larger trip limits were allowed for those fishing primarily for flatfish with small diameter footrope trawl gear. A study by Hannah (2003) showed that trawlers avoided rocky reef areas on the shelf as a result of the regulation, and that encounter rates of these species were reduced. Enough fish were caught however to require further action by the Council. OYs for shelf rockfish such as canary rockfish, yelloweye rockfish, and boccacio were so low the Council more recently has prohibited fishing of nearly all gears within RCAs, including small and large footrope trawl gears and groundfish directed hook and line gears (?). Under *status quo,* these measures have a direct effect of eliminating bycatch and bycatch mortality of species within the RCA. Also, effort can increase outside of RCAs creating new challenges to maintaining harvest below OYs specified for overfished species, even at very low encounter rates seen outside of RCAs. Effort shifting can also have a direct impact, increasing bycatch and bycatch mortality of overfished species <u>outside</u> of the RCA boundaries.

State action has also been taken to require fish excluder devices to reduce rockfish catch in the shrimp trawl fishery, thus reducing bycatch. Survival rates of excluded fish are largely unknown (Davis and Ryer 2003). With use of fish excluders, the catch of rockfish and bycatch mortality in the shrimp trawl fishery should be lower in comparison with nets that do not use these devices. Fish caught in trawls without excluder devices can escape through meshes or may be discarded once brought to the surface. Only very small fish can escape through the meshes of a shrimp trawl.

Video observation of fish excluders has shown that many fish are able to actively seek and find exits or passively be excluded from shrimp trawls, while the net is at fishing depth. Escaping rockfish avoid barotrauma associated with being brought to the surface and discarded. Studies have shown that time on deck (Parker *et al.* 2003) and temperature gradient (Davis and Ryer 2003)are important factors in survivability of fishes without swim bladders, such as lingcod and sablefish. While they may have an increased chance of survival when released at the surface, trauma inducing factors could be avoided altogether through the use of fish excluders (Hannah 2003b). Additional delayed morality may occur however. Laboratory studies have shown that direct mortality can still occur and behavioral impairment can cause additional delayed mortality (Davis and Ryer 2003). Under *status quo*, state requirements for excluder gear would have a positive and direct impact, reducing bycatch over gears that did not use these devices. Excluders and the selectivity effects of mesh size in general are likely to have a direct impact, causing an unquantifiable amount of bycatch mortality.

Catch of overfished species is expected to be very low to non-existent in fixed gear groundfish fisheries. Although 20 mt of lingcod may be taken by fixed gear limited entry fishers, overall OY is not likely to be attained. Bycatch and bycatch mortality lingcod caught with fixed is related to the minimum size limit of 24 inches and handling effects on fish described above. Little is known about survivability of fish escaping gear prior to it being hauled to the surface.

Emphasis Species

Other abundant and important groundfish found in the shelf environment include yellowtail rockfish, chilipepper, shelf flatfishes including arrowtooth flounder, petrale sole, and English sole. Important slope complex species include Dover sole, short and longspine thornyhead, and sablefish (the 'DTS' complex).

Gear restrictions, modifications, and deployment practices can reduce bycatch and bycatch mortality of groundfish. The minimum 4.5" mesh size aids in the escapement of juvenile or small sablefish and flatfish, although enough small fish are retained to contribute to significant size related discard. Sablefish also lack a swim bladder and likely have a higher rate of survival if caught and released.

Mesh size studies have shown that discard of undersized English sole may make up more than 50% of the catch in numbers (TenEyck and Demory 1975). Nearly all of the males and approximately 19% of the females were discarded. English sole have a prominent anal fin spine that has a tendency to catch on trawl meshes. The last stock assessment for female English sole used an assume rate of discard of 12.4% during the period 1985-1992 (Sampson and Stewart 1993). Rates of survival of escaping fish are not known.

Small footrope gear effective at fishing flatfish on non-rocky habitat, and large footrope gear was prohibited within RCAs in 2003 due to incidental catch of overfished rockfish species. Trip limits are structured to effectively limit practical use of large footrope gears for deeper water species, seaward of RCAs.
State action taken to require fish excluder devices and reduce canary rockfish catch in the shrimp trawl fishery affects overall catch of other groundfish species as well (Hannah *et al.* 1996). Survival rates of excluded fish are not known and there is no estimate of bycatch mortality (see discussion above under Overfished Groundfish). Direct impacts include reduced bycatch, reduced bycatch mortality for some of the fish, and some increased unobserved bycatch mortality of fish interacting with excluder gear.

Efforts to access other healthier groundfish stocks under a new management regime explored in this EIS, where depth-based restrictions reduce access, may depend on refining fishing gear configurations to make them more selective for these species. Efforts are planned and ongoing through EFPs sponsored by CDFG, ODFW, and WDFW. If successful, gear modifications may allow more access to yellowtail rockfish or flatfish, while minimizing impacts to overfished species. The impact of such gear may result in increased catches of species harvested below OY. To the degree catches increase, bycatch and bycatch mortality may increase. Gear modifications could have a net overall benefit by reducing bycatch and bycatch mortality of overfished species.
(add Wallace reference if appropriate - arrowtooth flounder)
(add Parker reference if appropriate - flatfish trawl efp and lingcod)

Gear restrictions or prohibitions are effective at reducing bycatch within RCAs. Little is known about the fate of fish caught by trawl and fixed gears that manage to escape through meshes or become freed from hooks. Additional gear measures beyond those under *status quo* may be needed to reduce bycatch impacts outside of RCAs.

Sablefish caught by hook or pot gear are known to be susceptible to mortality due to sand flea infestation. Studies in Alaska have found this source of mortality to be small and that all sources of discard amounted to only 12% of the total allowable catch (TAC) in the directed fishery (Richardson and O'Connell 2002). Sablefish may be caught and escape from hooks or through meshes of traps. The survivability of these fish is not known. In addition, fixed gear fishers release undersized sablefish contributing to bycatch and bycatch mortality. In 2002, the Council recommended an decrease in size limit from 22 inches to 20 inches to minimize the amount of sablefish discard. Studies cited above indicate that temperature gradient may influence survivability of sablefish . Time of year fish are harvested therefore influence the potential impact of temperature gradients. The individual cumulative tier limits and extended season may contribute to a reduction in bycatch and bycatch mortality (see discussion above under **Trip limits**).

Time/Area Closures effectively reduce bycatch and bycatch mortality within the boundaries of the closed area, and for a particular fishery sector, if fishing is prohibited. Outside of the boundaries, bycatch and bycatch mortality may increase if effort is shifted to open areas. Some level of harvest may be allowed within restricted fishing areas using modified gears. To the degree these gears are selective against catch of the species being protected, bycatch and bycatch mortality should be reduced.

<u>Overfished Groundfish</u>
Other regulations such as gear, time, depth, or area restrictions in the form of RCAs are designed to minimize the likelihood of encountering canary and yelloweye rockfish in the Northern Shelf Environment, and cowcod and bocaccio in the Southern Shelf Environment. The RCA strategy under *status quo* is to reduce or eliminate effort where there is a high encounter rate of overfished species and redirect effort outside of the RCA where encounter rates are low. Because of the seasonal distributional behavior of rockfish, encounter rates and fishing patterns are monitored and adjustments are made to keep overall harvest within total catch OYs. Some rockfish have a wider distribution than others, or make seasonal movements requiring the use of large RCAs.

Canary rockfish are seasonally more abundant shoreward of the RCAs inner depth limits and landing limits are adjusted to reflect this seasonal distribution to minimize encounter rates. Seasonal mobility and aggregating behavior of canary rockfish within and outside of RCAs may affect ratios of incidental catch of this species to other groundfish. Under status quo, adverse changes to ratios may not be accounted for until the end of the fishing season. Bycatch and bycatch mortality may increase as a consequence. Recent changes in the depth limits of the northern RCA are intended to reduce the chances of fishers encountering large concentrations of canary rockfish, however.

Cowcod are at very low levels of abundance. Cowcod RCAs are small compared to other shelf RCAS and are located in the southern shelf environment. The cowcod RCA was designed to protect mature fish with a high site affinity for habitats consisting of rocky reefs with overhangs and sheltering caves.

Emphasis Species

Rockfish Conservation Areas under status quo effectively eliminate fishing in areas where overfished rockfish are concentrated. See discussion in under Overfished Groundfish above. Other shelf rockfish species are underutilized under current area management. Yellowtail and chilipepper rockfishes annual catches are both well below OY (Table 4.2.0).

RCAs may also concentrate effort seaward of the RCA boundary. The DTS complex catch, bycatch, and bycatch mortality could increase during these closures due to effort shifting.

Several species of groundfish move onto the shelf during certain times of the year. RCAs may reduce the vulnerability of these other species to harvest, thereby reducing bycatch and bycatch mortality, depending on the timing and application of the RCA.

English sole and other shelf or nearshore flatfish may still be taken with small footrope trawls fished in the North Shelf Environment shoreward of 50 or 100 fm depending on time of year. RCAs would reduce access to flatfish to some degree, although a significant proportion of the biomass is shoreward of 50 fm.

If effort concentrates shoreward of RCAs, catch, bycatch, and bycatch mortality of shoreward species may also increase.

4.2.2 Impacts of Alternative 2: *Larger trip limits - fleet reduction*

Summary of Alternative 2 The policy goal of this alternative is to reduce bycatch by reducing harvest capacity and increasing trip limit size without reducing the length of the season. In this alternative, bycatch and bycatch mortality is controlled in part by modifying effort and gear efficiency. This goal supports Council objectives of maintaining a year-round groundfish fishery, preventing overfishing, and rebuilding overfished stocks while maintaining an economical monitoring program. It adds the new objective of reducing fleet capacity which is embodied in the Council adopted Strategic Plan for west coast groundfish.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 2:

- **Harvest Levels** (harvest policy, rebuilding) ABCs and OYs are assumed to be the same as under *status quo* however, proportionately more catch would be available to individual vessels remaining in the fleet compared to *status quo*. The Council could make a decision to utilize any proportionate fleet increase in catch share to shorten the time to rebuild overfished species. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (See performance standards and OY reserves in Table 4.3.2).
- **Vessel trip limits** Vessel trip limits are used and should increase under this alternative due to a 50% reduction in effort through capacity reduction. Regulatory induced discard is

inversely proportional to trip limit size, the direct impacts of this alternative would be to reduce bycatch and associated mortality. This tool ranks between 2nd to 4th out of a range of 1-4 scored for the alternatives (Table 4.3.2).

- **Vessel catch limits** Vessel catch limits not explicitly used as a tool in this alternative. This tool ranks last or 4th out of a range of 1-4 scored for the alternatives (Table 4.3.2).
- **Gear regulations** Gear regulations under this alternative would be the same or similar to those in Alternative 1. It is not anticipated that a 50% reduction in fleet capacity would permit the use of large footrope gear within current RCA boundaries. This tool is ranked 2nd out of a range of 1-3 scored for the alternatives (Table 4.3.2).
- **Time/area closures** The application of RCAs would be the same as those in Alternative 1. A 50% reduction in fishing effort might allow redefinition of the timing and application of closed areas to provide more opportunities for the remaining fleet to access other groundfish resources within current RCA boundaries. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.2).
- **Capacity reduction** Capacity reduction could take place in the form of a vessel buy-back program resulting in a 50% reduction in effective effort. Effective effort is effort that produces an average catch of groundfish per trawl hour fished. Effort reduction should create larger shares of catch for the remaining fleet and increase the efficiency of other tools used to reduce bycatch and bycatch mortality of groundfish. Alternatively, a buyback program may not be successful in reducing effective effort if the lowest producing vessels retire from the fleet. If the latter scenario were to be true, positive impacts on reducing bycatch and bycatch mortality might be lessened, but would still have a net benefit compared to Alternative 1. This tool ranks 1st out of a range of 1-3scored for the alternatives (Table 4.3.2).
- **Data reporting, record-keeping, and monitoring.** Catch reporting, record-keeping, and monitoring through use of observers may improve over *status quo*. Assuming the number of observer days remains the same, a higher proportion of total trips should have observers due to the reduced fleet size, larger trip limits, and reduced total number of trips. If effort increases, trip limits may have to be reduced, and observer coverage would become more like *status quo.* This tool is ranked 4th out of a range of 1-5 scored for the alternatives (Table 4.3.2).

Impacts on Groundfish

The Alternative 2 ranking of effects on reducing groundfish bycatch, bycatch mortality, and increasing accountability are summarized in Table 4.3.2. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Harvest Levels would be the same as under *status quo* for groundfish. Catch available based on recommended OYs would be shared among fewer vessels under this option. The Council could make a decision to utilize any proportionate fleet increase in OY share to shorten the time to rebuild overfished species.
Other than soft sector allocations similar to *status quo*, there would be no performance standards or OY reserves, and ranking of this tool the same as *status quo*, or 3rd out of the range of 1-3.

Trip Limits should increase, especially outside of RCAs as a consequence of a 50% reduction in effective capacity of the commercial fleet. Effects of increased trip limits described above under General Effects of Fishery Management Tools are likely to be significant compared to *status quo* and rank 2nd or 3rd out of a range of 1-4 scored for other alternatives, depending on the species. Some alternatives rank 1st due to elimination of trip limits as a tool.

Overfished Groundfish
Increased trip limit size may have a direct and positive impact, making possible an increase in per vessel retained catch of overfished groundfish and reducing bycatch associated with regulatory induced discards. In a study of west coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch *et al.* 1988). All limits of overfished rockfish are low under *status quo* compared to historical levels. Reducing discard by increasing trip limit size would still depend on the appropriate application of RCAs and ratio management. A fine balance would be needed to allow more overfished species to be caught as incidental catch to other target strategies, without creating a trip limit large enough to encourage targeting of the overfished species.

The Council could elect to keep limits lower in an attempt to rebuild overfished species faster. Bycatch and bycatch mortality might be reduced in comparison to the above scenario, due to a reduction in overall harvest opportunity. The smaller limits might offset this reduction due to the effect of smaller trip limits on regulatory induced bycatch.

Effects of increased trip limits result from capacity reduction. The alternative ranks 2nd in terms of ability of the trip limit tool to reduce bycatch and bycatch mortality of overfished species (Table 4.3.2).

Emphasis Species
Vessel trip limits could increase outside of RCAs boundaries as a consequence of a 50% reduction in effective capacity of the commercial fleet. Ratio management would allow more access to other groundfish as long as catch of overfished species did not exceed OY. Under status quo, several species of groundfish are harvested well below OY due to constraints on overfished species such as shortspine thornyhead currently under precautionary management. Under *status quo,* for example, there appears to be a lack of attainment of OYs for sablefish and longspine thornyhead at the same time there may be high discard rates of sablefish and shortspine thornyhead. A larger trip limit may help fishers gain access to OY and may reduce discarding.

Increased trip limit size should have little impact on some species that are more limited by markets than regulatory trip limits under status quo. For example, landings of English sole are limited by size and market limits, not trip limit size.

Because increased trip limit size may not result in a change in harvest for many emphasis species due to existing non-regulatory constraints such as undersized fish and market limits, the trip limit tool used in Alternative 2 ranks 3rd among alternative scores ranging from 1-4 (Table 4.3.2).

Since it is assumed most of the capacity reduction would apply to the trawl fleet, this tool would have less impact on trip limits for cabezon and black rockfish compared to other species. Cabezon and black rockfish are caught primarily by commercial limited entry or open access hook and line fishers and the recreational fishery. Effects of increased trip limits therefore, on reducing bycatch and bycatch mortality for nearshore species like black rockfish and cabezon under ranks 4rd out of a possible range of 1-4 (Table 4.3.2).

Gear Restrictions under this alternative might be relaxed compared to *status quo.* Gear restrictions are likely to remain the same as under *status quo* in the near future due to rebuilding requirements of overfished species, however. Alternative 2 application of gear tools therefore rank the same as *status quo*, or 2nd among alternative scores ranging from 1-3 (Table 4.3.2).

Overfished Groundfish
It is not anticipated that a 50% reduction in fleet capacity would permit the use of large footrope gear within current RCA boundaries in the near future.

Emphasis Species
Current regulations prohibit fishing within RCAs by most gear types, including groundfish trawl gears with the exception of pelagic trawls. A 50% reduction in effort may allow use of small foot rope trawl gears within RCAs. An analysis of Oregon and Washington trawl logbook data showed that both trip limits and the 8 inch size restriction on trawl roller gear were effective in reducing or eliminating trawl effort over 'prime trawlable rockfish habitat' (Hannah 2003). Current shelf RCAs have a significant amount of ground still trawlable with small footrope trawl gears. If fishing with these trawls were allowed within RCAs, bycatch and bycatch mortality could increase for both overfished and healthy groundfish stocks.

Time/Area Closures The timing, bathymetric limits, and gear restrictions associated with RCAs could be modified from those under *status quo* at lower levels of effort. RCAs are likely to remain the same as under *status quo* in the near future due to rebuilding requirements of overfished species, however. Alternative 2 application of time/area closures therefore rank the same as *status quo*, or 2nd among alternative scores ranging from 1-3 (Table 4.3.2).

Overfished Groundfish
A 50% reduction in fishing effort might allow re-definition of the timing and application of closed areas to provide more opportunities for the remaining fleet to access other groundfish resources within current RCA boundaries. Increased access to resources within the RCA may increase bycatch, and bycatch mortality of overfished species. On the other hand, the Council could choose to reduce overall catch levels along with fleet reductions and use lower catch rates to rebuild overfished stocks faster. Reduced harvest and faster rebuilding would likely require continuance of *status quo* RCAs.

Emphasis Species
A 50% reduction in fishing effort might allow redefinition of the timing and application of closed areas to provide more opportunities for the remaining fleet to access other groundfish resources within current RCA boundaries. For instance, current regulations prohibit bottom trawling on the continental shelf between 50 and 200 fm, affecting the harvest of yellowtail

rockfish, chilipepper rockfish, English sole and other flatfish species. Moving the inner boundary of the RCA out to 100 fm would allow access to more of the shelf flatfish such as English sole, sand sole, rex sole, and petrale sole that have moved into shallower water during the summer. Bycatch and bycatch mortality may be similar to *status quo* as current catch levels are low with respect to OY and most of the bycatch is associated with undersized fish and market limits.

Capacity Reduction Capacity reduction would take place in the form of a vessel buy-back program, that would reduce effective effort by 50%. Effects of capacity reduction described above under General Effects of Fishery Management Tools are likely to be significant compared to *status quo* and other alternatives. Alternative 2's use of the tool ranks 1st or 3rd out of a range of 1-4 scored for other alternatives, depending on the species.

<u>Overfished Groundfish</u>
Assuming a 50% reduction in effective effort occurred through a buy-back program, a proportionate increase in overfished species trip limit size would be anticipated. Thus, effort reduction would have an indirect impact on reducing bycatch and bycatch mortality.

<u>Emphasis Species</u>
Trip limits for several species of groundfish at or near MSY should increase as a consequence of a 50% reduction in effective effort under this alternative. Effort reduction would have an indirect effect on reducing bycatch and bycatch mortality of other groundfish.

Since it is assumed most of the capacity reduction would apply to the trawl fleet, this tool would have less impact on cabezon and black rockfish compared to other species. Cabezon and black rockfish are caught primarily by commercial limited entry or open access hook and line fishers and the recreational fishery. Effects of capacity reduction on reducing bycatch and bycatch mortality for nearshore species like black rockfish and cabezon under ranks 3rd out of a possible range of 1-3 (Table 4.3.2).

4.2.3 Impacts of Alternative 3: *Larger trip limits - shorten season*

Summary of Alternative 3 The policy goal of this alternative is to reduce bycatch by shortening the fishing season by 50%. In this alternative, bycatch and bycatch mortality is controlled in part by modifying effort and gear efficiency. It attempts to accomplish effort reduction sought in alternative 2 without reducing fleet size. This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks while maintaining an economical monitoring program. It may be contrary to the current goal of maintaining a year-round groundfish fishery, although platooning is used in an attempt to accomplish this objective.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 3:

- Harvest Levels (harvest policy, rebuilding) Harvest Levels are assumed to be the same as under *status quo*.
- **Vessel trip limits** This alternative assumes the season would be shortened for fishing vessels and that some form of platooning would be used to maintain fishing throughout the year. Vessel trip limits under this alternative would be the same as under alternative 2. Season length for the platooned fleet would be modeled by the GMT to maintain trip limits. Trip limits equivalent to those in Alternative 2 would reduce bycatch and bycatch mortality in a fashion similar to alternative 2. This tool ranks 3rd out of a range of 1-4 scored for the alternatives.
- **Vessel catch limits** Vessel catch limits not explicitly used as a tool in this alternative. This tool ranks last or 4th out of a range of 1-4 scored for the alternatives (Table 4.3.3).
- **Gear Regulations** under this alternative would be similar to *status quo* and be structured to keep catches within the OY limits for overfished species. It is not anticipated that a 50% reduction in fishing season would permit the use of large footrope gear within current RCA boundaries, however small footrope gear may be re-introduced into RCAs. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.3).
- **Time/area closures** In addition to the RCAs used in *status quo*, this alternative compresses the fishery through seasonal closures for a platooned fleet. For instance, each half of the fleet would have a fishing season of only 6 months. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.3).
- **Capacity reduction** No capacity reduction is considered under this alternative. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.3).
- **Data reporting, record-keeping, and monitoring** Catch reporting, record-keeping, and monitoring with the same number of observer days as under *status quo* is assumed. A compressed season would mean that the percentage of total trips covered by observers would increase over *status quo*. This tool is ranked 3rd out of a range of 1-5 scored for the alternatives (Table 4.3.3).

Impacts on Groundfish

Effects of tools used in alternative 3 to reduce groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.3. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Harvest Levels Objectives for setting optimum yield would remain the same as in *status quo.* Under alternative 3, fishing periods would be compressed or the season shortened. Catch shares should increase on a per trip basis compared to *status quo* but fleet size would remain the same. Other than soft sector allocations similar to *status quo*, there would be no performance standards or OY reserves. Ranking of this tool as used in alternative 3 would be the same as *status quo*, or 3rd out of the range of 1-3 (Table 4.3.3).

<u>Overfished Groundfish</u>

On a per vessel basis, a shorter season may allow larger shares of OY per trip due to potentially larger trip limits compared to *status quo*, and would have an impact similar to Alternative 2, reducing bycatch and bycatch mortality of overfished species.

Emphasis Species
Objectives for optimum yield would remain the same as in *status quo.* On a per vessel basis, a shorter season may allow larger shares of OY per trip compared to *status quo*. Several species of groundfish at or above MSY are currently under-harvested due to constraints on overfished stocks or market limits. One possible consequence of this alternative is that more OY would go unharvested due to the reduced season.

Vessel trip limits Vessel trip limits would initially be the same as those in alternative 2. The season would be shortened to match the new trip limit. The shortened season would allow access to more of the overall OY for groundfish species. Much would depend on fleet response to a shortened season and larger cumulative limit. Platooning of the fleet would be done to maintain a supply of groundfish year-round. If fishers increase effort to compensate for the reduced season, season length would be reduced to maintain trip limit size. The compressed season anticipated larger trip limits should have a significant impact on reducing bycatch and bycatch mortality compared to *status quo.* Although trip limits should be similar to alternative 2, the capacity reduction alternative, this alternative ranks lower as it may be difficult to optimize trip limits and season length in such a fashion as to minimize bycatch and bycatch mortality compared to alternative 2 (Table 4.3.3).

Overfished Groundfish
Vessel trip limits would increase, especially outside of RCAs as a consequence of a 50% reduction in the fishing season. The fleet would be platooned into two or three groups with shortened fishing periods. This would create a more even flow of fish and supports the current Council goal of maintaining a year-season. In either case, the larger trip limit sizes would tend to decrease bycatch and bycatch mortality associated with regulatory induced discards. If fishers compensate for the shortened season and larger trip limit by increasing effort, the benefits of a shortened season might not be realized. Too much effort could result in the season being reduced. A shorter season may reduce harvest if some fishers elect not fish during the openings. Bycatch and bycatch mortality would be reduced but product flow may be interrupted.

Emphasis Species
Vessel trip limits would increase, especially outside of RCAs as a consequence of a 50% reduction in the fishing season.

As was described above under the *status quo,* bycatch of species within the DTS may be the result of several factors, including size, attainment of regulatory limit, and high grading related price structure of different sizes of sablefish. A 50% reduction in fishing season and increased trip limits for components of the complex would tend to reduce regulatory induced discard. Within the DTS complex, bycatch of shortspine thornyhead may be reduced if a larger trip limit for this species is allowed. High grading of sablefish may still occur, however.

The potential increase in trip limit size not likely a significant factor for some species of groundfish like those in the other flatfish category. Landing limits under *status quo* are quite liberal compared to current catches and attainment of the cumulative limit under alternative 3 is not likely. Bycatch and bycatch mortality is related to market limitations related to undersized fish, price, and constraints on quantity. If fleet response to the shortened season is to seek some alternative fishery rather than increase effort during season openings, bycatch and bycatch mortality may be reduced due to a reduction in overall harvest levels.

Gear Regulations Gear regulations alternative would be similar to *status quo* and structured to keep catches within the OY limits for overfished species. Gear restrictions are likely to remain the same as under *status quo* in the near future due to rebuilding requirements of overfished species, however. Alternative 3 application of gear tools therefore ranks the same as *status quo*, or 2nd among alternative scores ranging from 1-3 (Table 4.3.3).

Overfished Groundfish
It is not anticipated that a 50% reduction in fishing season would permit the use of large footrope gear within current RCA boundaries. However, small footrope trawls could be re-introduced into RCAs if overall OYs for overfished species could be maintained. Currently, lingcod and yelloweye catches remain below OY. Lingcod in particular may be harvested at a higher rate if small footrope trawls are reintroduced. Even with more liberal trip limits and new gear options, canary rockfish catch is very close to OY, thus would constrain access to fishing within the RCAs. Thus, bycatch and bycatch mortality within RCAs could increase over *status quo,* if management measures similar to those used in 2000-2002 were employed within the RCAs. Current canary rockfish, therefore may preclude use of small roller gear within the RCAs. A similar circumstance exists for the southern shelf area - boccacio catch under *status quo* is very close to OY.

Emphasis Species
Larger trip limits stemming from a shorter season may allow access to species of groundfish within the RCA that are precluded from harvest under *status quo.* Harvest levels for several species of shelf groundfish are below current OY levels. Use of small footrope gear could allow more access to Dover, English and petrale soles found on the shelf. Unfortunately, canary rockfish and bocaccio catches under *status quo* are very close to OY, so the use of such gear is unlikely.

Time/Area Closures Fishing Season would be significantly different than the other alternatives. The primary effect of seasonal closures is modeled under the trip limit tool for this alternative (see above).

RCAs similar to *status quo* would be used.. RCAs are likely to remain the same as under *status quo* in the near future due to rebuilding requirements of overfished species, however. Alternative 3 application of time/area closures therefore rank the same as *status quo*, or 2nd among alternative scores ranging from 1-3 (Table 4.3.3).

Overfished Groundfish
The principal tool for this alternative is to reduce time on the water using seasonal closures. Reducing time on the water would allow larger trip limits during open periods. As was pointed out above, this would have a positive benefit as larger trip limits tend to reduce bycatch in the form of regulatory induced discard of overfished species. Platooning of the fleet would be done to maintain a year-round flow of groundfish to markets, thus impacts would be comparable to alternative 2. Compared to *status quo*, this alternative would still have a positive benefit in

reducing bycatch and bycatch mortality of overfished species due to the general effect of increased trip limits size. The season may have to be shortened in order to maintain trip limit size. If the season is too short, some fishers may be elect not to fish. Overall catch of overfished species my decline or trip limits could be increased. The impact of effort reduction due to fishers opting out, would be a reduction in bycatch and bycatch mortality of overfished species.

Emphasis Species

In addition to the RCAs described under Alternative 1, the principal tool for this alternative is to reduce time on the water using seasonal closures. Depending on the timing of a seasonal closure, bycatch and bycatch mortality may be reduced. If platooning is considered as an option, fisheries outside of the RCAs might be feasible as increased trip limits would provide some flexibility in application of ratio management. For example, the DTS fishery could provide year round opportunities for a platooned fleet with larger trip limit sizes. In addition, a significant proportion of flatfish are distributed shoreward of RCAs, there may be an opportunity to have exceptions to closures for the shallow water flatfish fishery.

4.2.4 Impacts of Alternative 4: *Fleet sector catch limits*

Summary of Alternative 4 The policy goal of this alternative is to reduce bycatch by setting catch limits for the various fleet sectors and establishing an in-season catch monitoring or verification program to ensure catch caps are not exceeded. In this alternative control of bycatch and bycatch mortality is effected by controlling overall catch and gear effeciency. This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is increased over *status quo* at an increased cost.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 4:

- Harvest Levels (harvest policy, rebuilding) Objectives for optimum yield and rebuilding would remain the same as in s*tatus quo.* Harvest policy would be modified from *status quo* in that OY would be broken down into caps for each fishing sector with in-season monitoring of caps. Fishery sectors for groundfish would be broad consisting of separate fleet caps for limited entry midwater trawl, limited entry bottom trawl, limited entry fixed gear, open access, and recreational fleets. Overfished species constrain harvest of other groundfish and are distributed unevenly along the coast. Thus, this alternative assumes a partitioning of the caps north and south of Cape Mendicino at 40° 10' N. Lat. for most species. When OY is reached, further fishing would be prohibited or severely curtailed. A portion of other groundfish OY would be set aside in reserve for the fishery sector with the lowest bycatch to provide an incentive to lower catch rates of overfished species. The primary direct effect of this Alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. This tool is ranked 2nd out of a range of 1-3 scored for the alternatives (See performance standards and OY reserves in Table 4.3.4)**.**

- **Vessel trip limits** Vessel trip limits would initially be the same as *status quo* and based on previously observed joint catch ratios of overfished and co-occurring groundfish species. Vessel trip limits may be altered compared to the *status quo.* More careful monitoring of catch coupled with fleet sector incentives would reduce catch and bycatch of overfished species. To the degree that limits were liberalized, bycatch and bycatch mortality of overfished species may be reduced. This tool ranks between 2nd and 3rd out of a range of 1-4 scored for the alternatives (Table 4.3.4)**.**
- **Catch Limits** Sector allocation would be used to partition available OY into sector caps by fishery. Increased monitoring and sector management measures would provide fishers with incentives to keep within sector caps reducing bycatch and bycatch mortality compared to the first 3 alternatives. This tool ranks 3rd out of a range of 1-4 scored for the alternatives (Table 4.3.4)

- **Gear Regulations** Gear regulations under this alternative would be the same or similar to *status quo*, and would be structured to keep catches within the OY limits for overfished species. Incentives would be stronger to modify gear in order to reduce bycatch and bycatch mortality, due to strict caps and robust monitoring system of this alternative. Gear modifications that reduced the take of overfished rockfish outside of RCAs would have a direct positive impact on bycatch and bycatch mortality, compared to the first three alternatives. The fate of excluded fish is unknown. Fish interacting with and escaping fishing gear may succumb to delayed mortality even though bycatch in the form of discards is reduced. This tool is ranked 2nd out of a range of 1-3 scored for the alternatives (Table 4.3.4).

- **Time/Area Closures** Initially time and area closures (RCAs) would be similar to those under *status quo*, and would be based on the previously observed catch ratios of various groundfish species. Some additional flexibility might be possible due to increased monitoring and updating of catch ratios and performance of the fishing sectors. This alternative may allow changes in time or depth of RCAs based on OY cap tracking of overfished species. Closures, when and where they occur, may directly reduce bycatch and bycatch mortality of overfished within the closed area. Due to the general lack of incentives to discard overfished species under this alternative, most of the effect of bycatch reduction would likely be accomplished through higher rates of retention. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.4).

- **Capacity Reduction** Capacity reduction is not considered under this alternative. This tool is ranked 3rd out of a range of 1-3 scored for the alternatives (Table 4.3.4)

- **Data Reporting, Record-keeping, and Monitoring** Catch reporting, record keeping, and monitoring uses a more robust program than *status quo*. 100% logbook coverage would be required to aid in improving accuracy of estimated catch by commercial and charter boats. Observer coverage of commercial fleets would be increased and with coverage placed on a subsets of each sector. Observed catch rates would be extrapolated (expanded) to the entire sector. Recreational sampling would be also be increased. The net effect would be to estimate total catch to within $\pm$ 25%. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the first three alternatives as fishers are more likely to retain catches of overfished species . Bycatch mortality of overfished species caught and released in the recreational fishery is unknown. This tool is ranked 2nd out of a range of 1-5 scored for the alternatives (Table 4.3.4).

Impacts on Groundfish

Effects of tools used in alternative 4 to reduce groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.4. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Harvest Levels Objectives for optimum yield and rebuilding would remain the same as in s*tatus quo.* Harvest policy would be modified from *status quo* in that OY would be broken down into caps allocated to each fishing sector with in-season monitoring of caps. Peformance standards and sector allocations with OY reserves should have a significant effect, reducing potential bycatch and bycatch mortality compared to alternatives 1-3. Ranking of this tool as used in alternative 4 would be 3rd out of the range of 1-4 (Table 4.3.4).

Overfished Groundfish
Under this alternative, overfished species OY would be broken down into caps for each fishing sector with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A portion of other groundfish OY would be set aside in reserve for each fishery sector to provide an incentive to lower catch rates of overfished species. If successful, the primary direct effect of this alternative would be reductions in bycatch of overfished species due to strict caps and monitoring of these species. It is highly likely that the shelf dwelling canary rockfish and boccacio will present the biggest challenge to sectors. Current harvest levels under *status quo* conditions are very close to OY. Catch of other overfished species are below OY largely due to fishing constraints caused by these two species.

There is some question as to whether incentives work on a fishery sector basis. Huppert *et al.* (1992) suggested that sector based incentive systems tend to penalize those participants who adopted methods of reducing bycatch of prohibited species as fewer target species are likely to be caught. Sector based incentive programs work best for relatively small and discreet fishing units like fishing co-operatives. The Pacific whiting fishery sector utilizes a similar program to limit harvest of salmon incidental catch.

The limited entry fixed gear fleet would likely be successful limiting bycatch of non-target species of concern (halibut, lingcod, and overfished rockfish), as the fleet size and catch of overfished species is small. In contrast, the recreational sector may have a difficult time controlling catch of overfished species through an incentive program as there are many and diverse participants. Thus, other means of controlling this sectors OY cap would likely be more effective.

Emphasis Species
Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch reducing fishing tactics. A reduction in effort could result from early attainment of overfished species sector caps. The direct impact of OY caps may result in less harvest of other groundfish, thus reducing bycatch and bycatch mortality at the expense of lost economic opportunity. On the other hand, incentives, in the form of additional OY for the fishing sector may change enough of the sectors fishing practices to reduce bycatch of overfished species and increase catch of other groundfish. If bycatch is proportional to catch, bycatch and bycatch mortality may increase for other groundfish.

Vessel trip limits would initially be the same as *status quo* and based on previously observed joint catch ratios of overfished species and various groundfish species. Trip limits might be relaxed (increased) depending on the performance of fleet sectors at maintaining catch caps. Within this alternative, trip limits rank 2nd among alternative scores ranging from 1-4 (Table 4.3.4).

Overfished Groundfish
Vessel trip limits could be altered compared to the status quo due to more careful monitoring of catch, and vessel incentives to minimize catch and bycatch of overfished species, as the season progresses. To the degree that limits were liberalized, bycatch and bycatch mortality of overfished species may be reduced. Alternative 4 applies caps on a sector basis. Individual vessels may not have as strong of an incentive to avoid overfished species as in Alternatives 5 and 6. Therefore, it is likely that the greatest source of bycatch reduction is likely to be due to increased retention rates for bottom trawlers.

Studies of Alaska fisheries have shown that sector caps work with small identifiable fishing units, like cooperatives. The west coast whiting fleet is organized along similar lines and appear successful at implementing voluntary caps on bycatch of prohibited species. Under this alternative, a pelagic fishery catch cap for overfished shelf rockfish and widow rockfish may effectively managed by Pacific whiting cooperatives.

Emphasis Species
Limit changes under this alternative are not likely to affect those species with catch levels below existing cumulative catch limits, especially if they are market limited. Effects of potential limit changes on these species were ranked lower than overfished species (see shaded scores under Trip limits in Table 4.3.4). Catches of more desirable species, like yellowtail rockfish, currently harvested below cumulative catch limits due to constraints associated with overfished species may be more accessible if the vessel sector incentive program is successful.

Gear restrictions Management under alternative 4 would include incentives to modify gear as an aid in reducing bycatch and bycatch mortality and keeping under strict sector caps. Gear restrictions applied within this alternative rank 2nd out of a range of 1-3 among alternatives.

Overfished Groundfish
Gear modifications that reduced the take of rockfish outside of RCAs may have a direct positive impact on bycatch and bycatch mortality of overfished species, compared to the first three alternatives. Depending on the type of gear modification, some un-observed impacts may occur leading to bycatch mortality. Little is known about the survivability of fish escaping through meshes or escape panels. Fish excluder devices that eliminate overfished rockfish species provide a better opportunity for survival than sorting and discarding fish at the surface, which is generally lethal for rockfishes (see discussion under Alternative 1 *status quo* and Davis and Ryer (2003)). Cut-back trawls are being experimented with under EFPs. These nets are thought to be highly selective for flatfish and may allow rockfish to avoid capture without contact (Parker 2003).

With caps applied on a sector basis however, individual vessels may not have as strong of an incentive to modify gear to eliminate take of overfished species as in Alternatives 5 and 6 (see discussion above under **Harvest Levels**).

Emphasis Species
It is hoped that incentives to modify gear to reduce bycatch and bycatch mortality of overfished species would be strong, due to strict caps and robust monitoring system. If sector based caps are

successful at minimizing bycatch of overfished species, more of the OY for other groundfish should be accessible. The midwater trawl fishery may be successful in taking yellowtail rockfish without excessive bycatch of widow rockfish for example. The DTS fishery might enjoy a large portion of overall OY if, through incentives, undersized sablefish and shortspine thornyhead bycatch could be reduced. Impacts to nearshore flatfish bycatch and bycatch mortality are unknown as changes in gear are likely to be done to reduce impacts to overfished species. As pointed out above, the strength of the incentives depends on changes in gear and behavior on the part of the entire sector in order. There may not be as strong as incentive as possible if caps were applied on an individual vessel basis (See alternatives 5 and 6).

Time/area closures Initially time and area closures (RCAs) would be similar to those under *status quo*, and would be based on the previously observed catch ratios of various groundfish species. Some additional flexibility in defining RCAs might be possible if fleet sector response to sector caps reduces bycatch. Time/area closures applied within alternative 4 rank 2nd over a range of 1-3 among alternatives (Table 4.3.4).

Overfished Groundfish

This alternative may allow changes in time or depth of seasonal RCAs if fleet sectors are successful at maintaining harvest levels of overfished species at or below OY sector caps. Impacts to bycatch and bycatch mortality of overfished species would likely be the same as under *status quo*. Gains made due to successful fleet response to sector caps may be offset somewhat if managers change RCA boundaries to allow new opportunities to harvest other groundfish. Encounter rates with overfished shelf rockfish could increase as a result. If fishers retain overfished species, overall bycatch should be less than *status quo.*

Emphasis Species

Initially time and area closures (RCAs) would be similar to those under *status quo*, and would be based on the previously observed catch ratios of various groundfish species. Impacts to bycatch and bycatch mortality would likely be the same as under *status quo.* If RCA boundaries are changed to allow more access to other groundfish, catch, bycatch and bycatch mortality of other shelf groundfish could increase somewhat.

4.2.5 Impacts of Alternative 5: *Vessel catch limits*

Summary of Alternative 5 The policy goal of this alternative is to significantly reduce bycatch by limiting catch of each vessel through the use of transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (IFQs). Direct control of catch and individual vessel accountability sets this alternative apart from the previous alternatives. A robust monitoring or catch verification program would be implemented to ensure catch caps are not exceeded. Discarding of overfished species would be prohibited. Gear regulations would be flexible, allowing fishers the ability to modify gear and operations to avoid catch of overfished species and reduce unwanted bycatch of all species. A system of rewards in the form of reserved OY would be used to create vessel incentives to reduce bycatch of overfished species.

This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is increased over *status quo* at an increased cost.

Discussion of Tools Used The following mix of management measures are applied to create Alternative 5:

- **Harvest Levels** Optimum yield would remain the same as in *status quo,* however distributions of available OY would be broken down into caps for each fishing vessel with in-season monitoring of caps. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. The primary direct effect of this alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. Thus, bycatch (discarded catch) of overfished species should be reduced with this alternative as there would be little incentive to discard. This tool ranks 1st out of a range of 1-2 scored for alternatives (See Performance standard and OY reserves in Table 4.3.5).

- **Vessel trip limits** Vessel trip limits would be relaxed or absent, as each vessel would have an individual caps on overfished and other groundfish species. Direct effects expected under this alternative compared to *status quo* would be a reduction in regulatory induced discard of overfished species due to the absence of trip limits. This tool ranks 1st out of a range of 1-4 scored for the alternatives (Table 4.3.5).

- **Vessel Catch Limits** Individual vessel caps in the form of transferable restricted species catch quotas (RSQ) for overfished stocks and individual transferable fishing quotas (IFQ) for other groundfish species would be established with this alternative. Bycatch could be avoided due to relaxed trip limits. Catch limits should work positively to minimize discard of overfished species as there would exist no incentive to discard fish. In addition, RSQ or IFQ shares could be purchased if a fisher needed more share of groundfish to continue fishing. When vessels attain limits and cease fishing, bycatch and bycatch mortality would also be reduced to the degree overall effort is reduced when a vessel reaches a cap. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of all species with RSQs. This tool ranks 1st or 2nd out of a range of 1-4 for the alternatives, depending on the species (Table 4.3.5).

- **Gear Regulations** Gear regulation would be more flexible than under *status quo.* Gear modification would be facilitated allowing fishers to experiment with different methods to reduce bycatch of overfished species. Strict caps and a robust catch monitoring system would allow fishers to chose modified gear in order to keep within a cap or seek other alternatives such as purchasing more quota shares or fish using a different strategy. This tool ranks 3rd out of a range of 1-3 for the alternatives (Table 4.3.5).

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- **Time/Area Closures** would be applied in a manner similar to the first four alternatives. However, under an RSQ/IFQ program, RCAs as they are currently used may be unnecessary. Once an individual vessel's RSQ/IFQ is attained, the vessel must cease to fish anywhere, until the fisher can obtain more quota. There may some limited circumstances where continued fishing might be allowed where the likelihood of encountering the particular species would be highly unlikely. Under an individual vessel catch limit/quota program, fishers would have greater incentive to improve the selectivity of their fishing gear and techniques, avoiding "troublesome" areas in the process and fishing more in areas where they can maximize their profit.

  Other types of time/area closures, such as habitat areas of particular concern, research reserves, etc., would apply to all types of fishing activities specified for those areas. This tool ranks 1st for most species, out of a range of 1-3 for the alternatives (Table 4.3.5).

- **Capacity Reduction** No direct reduction in capacity is considered under this alternative. See discussion under status *quo.* Some capacity reduction may occur if vessel owners sell RSQ or IFQ shares and elect to fish in a non-groundfish fishery. Capacity reduction accomplished through RSQ/ IFQ sales could have a positive direct effect on the overfished species, if a species cap for a vessel is not used by the vessel. Excess cap could be re-distributed to active fishers or left in reserve. This tool ranks 2nd out of a range of 1-3 for the alternatives (Table 4.3.5).

- **Data Reporting, Record-keeping, and Monitoring** Increased observer coverage would be required. VMS would be used to ensure vessels did not fish within RCAs or other closed areas (PFMC 2003e). Recreational sampling would also be increased under this alternative. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the first three alternatives as fishers are likely to retain catches. Bycatch mortality of groundfish caught and released in the recreational fishery is unknown. This tool ranks 1st or 2nd out of a range of 1-5 scored for the alternatives depending on the species (Table 4.3.5).

Impacts on Groundfish
Effects of tools used in alternative 5 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.5. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Harvest Levels would differ from *status quo* in that OYs would be allocated to individual vessels in the form of RSQ and IFQ shares with a portion held in reserve. Performance standards and OY reserves are required by this alternative. Harvest caps cannot be exceeded by individual vessels and overfished species must be retained. Shares may be purchased in order to continue fishing. This alternative ranks 1st out of a range of 1-3 in terms of performance standards and OY reserves (Table 4.3.5).

Overfished Groundfish
OY for overfished species would be broken down into RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused or reserve OY for other groundfish would be made available to those vessels that had not taken their overfished species OY share.

Canary rockfish and boccacio catches are currently very close to OY, and constrain catches of other co-occurring groundfish. Under this alternative, incentives would be strong to develop specific gear modifications and adopt new fishing strategies to avoid taking these species. Without transferability, it might be impossible to conduct a fishery where encounter rates of these two species is high. OY shares under this alternative will be very small on a per vessel basis. One indirect effect will be a partitioning of the fleet into different fishing strategies, as vessel owners buy and sell RSQ and IFQ shares to make fishing practical and profitable for a particular strategy.

The primary direct effect of this alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. Thus, overfished species bycatch (discarded catch) should be reduced or eliminated with this alternative as there would be less incentive to do so. Discarded fish counts against the IFQ and observer coverage under this alternative is 100% of the commercial fleet. Some discarding could continue in minor nearshore and recreational fisheries.

Emphasis Species
OY for other groundfish would be broken down into IFQs for each fishing vessel with in-season monitoring of caps. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. When OY is reached, further fishing would be prohibited or severely curtailed, unless additional IFQ share was purchased.

As was pointed out above, there may be strong incentives to buy and sell RSQ and IFQ shares in order to more selectively fish using different strategies. Fishers are not currently able to access other groundfish at or near MSY levels. As an example, some fishers may successfully modify gear and/or purchase enough canary rockfish RSQ to take advantage of yellowtail rockfish IFQ.

If enough fishers are successful at acquiring RSQ shares and/or are able to make appropriate gear modifications to catch more OY of other groundfish then catches of more species may move toward OY levels. The result may be an increase in bycatch and bycatch mortality of other groundfish due to higher catch attainment.

Some bycatch and discard mortality could still occur if a vessel approaches attainment of the IFQ. There may be some incentive to finish out the season by spreading out the remaining IFQ in order to maintain the supply of groundfish to the market. In addition, some bycatch and bycatch mortality could occur on the last trip when the IFQ is reached.

Vessel trip limits would be relaxed or absent. Essentially the trip limit would amount to the RSQ or IFQ that could be taken on an annual basis. Markets may influence trip size, however, and some bycatch and bycatch mortality may occur as a consequence. See discussion above under Harvest Levels. Trip limits rank 1st out of a range of 1-4 for this alternative (Table 4.3.5).

Overfished Groundfish

There would be no need for a trip limit as each vessel would have an individual cap on overfished species and an ITQ for other groundfish species. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species due to relaxed trip limits.

Emphasis Species

Vessel trip limits would be relaxed or absent, as each vessel would have an individual RSQ cap on overfished species and an IFQ for other groundfish species. Under this alternative, regulatory induced discards of other groundfish are not anticipated. Market induced discard resulting from size, price, and quantity requirements would be expected.

Vessel catch limits Transferable individual vessel RSQs for overfished species would be established with this alternative. Transferable IFQs would be established for other groundfish species (See discussion under **Harvest Levels**). Overfished species would have to be retained and discarded catch of other species would count against a vessels quota. Bycatch and bycatch mortality would therefore be significantly reduced. compared to other alternatives not using individual quotas. Vessel catch limits in the form of RSQs and IFQs rank 2nd out of a range of 1-4 scored for the alternatives.

Overfished Groundfish

Individual catch limits should work positively to reduce discard of overfished species to near zero, due to a 100% retention requirement and relaxed trip limits. Regulatory induced discard associated with trip limits should be also be eliminated. OY reserves would provide incentives to minimize catch of overfished species.

RSQ shares would need to be purchased if a fisher needed more share of groundfish to continue fishing. Shares of canary rockfish and bocaccio in particular would be very small on a per vessel basis. Fishers are likely to purchase RSQ shares to participate in a fishing strategy that increases the likelihood of encountering canary rockfish and bocaccio. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species.

Emphasis Species
Individual transferable quotas (IFQs) would be established for other groundfish species. Regulatory induced bycatch for some species of other groundfish like yellowtail rockfish and shortspine thornyhead could be avoided due to relaxed trip limits. IFQ shares will need to be purchased if a fisher needed more share of groundfish to continue fishing. Vessel catch limits are not expected to change bycatch and bycatch mortality of some groundfish species currently limited by market factors. Sablefish is not currently overfished and 100% retention would not be required. Some high-grading and discard is likely to occur with this species. English sole is another example of a species limited primarily by market factors. Bycatch of some species could increase if a vessel owner sold IFQ shares for some species and continued to fish in an area for other species.

Gear restrictions would be more flexible than *status quo.* Individual fishers would have the choice to modify gear to reduce effeciency, but would not be required to do so. Since regulatory gear requirements would be relaxed, fishers could also develop gear to more efficiently take a particular species. As a bycatch and bycatch mortality reduction tool, a rank of 3 out of a range of scores from 1-3 was assigned for this alternative, due to reduced regulatory constraints (Table 4.3.5. Note: from an economic standpoint, this tool may rank higher).

Overfished Groundfish
Gear modification would be facilitated allowing fishers to experiment with different methods to reduce bycatch of overfished shelf rockfish species. Strict caps and a robust catch monitoring system would allow relaxation of the EFP process normally required for modified gear. To the degree gear modifications were successful, this alternative may have a positive direct effect of reducing bycatch and bycatch mortality of overfished species. A more likely scenario is a reduction in bycatch due to higher retention rates, as fishers by and sell RSQ shares to develop selective fishing strategies that allow more access to other groundfish..

Emphasis Species
Gear regulation would be more flexible, allowing experimentation and modification to reduce bycatch and bycatch mortality of overfished species. The impact of such modifications on other groundfish is unknown.

Time/area closures would be based more on need to protect sensitive species, to protect essential fish habitat, and protect other benthic infauna such as corals and invertebrates. In order to accomplish this, the alternative proposes closures of areas to groundfish gears that make bottom contact. This tool is ranked 1st over a range of 1-3 in reducing bycatch and bycatch mortality of demersal bottom dwelling species.

Overfished Groundfish

Cowcod may still require an RCA to accomplish rebuilding. In addition other areas closed to bottom trawling, pot or longline gear in order to protect essential fish habitat would significantly reduce bycatch and bycatch mortality within those areas. Overfished species such as Pacific whiting and widow rockfish could still be taken up to OY dictated RSQ caps by vessels using pelagic gear (pelagic trawls and some hook and line gears). The effect of an area closed to bottom fishing would have less impact on the bycatch and bycatch mortality of Pacific whiting and widow rockfish (See shaded scores in Table 4.3.5).

Emphasis Species

Areas closed to bottom trawling, pot, and longline gears to protect essential fish habitat would significantly reduce other groundfish bycatch and bycatch mortality.

Capacity reduction No direct reduction in capacity is considered under this alternative. Some reduction could occur if fishers sold their RSQ and IFQ shares and retired from the fishery. Indirectly, capacity reduction could occur, and this tool is ranked 2nd over a range of alternative scores from 1-3 (Table 4.3.5).

Overfished Groundfish

Some capacity reduction may occur if vessel owners sell RSQ and IFQ shares and elect to fish in a non-groundfish fishery. Capacity reduction accomplished through RSQ and IFQ sales could have a positive direct reducing bycatch of overfished species. Some vessel owners may also chose to fish in other fisheries and hold onto RSQ and IFQ shares. To the degree shares were unused, catch, bycatch, and bycatch mortality would be reduced.

Emphasis Species

See discussion above.

4.2.6 Impacts of Alternative 6: *Full retention - MPAs*

Summary of Alternative 6: The policy goal of this alternative is to reduce bycatch to near zero by establishing large MPAs in areas where overfished groundfish are most likely to be encountered, prohibiting discard of groundfish, and accurately accounting for catch. This alternative controls bycatch and bycatch mortality by direct controls on both catch, effort, and gear efficiency.

This alternative supports Council objectives for protecting and rebuilding depleted groundfish stocks at a higher cost for monitoring than status quo.

Discussion of Tools Used: The following mix of management measures are applied to create Alternative 6:

- **Harvest Levels** Harvest OY would remain the same as in *status quo,* however distributions of available OY would be broken down into caps for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. The primary direct effect of this Alternative would be a reductions in bycatch of groundfish to near 0 due to strict caps, 100% retention of all groundfish, and 100% observer coverage of the commercial fleet. Unobserved recreational trips would be the primary source bycatch. This tool ranks 1st out of a range of 1-2 scored for alternatives (See Performance standard and OY reserves in Table 4.2.6).

- **Vessel trip limits** Vessel trip limits would be relaxed or absent, as each vessel would have an individual cap on overfished species. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard due to relaxed trip limits and 100% retention requirement. This tool ranks 1st out of a range of 1-4 scored for the alternatives (Table 4.3.5).

- **Vessel Catch Limits** Individual vessel caps in the form of RSQs for overfished stocks and IFQs for other groundfish would be established. 100% of all groundfish would be retained. Thus, bycatch would be near 0. This tool ranks 1st or 2nd out of a range of 1-4 for the alternatives, depending on the species (Table 4.3.6).

- **Gear Regulations** Gear regulation would be actively used to reduce bycatch and bycatch mortality. Through an incentive program, fishers would be encouraged to experiment with gear modifications, use different gear types, or adopt different fishing strategies to stay within bycatch caps. 100% observer coverage of the commercial fleet would allow relaxation of the EFP process normally required for modified gear. Gear modifications may result in exclusion of undersized and overfished groundfish. Bycatch could take the form fish caught but excluded by the gear. The bycatch mortality of escaping fish is unknown. This tool ranks 1st out of a range of 1-3 scored for the alternatives (Table 4.3.6).

- **Time/Area Closures** would take the form of large permanent or semi-permanent MPAs. The placement and size may differ significantly from all of the other alternatives. For purposes of this analysis, we assume MPAs would be patterned after option 3a of the Council's Phase I Technical Analysis of marine reserves (PFMC 2001). This type of reserve would be tailored to protect overfished species and would set aside 20% of the habitat or biomass with a similar reduction in harvest of the species. MPAs should directly reduce bycatch and bycatch mortality of fish within the closed area. The amount of reduction in bycatch and bycatch mortality due to an MPA would be in proportion to the amount of habitat set aside compared to the total amount of habitat vulnerable to fishing. This would vary depending on the species protected and design of the MPA. The 100% retention requirement would still be the primary means of reducing bycatch outside of MPAs. Some indirect benefits to the groundfish resource would likely occur due to reduce disturbance of habitat afforded by an MPA. This tool ranks 1st out of a range of 1-3 scored for the alternatives (Table 4.3.6).

- **Capacity Reduction** No direct reduction in capacity is considered under this alternative. Tradable IQs may result in consolidation of the fleet though sales of RSQ and IFQ shares (See alternative 5 discussion on capacity reduction). This tool ranks 2nd out of a range of 3 for the alternatives (Table 4.3.6).

- **Data Reporting,** Record-keeping, and Monitoring 100% observer coverage and 100% retention of all groundfish would be required for all commercial fishing sectors. Recreational sampling would also be increased under this alternative. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch compared to other alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the other alternatives, as fishers will be required to retain catches. Bycatch mortality of fish caught and released in the recreational fishery is unknown. This tool ranks 1st out of a range of 1-5 scored for the alternatives (Table 4.3.6).

Impacts on Groundfish

Effects of tools used in alternative 6 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.6. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Harvest Levels OYs would remain the same as in *status quo,* however distributions of available OY would be broken down into caps for each fishing vessel with in-season monitoring of caps. Performance standards and OY reserves are required by this alternative. Harvest caps cannot be exceeded by individual vessels and overfished species must be retained. Shares may be purchased in order to continue fishing. This alternative ranks 1st out of a range of 1-3 in terms of performance standards and OY reserves (Table 4.3.6).

<u>Overfished Groundfish</u>
OY for overfished species would then be broken down into caps or RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment.

The impacts of application of this tool within alternative 6 is similar to the impacts described under alternative 5. Small individual shares of RSQ for some species like canary rockfish and boccacio would have to be purchased and sold to consolidate enough share to fish under certain strategies. The primary direct effect of this Alternative would be reductions in bycatch due to strict caps and 100% retention of all groundfish. Thus, overfished species bycatch (discarded catch) should be near 0 with this alternative due to 100% retention requirement. Unobserved recreational trips would be the primary source overfished species bycatch.

<u>Emphasis Species</u>
Objectives for optimum yield would remain the same as in *Status quo*. OY for overfished species only would then be broken down into caps for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. Tradable IFQ shares would have impacts similar to alternative 5 in that shares are likely to be bought and sold to consolidate fishing strategies. This alternative differs from alternative 5 in that all groundfish must be retained. The primary direct effect of this Alternative would be reductions in bycatch due to strict caps and 100% retention of all groundfish

Vessel trip limits would be relaxed or absent, as each vessel would have an individual RSQ and IFQ caps on groundfish. Essentially the trip limit would take the form of an individual vessel annual quota. Trip limits rank 1st out of a range of 1-4 for this alternative (Table 4.3.6).

<u>Overfished Groundfish</u>
Vessel trip limits would be relaxed or absent, as each vessel would have an individual cap on overfished species. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species due to relaxed trip limits and 100% retention requirement.

<u>Emphasis Species</u>
Vessel trip limits would be relaxed or absent, as each vessel would have an individual cap on other groundfish. Direct effects expected under this alternative compared to status quo would be a reduction in size related and market induced discard of other groundfish due to the 100% retention requirement.

Vessel catch limits Individual vessel caps for overfished stocks would be established with this Alternative. 100% of all groundfish would be retained. Bycatch and bycatch mortality would therefore be significantly reduced. compared to other alternatives not using individual quotas and to alternative 5. Vessel catch limits in the form of RSQs and IFQs rank 1st out of a range of 1-4 scored for the alternatives.

<u>Overfished Groundfish</u>
The impacts to overfished groundfish would be similar to those under alternative 5. The 100% retention requirement would and 100% observer coverage would reduce bycatch of overfished species to near 0. Regulatory induced bycatch would be eliminated. See discussion above under alternative 5.

<u>Emphasis Species</u>
Individual transferable quotas (IFQs) would be established for other groundfish with this alternative. This application of catch limits in this alternative be similar to alternative 5. Impacts would be different due to the 100% retention requirement and 100% observer coverage. Bycatch of other groundfish would be near zero and regulatory and market related bycatch would be eliminated.

Gear restrictions would be applied more fully than *status quo.* Gear restrictions ranks 1st out alternative scores ranging from 1-3 (Table 4.3.6).

<u>Overfished Groundfish</u>
Fishers would be encouraged to experiment with gears in order to reduce bycatch and stay within RSQs. The best gears at reducing bycatch would be developed and applied. Some unseen mortality could take the form of overfished species caught but excluded by fishing gears. The bycatch mortality of escaping fish is unknown.

<u>Emphasis Species</u>
Fishers would be encouraged to experiment with gears in order to reduce bycatch and stay within IFQs. The best gears at reducing bycatch would be developed and applied. The 100% retention requirement may be very challenging for some fishers seeking ways of selecting against un-marketable fish. For example, fishers may increase mesh-size to in an attempt to eliminate most of the undersized fish. Reduction of catch of unwanted fish would contribute to the reduction in bycatch. However, unseen mortality could take the form of undersized fish caught but excluded by the gear. Impacts of direct and delayed mortality of escaping fish is poorly understood.

Time/area closures would take the form of permanent or semi-permanent MPAs. The placement and size may differ significantly from all of the other alternatives. We assume these areas to set aside at least 20% of the habitat or biomass of the overfished species, and that biomass available for harvest would be similarly reduced. MPAs would have more permanency than RCAs described in previous alternatives. Areas proposed by this alternative would be closed to all fishing. This tool ranks 1st out of alternative scores ranging from 1-3 (Table 4.3.6)

<u>Overfished Groundfish</u>
Habitat mapping would need to be accomplished in order to define new boundaries for overfished species. Because there are several overfished species, the proportion of area set aside to total fishable area may be larger or smaller than 20%. Impacts will be difficult to determine until the location and composite size of these areas are determined.

MPAs should directly reduce bycatch and bycatch mortality of overfished species within the closed area. The amount of reduction in bycatch and bycatch mortality due to an MPA would be in proportion to the amount of overfished species habitat set aside compared to the total amount of overfished species habitat vulnerable to fishing. Movement of fish into and out of reserves may confound efforts to protect fish using them. If harvest is not reduced, effort will likely shift away from MPAs to adjacent areas increasing impacts of fishing outside of the MPAs. Bycatch and bycatch mortality could increase unless catch is reduced in proportion the area set aside.
Studies of groundfish trawl fishery of the coast of British Columbia suggest fishing changes species composition and spatial structure of the fishery. Movement of trawlers through redistribution of effort and fish movement appears to reduce vulnerability (Walters and Bonfil 1999). The authors suggested use of individual effort quotas (rather than catch) and use of carefully placed MPAs to protect sensitive stocks.

Impacts of various MPA options for bocaccio, Pacific ocean perch, and lingcod are described in the Phase I Council report on marine reserves (PFMC 2001). Benefits of the reserves appear to be a reduction in rebuilding time similar to that which could be obtained through a reduction in exploitation rate, and reduced habitat impacts. Some loss of fishing opportunity will occur with MPAs using a reduced harvest rate (option 3a).

The 100% retention requirement would still be the primary means of reducing overfished species bycatch. Some indirect benefits to the overfished species would likely occur due to reduced disturbance of habitat afforded by an MPA.

<u>Emphasis Species</u>
Time/area closures would take the form of permanent or semi-permanent MPAs. The placement and size may differ significantly from all of the other alternatives. MPAs should directly reduce bycatch and bycatch mortality of other groundfish species within the closed area. The amount of reduction in bycatch due to an MPA would be in proportion to the amount of other species living within overfished species habitat set aside, compared to the total amount of habitat vulnerable to fishing.

The 100% retention requirement would be the primary means of reducing bycatch outside of MPAs.

Glossary and Acronyms

A

ABC	Acceptable biological catch – see below
Abyss	The deepest part of the ocean.
Acceptable biological catch	(**ABC**) Refers to the allowable catch for a species or species group, based on its estimated abundance. The ABC is used to set the upper limit of the annual total allowable catch and is calculated by applying the estimated or proxy harvest rate that produces maximum sustainable yield to the estimated exploitable stock biomass.
Allocation	Distribution of the opportunity to fish among user groups or individuals. The share a user group gets in sometimes based on historic harvest amounts.
Alternatives	Different combinations of management objectives and measures to reduce bycatch to the extent practicable, reduce bycatch mortality, and to assess the amount and type of bycatch in the fishery. This EIS analyzes the environmental impacts of each alternative.
Angler	A person catching fish or shellfish with no intent to sell. This includes people releasing the catch.
Annuli	Annual variations in the pattern of growth rings on fish scales or otoliths.
Anthropogenic	Refers to the effects of human activities.

B

B_0	Unfished biomass; the estimated size of a fish stock at equilibrium in the absence of fishing.
$B_{25\%}$	25% of unfished biomass. This is the Council's threshold for declaring a stock overfished or the Minimum Stock Size Threshold.
$B_{40\%}$	40% of unfished biomass. This is the Council's threshold for declaring a stock rebuilt or the size of the stock estimated to produce MSY. This is also referred to as B_{MSY}.
Bag limit	The number and/or size of a species that a person can legally take in a day or trip. This may or may not be the same as a possession limit.
Baleen	A specialized plate of horny material used by some species of whales (Mysticetes) to filter-feed.
Barotrauma	Physical trauma or injury to a fish due to pressure change. When a fish is rapidly brought from deep water to the surface, the drop in pressure can cause a variety of physical problems, such as severe expansion of the swim bladder and gas bubbles in the blood.
Bathymetry	The measurement of ocean depth.
Bathypelagic Zone	The zone of the ocean that extends from 1,000m to 4,000m below the surface of the ocean.
Benthic	Refers to organisms that live on or in the ocean floor.

Benthic Invertebrate	An animal, such as a mollusk, with no spinal column that lives on the ocean floor.
Best available science	The term "best available science" comes from the second National Standard listed in the Magnuson-Stevens Act and is the informational standard mandated for decision-making.
Bight	A name for the water body found abutting a large indentation in the coast. A bight is less enclosed than a bay.
Bimodal distribution	Indicating two length groups within which individuals are most abundant, possibly with other less abundant length groups around them.
Bioaccumulation	The build-up over time of substances (like metals) that cannot be excreted by an organism.
Biodiversity	The variation in life on Earth reflected at all levels, from various ecosystems and species, to the genetic variation within a species. See also ecosystem diversity, species diversity, genetic diversity.
Biological Opinion	A scientific assessment issued by the National Marine Fisheries Service, as required by the Endangered Species Act for listed species.
Biomass	The total weight of a group (or stock) of fish in a given area. The term biomass means total biomass (age one and above) unless stated otherwise.
BiOp	Biological opinion (see above)
Biota	Refers to any and all living organisms and the ecosystems in which they exist.
Biotic Factor	A living component of the environment which arises from and affects living organisms (distinct from physical factors). For example, the interaction between predators and prey is a biotic interaction.
Bioturbation	Disturbance of soft sediments by the movements and feeding activities of infauna (animals that live just beneath the surface of the sea bed).
B_{MSY}	The biomass that produces the maximum sustainable yield.
BO	Biological opinion (see above)
BRD	Bycatch reduction device (finfish excluders, etc.). These are devices incorporated in fishing gears designed to reduce the take of non-target species.
Bycatch	In this EIS, the term bycatch is used to mean discarded catch of any living marine resource, plus any unobserved mortality that results from a direct encounter with fishing gear. This is slightly broader than the Magnuson-Stevens Act definition, which is limited to fish and therefore does not include marine mammals and seabirds. These species are included in this EIS definition because they are protected by other laws and must also be avoided by fishers. Bycatch includes economic discards, regulatory discards, and fish donated to a charitable organization.
Bycatch model	A model used to calculate amounts of overfished species and other groundfish expected to be caught under various trip limits or certain combinations of measures. Strictly speaking, it calculates expected catch rather than bycatch.

C

CA	California

CalCOFI California Cooperative Fishery Investigation

California Rockfish Conservation Area The **CRCA** is defined as, (1) Ocean waters 20 fm to 250 fm between Cape Mendocino and Point Reyes and 20fm to 150 fm between Point Reyes and the U.S.-Mexico Border, and (2) the Cowcod Conservation Areas. The purpose of the CRCA is to regulate all gear types that have a potentially significant affect on rebuilding of overfished rockfish species south of Cape Mendocino.

California Bight The region of concave coastline off Southern California between the headland at Point Conception and the U.S./Mexican border, and encompassing various islands, shallow banks, basins and troughs extending from the coast roughly 200 km offshore.

Catch The total number or poundage of fish captured from an area over some period of time. This includes fish that are caught but released or discarded instead of being landed. The catch may take place in an area different from where the fish are landed. Note that catch, harvest, and landings are different terms with different definitions.

Catcher/processor A factory-trawl vessel that participates in the Pacific whiting fishery. This type of vessel catches fish and processes fish. Also, a sector of the whiting fishery.

Catch per unit of effort (CPUE) The quantity of fish caught (in number or in weight) with one standard Unit of fishing effort; (e.g., number of fish taken per 1,000 hooks per day or weight of fish, in tons, taken per hour of trawling). CPUE is often considered an index of fish biomass (or abundance). Sometimes referred to as catch rate. CPUE may be used as a measure of economic efficiency of fishing as well as an index of fish abundance.

CCA Cowcod Conservation Area(s) - see below

CDFG California Department of Fish and Game

CEQ Council on Environmental Quality

Cetaceans Marine mammals of the order *Cetacea*. Includes whales, dolphins and porpoises.

CFR Code of Federal Regulations – see below

cm centimeter

Coastal pelagic species (**CPS**) Coastal pelagic species are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. They are usually planktivorous (plankton-eating) and the main forage of higher level predators such as tuna, salmon, most groundfish, and man. Examples are herring, squid, anchovy, sardine, and mackerel.

Coastal Zone Management Act (**CZMA**) An act of federal law with the main objective to encourage and assist states in developing coastal zone management programs, to coordinate state activities, and to safeguard regional and national interests in the coastal zone.

Code of Federal Regulations (**CFR**) A codification of the regulations published in the *Federal Register* by the executive departments and agencies of the federal government. The CFR is divided into 50 titles that represent broad areas subject to federal regulation. Title 50 contains wildlife and fisheries regulations.

Codend The end of a trawl net. Fish are eventually swept into the codend as the net is dragged along.

Cohort	In a stock, a group of fish generated during the same spawning season and born during the same time period. Also, in cold and temperate areas, where fish are long-lived, a cohort corresponds usually to fish born during the same year (a year class).
Commercial fishing	Fishing in which the fish harvested, either whole or in part, are intended to enter commerce through sale, barter, or trade.
Commercial Fishery	A term related to the whole process of catching and marketing fish and shellfish for sale. It refers to and includes fisheries resources, fishermen, and related businesses directly or indirectly involved in harvesting, processing, or sales.
Community	An ecological unit composed of the various populations of micro-organisms, plants, and animals that inhabit a particular area.
Continental Shelf	The submerged continental land mass, not usually deeper than about 100 fathoms (200 m). The shelf may extend from a few miles off the coastline to several hundred miles.
Continental Slope	The steeply sloping seabed that connects the continental shelf and continental rise.
Convergence	The contact at the sea surface between two water masses converging, one plunging below the other.
Co-occurring stocks	Stocks of different fish that swim or school near one another, and may be caught together.
Coriolis effect	The deflection of air or water bodies, relative to the solid earth beneath, as a result of the earth's eastward rotation.
Council	Pacific Fishery Management Council
Cowcod Conservation Area(s)	(**CCA**) Two areas located in the Southern California Bight southwest of Santa Monica to the California-Mexico border that encompass roughly 4,300 nm^2 of habitat where the highest densities of cowcod occur. These areas are closed to bottom fishing in order to rebuild the cowcod stock to B_{MSY}.
CPFV	Commercial passenger fishing vessel or charterboat operating in waters off California
CPS	Coastal pelagic species - see above
CPUE	Catch per unit of effort - see above
CRCA	California Rockfish Conservation Area - see above
Cumulative limit	The total allowable amount of a species or species group, by weight, that a vessel may take and retain, possess, or land during a period of time. Fishers may take as many landings of a species or species complex as they like as long as they do not exceed the cumulative limit that applies to the vessel or permit during the designated period.
CZMA	Coastal Zone Management Act - see above

D

Decomposer An organism which gains energy by breaking down the final remains of living things. Predominantly bacteria and fungi, decomposers are important in freeing the last of minerals and nutrients from organic matter and recycling them back into the food web. See also decomposition; compare detrivore.

Decomposition The biochemical process where biological materials are broken down into smaller particles and eventually into basic chemical compounds and elements. See also decomposer.

DEIS Draft environmental impact statement

Demersal Fish and animals living in close relation with the sea floor.

Density dependence The degree to which recruitment changes as spawning biomass changes. Typically we assume that a Beverton-Holt form is appropriate and that the level of density-dependence is such that the recruitment only declines by 10% when the spawning biomass declines by 50%.

Derby fishery A fishery of a few days' or weeks' duration during which fishers compete to take as much catch as they can before the fishery closes.

Detritus Dead organic matter of plant or animal. See also detrivore.

Detrivore An organism that feeds on large bits of dead and decaying organic matter (detritus). What detrivores leave behind is used by decomposers. Crabs and seabirds are examples of detrivores. Compare decomposer; see also detritus.

Diatom One-celled phytoplankton with an external skeleton of silica.

Dispersal The spreading of individuals throughout suitable habitat within or outside the population range. In a more restricted sense, the movement of young animals away from their point of origin to locations where they will live at maturity

Distribution (1) A species distribution is the spatial pattern of its population or populations over its geographic range. (2) A population age distribution is the proportions of individuals in various age classes. (3) Within a population, individuals may be distributed evenly, randomly, or in groups throughout suitable habitat.

Diversity Genetic variations that allow a population to use a wider array of environments, protect against short-term spatial or temporal changes in the environment and survive long-term environmental changes.

Downwelling The process whereby prevailing seasonal winds create surface currents that cause surface water to sink, bringing nutrient-poor ocean surface water into the area.

DTS complex Dover sole/thornyhead/trawl-caught sablefish complex

E

EA Environmental assessment – see below

EC Enforcement Consultants – see below

Ecological Niche The role a plant or animal plays in its community. The niche of an organism is defined by what it eats, its predators, salt tolerances, light requirements etc. Two species are not stabile if they both live in the same habitat if they occupy identical niches.

Ecology The study of the physical and biological interactions between an organism and its natural environment.

Economic discard	The portion of bycatch that is not caused by regulations but is related to other factors. Fish discarded because they are too small to be sold, or the wrong species, are considered to be economic discards. Broadly defined it can mean all discard that is not related to regulations.
Ecosystem	A community of plants, animals and other organisms that are linked by energy and nutrient flows and that interact with each other and with the physical environment.
Ecosystem Diversity	The diversity of biological communities and their physical environment. Diversity is determined by the species composition, physical structure and processes within an ecosystem. This is the highest level of biodiversity. See also biodiversity; compare species diversity, genetic diversity.
EEZ	Exclusive Economic Zone – see below
Effects	Impacts; anticipated results of an action. Effects include ecological, aesthetic, historic, cultural, economic, social, or health. They may be beneficial or detrimental. An EIS describes and analyzes anticipated effects of the alternatives. (Also, see impacts below)
Effort	The amount of time and fishing power used to harvest fish. Fishing power includes gear size, boat size, and horsepower.
EFH	Essential fish habitat – see below
EFP	Exempted fishing permit – see below
EIS	Environmental impact statement – see below
Ekman circulation	Movement of surface water at an angle from the wind, as a result of the Coriolis effect.
El Niño Southern Oscillation	(**ENSO** or **El Niño**) Abnormally warm ocean climate conditions, which in some years affect the Eastern coast of Latin America (centered on Peru) often around Christmas time. The anomaly is accompanied by dramatic changes in species abundance and distribution, higher local rainfall and flooding, massive deaths of fish and their predators. Many other climatic anomalies around the world are attributed to consequences of El Niño. See also La Niña, below.
Endangered Species Act	(**ESA**) An act of federal law that provides for the conservation of endangered and threatened species of fish, wildlife, and plants. When preparing fishery management plans, councils are required to consult with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to determine whether the fishing under a fishery management plan is likely to jeopardize the continued existence of an ESA-listed species, or to result in harm to its critical habitat.
Endemic	An animal or plant species that naturally occurs in an area.
Energetics	The study of the flow and transformation of energy, as between trophic levels.
Enforcement Consultants	A Council committee that provides advice on enforcement of fishery regulations.
ENSO	El Niño Southern Oscillation – see above
Environment	All of the physical, chemical, and biological factors in the area where a plant or animal lives.

Environmental assessment	(**EA**) As part of the National Environmental Policy Act (NEPA) process, an EA is a concise public document that provides evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact.
Environmental impact statement	(**EIS**) As part of the National Environmental Policy Act (NEPA) process, an EIS is an analysis of the expected impacts resulting from the implementation of a fisheries management or development plan (or some other proposed action) on the environment. EISs are required for all fishery management plans as well as significant amendments to existing plans. The purpose of an EIS is to ensure that the fishery management plan gives appropriate consideration to environmental values in order to prevent harm to the environment.
EO	Executive Order
EO 12866	A Federal executive order that, among other things, requires agencies to assess the economic costs and benefits of all regulatory proposals and complete a Regulatory Impact Analysis (RIA) that describes the costs and benefits of the proposed rule and alternative approaches, and justifies the chosen approach. See RIR.
Epibenthic	A term for organisms that live attached to the bottom.
Epipelagic zone	The upper region of the sea from the surface to about 200-300 meters depth. see Photic Zone
Epiphyte	A plant that grows on another plant.
ESA	Endangered Species Act
Essential fish habitat	(**EFH**) Those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.
Estuary	A semi-enclosed body of water with an open connection to the sea. Typically there is a mixing of sea and fresh water, and the influx of nutrients from both sources results in high productivity.
Evolutionarily Significant Unit	**(ESU)** a population segment equivalent to the “Distinct Population” referred to in the Endangered Species Act
Exclusive Economic Zone	(**EEZ**) All waters from the seaward boundary of coastal states out to 200 nautical miles. This was formally called the Fishery Conservation Zone (FCZ).
Exempted fishing permit	(**EFP**) A permit issued by National Marine Fisheries Service that allows exemptions from some federal fishing regulations in order to study the effectiveness, bycatch rate, or other aspects of an experimental fishing gear or technique.
Exploitable biomass	The biomass that is available to a unit of fishing effort. Defined as the sum of the population biomass at age (calculated as the mean within the fishing year) multiplied by the age-specific availability to the fishery. Exploitable biomass is equivalent to the catch biomass divided by the instantaneous fishing mortality rate.
Extirpation	Situation when something is no longer present.
Exvessel	Refers to activities that occur when a commercial fishing boat lands or unloads a catch. For example, the price received by a captain for the catch is an exvessel price.

F

F The rate of fishing mortality. – see below

F_{MSY} is the fishing mortality rate that maximizes catch biomass in the long term.

F_{OF} is the rate of fishing mortality defined as overfishing.

$F_{x\%}$ is the rate of fishing mortality that will reduce female spawning biomass per recruit to x% of its unfished level. $F_{100\%}$ is zero, and $F_{40\%}$ is believed to be a reasonable proxy for F_{MSY} for some species.

Factory-trawl A type of vessel that catches fish with trawl gear and processes the fish onboard. Sometimes called catcher/processor. In the West Coast groundfish fishery, the only target species for this type of vessel is Pacific whiting.

Fathom Six feet.

FEAM Fishery economic assessment model – see below

Fecundity The potential of an organism to produce offspring, measured in the number of gametes produced.

Federal Register The *Federal Register* is the official daily publication for Rules, Proposed Rules, and Notices of Federal agencies and organizations, as well as Executive Orders and other Presidential documents. Fisheries regulations are not considered final until they are published in the *Federal Register*.

Finfish A common term to define fish as separate from shellfish.

Fish Fish means finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds.

Fish stock A population of a species of fish from which catches are taken in a fishery. Use of the term "fish stock" usually implies that the particular population is more or less isolated from other stocks of the same species, and hence self-sustaining.

Fisheries observers Trained professionals who monitor and record catch data from commercial fishing vessels and processing facilities. Observers collect data on species composition of the catch, weights, and disposition of fish caught, seabird sightings and marine mammal interactions. Observers also collect biological data such as sexed fish lengths, weights and aging structures.

Fishery All the activities involved in catching a species of fish or group of species.

Fishery-dependent Describes data about fish resources collected by sampling commercial and recreational catches.

Fishery-independent Describes data about fish resources collected by methods other than sampling commercial and recreational catches. An example of such a method is a NMFS trawl survey.

Fishery economic assessment model (**FEAM**) uses historical landings data, information on industry cost and margin structure (vessels and processors), and income multipliers generated by IMPLAN to produce estimates of "regionalized" local income impact after deducting for leakage of payments to non-residents and to non-local suppliers, wholesalers, and manufacturers.

Fishery management plan (**FMP**) A plan, and its amendments, that contains measures for conserving and managing specific fisheries and fish stocks.

Fishing	The catching, taking, or harvesting of fish; the attempted catching, taking, or harvesting of fish; any other activity that can reasonably be expected to result in the catching, taking, or harvesting of fish; any operations at sea in support of, or in preparation for, any of these activities. This term does not include any activity by a vessel conducting authorized scientific research.
Fishing community	A community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs. Includes fishing vessel owners, fishing families, operators, crew, recreational fishers, fish processors, gear suppliers, and others in the community who depend on fishing.
Fishing mortality	(**F**) - A measurement of the rate of removal of fish from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year; instantaneous is that percentage of fish dying at any one time. The acceptable rates of fishing mortality may vary from species to species.
Fishing year	January 1 through December 31.
Fixed gear	Fishing gear that is stationary after it is deployed (unlike trawl or troll gear which is moving when it is actively fishing). Within the context of the limited entry fleet, "fixed gear" means longline and fishpot (trap) gear. Within the context of the entire groundfish fishery, fixed gear includes longline, fishpot, and any other gear that is anchored at least at one end.
fm	fathom (6 feet)
FMP	fishery management plan – see above
Food Chain	A linear sequence of organisms that exist on successive trophic levels within a natural community, through which energy is transferred by feeding. Primary producers capture energy from the environment (through photo- or chemo-synthesis) and form the base of the food chain. Energy is then passed to primary consumers (herbivores) and on to secondary and tertiary consumers (carnivores and top carnivores) (e.g. phytoplankton -> zooplankton -> herring -> salmon -> killer whales). Once they die, these organisms are in turn consumed and their energy transferred to detrivores and decomposers.
Food Web	A non-linear network of feeding between organisms that includes many food chains, and hence multiple organisms on each trophic level. A network describing the feeding interactions of the species in an area.
Forage	Fish such as herring, smelt and krill that are eaten by seabirds, mammals, and larger fish.
FWS	U.S. Fish and Wildlife Service

G

Gamete	A reproductive cell.
GAP	Groundfish Advisory Subpanel – see below
GF	Groundfish
Ghost fishing	Situation when abandoned fishing gear continues to catch organisms
Gillnet	A curtain-like net suspended in the water with mesh openings large enough to permit only the heads of the fish to pass through, ensnaring them around the gills when they attempt to escape

GMT	Groundfish Management Team – see below
Green mud	Greenish sand deposits in which glauconite is abundant.
Groundfish	A species or group of fish that lives most of its life on or near the sea bottom.
Groundfish Advisory Subpanel	(**GAP**) The Council established the GAP to obtain the input of the people most affected by, or interested in, the management of the groundfish fishery. This advisory body is made up of representatives with recreational, trawl, fixed gear, open access, tribal, environmental, and processor interests. Their advice is solicited when preparing fishery management plans, reviewing plans before sending them to the Secretary, and reviewing the effectiveness of plans once they are in operation.
Groundfish Management Team	(**GMT**) Groundfish management plans are prepared by the Council's GMT, which consists of scientists and managers with specific technical knowledge of the groundfish fishery.

H

Habitat	The immediate space where an animal or plant lives and has food, water and protection. Habitat loss, which includes the destruction, degradation, or fragmentation of habitats, is the primary cause of decreasing biodiversity.
Harvest	The total number or poundage of fish caught and kept from an area over a period of time. Note that landings, catch and harvest are different.
Harvest specifications	The detailed regulations that make up management measures – for example, trawl footrope size, depth limits, net mesh size, etc.
Harvest guideline(s)	A numerical harvest level that is a general objective, but not a quota. Attainment of a harvest guideline does not require a management response, but it does prompt review of the fishery.
HG	Harvest guideline(s) – see above
High seas	All waters beyond the EEZ of the United States and beyond any foreign nation's EEZ, to the extent that such sea is recognized by the United States.
Highly migratory species	(**HMS**) In the Council context, highly migratory species in the Pacific Ocean include species managed under the HMS Fishery Management Plan: tunas, sharks, billfish/swordfish, and dorado or dolphinfish.
HMS	Highly migratory species – see above
Hydrography	The arrangement and movement of bodies of water, such as currents and water masses.

I

IFQ	Individual fishing quota. See below.
Impact	Effect; a change from current conditions, or a change that would result from an action. Impacts may be direct, indirect and cumulative, and may be significant or not significant. An EIS provides an analysis of expected impacts that would result from the alternatives being considered and identifies those considered to be significant.
IMPLAN	(IMpact Analysis for PLANning) a regional economic impact model

Incidental catch or incidental species	Groundfish species caught when fishing for the primary purpose of catching a different species or species group. Incidental catch that is released, returned to the sea, discarded at sea, or retained and donated to a charitable food organization is considered a type of bycatch.
Individual fishing quota	(IFQ) A Federal permit under a limited access system to harvest a quantity of fish, expressed by a unit or units representing a percentage of the total allowable catch of a fishery that may be received or held for exclusive use by a person (individual fisherman or vessel owner).
Individual transferable (or tradeable) quota	(ITQ) A type of IFQ allocated to individual fishermen or vessel owners and which can be sold, leased, exchanged, etc, to others.
Initial Regulatory Flexibility Analysis	(IRFA) An analysis required by the Regulatory Flexibility Act (see RFA).
INPFC	International North Pacific Fishery Commission – see below
International Pacific Halibut Commission	(IPHC) A Commission responsible for studying halibut stocks and the halibut fishery. The IPHC makes proposals to the U.S. and Canada concerning the regulation of the halibut fishery.
International North Pacific Fishery Commission	(INPFC) was a tri-lateral commission of Canada, Japan and the U.S. established in 1952, to coordinate marine fisheries research and address scientific and management issues of mutual concern. Although the Commission was dissolved in 1993, the statistical areas defined by the are still commonly used in marine fisheries management.
Intertidal	Between the high and low tide marks and periodically exposed to air.
IPHC	International Pacific Halibut Commission – see above
IRFA	Initial regulatory flexibility analysis – see above
Isotherm	An imaginary line passing through points on the earth's surface having the same mean temperature.
ITQ	Individual transferable (or tradeable) quota – see above

JKL

Jetty	A rocky structure constructed from land into the sea to protect shore-based property.
Jig	An artificial lure made to simulate live bait. It is usually made with a lead head cast on a single hook and is heavier than most other lures.
Juvenile	A young fish or animal that has not reached sexual maturity.
Keystone species	A species that maintains community structure through its feeding activities, and without which large changes would occur in the community.
Keystone predator	The dominant predator or the top predator that has a major influence on community structure. For example, sea otters are a keystone predator in kelp beds. Sea otters eat urchins that feed on kelp which house a huge diversity of other organisms. If sea otter populations are lowered in an area the kelp beds are generally reduced and urchin barrens appear.
Knot	A unit of speed equal to one nautical mile per hour (approximately 51 centimeters per second).

La Niña	An episode of strong trade winds and unusually low sea surface temperature in the central and eastern tropical Pacific. The opposite of El Niño (see above).
Landing	The number or poundage of fish unloaded at a dock by commercial fishermen or brought to shore by recreational fishermen for personal use. Landings are reported at the points at which fish are brought to shore. Note that landings, catch, and harvest define different things.
LE	Limited entry – see below
Limited entry fishery	A fishery for which a fixed number of permits have been issued in order to limit participation.
Limiting factor	A factor primarily responsible for determining the growth and/or reproduction of an organism or a population. The limiting factor may be a physical factor (such as temperature or light), a chemical factor (such as a particular nutrient), or a biological factor (such as a competing species). The limiting factor may differ at different times and places.
Littoral zone	The intertidal zone.
Local depletion	Local depletion occurs when localized catches take more fish than can be replaced either locally or through fish migrating into the catch area. Natural causes can also result in local depletion. Local depletion can occur apart from the status of the overall stock, and can be greater than decreases in the entire stock.
Logbook	A document or form for recording specified information about commercial fishing activities. Logbooks must be maintained by groundfish trawl vessels in accordance with state fishing regulations. Some logbook information is used in stock assessments, inseason monitoring, and predicting landings.
Long-term potential yield	The maximum long-term average yield that can be achieved through conscientious stewardship, by controlling the proportion of the population removed by harvesting by regulating fishing effort or total catch levels.

M

m	meters
M	Instantaneous natural mortality rate (as opposed to F, fishing mortality rate) or the rate of mortality not related to fishing.
Magnuson-Stevens Fishery Conservation and Management Act	The **MFCMA**, sometimes called the "**Magnuson-Stevens Act**," established the 200 nm fishery conservation zone (EEZ), the regional fishery management council system, and the process and mandates for regulating marine fisheries in the EEZ.
Marine Mammal Protection Act	The **MMPA** prohibits the harvest or harassment of marine mammals, although permits for incidental take of marine mammals while commercial fishing may be issued subject to regulation.
Marine Recreational Fisheries Statistical Survey	(**MRFSS**) A national survey conducted by National Marine Fisheries Service to estimate the impact of recreational fishing on marine resources.
Maturity	The age at which an animal is physically capable of reproduction

Maximum sustainable yield	(**MSY**) An estimate of the largest average annual catch or yield that can be continuously taken over a long period from a stock under prevailing ecological and environmental conditions . Since MSY is a long-term average, it need not be specified annually, but may be reassessed periodically based on the best scientific information available.
Maximum fishing mortality threshold	(**MFMT**) A threshold fishing mortality rate identified in the National Standard Guidelines above which constitutes overfishing.
MBTA	Migratory Bird Treaty Act
Mean	The sum of the data divided by the number of pieces of data; the average.
Median	Within a data set, the median is the number that divides the bottom 50% of the data from the top 50%.
Mesopelagic Zone	A somewhat arbitrary depth zone in offshore or oceanic waters, usually below 600 feet and above 3,000 (200-1,000 meters or 100-500 fathoms). It is bordered by the photic zone above and darkness below.
MFMT	Maximum fishing mortality threshold – see above
MHHW	Mean higher high water level or the average of the highest of two daily high tides in the Pacific Ocean (i.e., high tide line)
Minimum stock size threshold	(**MSST**) A threshold biomass used to determine if a stock is overfished. The proxy for groundfish MSST is $B_{25\%}$.
Mitigation	includes avoiding the impact altogether, minimizing impacts, rectifying the impact by repairing the environment, reducing or eliminating the impact over time, or compensating for the impact in other ways.
MLMA	California Marine Life Management Act.
MLPA	California Marine Life Protection Act.
mm	Millimeter
MMPA	Marine Mammal Protection Act – see above
Morphology	The physical characteristics of an individual.
Mothership	A vessel that does not catch groundfish but processes fish (whiting) delivered by other vessels. A sector of the whiting fishery.
MOU	Memorandum of Understanding
MPA	Marine protected area; an area in which some human activities are restricted.
MRFSS	Marine Recreational Fisheries Statistics Survey – see above
MRPZ	Marine resources protection zone
MSA	Magnuson-Stevens Fishery Conservation and Management Act (also known as Magnuson-Stevens Act) – see above
MSST	Minimum stock size threshold; sometimes called the overfishing threshold – see above
MSY	Maximum sustainable yield (see above).
mt	Metric ton = 2,204.62 pounds.

N

NAO	NOAA Administrative Order
National Standards Guidelines	(**NSG**) Guidelines issued by National Marine Fisheries Service to provide comprehensive guidance for the development of fishery management plans and amendments that comply with the national standards of the Magnuson-Stevens Act. These guidelines are found in Title 50, Code of Federal Regulations, part 600.
National Environmental Policy Act	(**NEPA**) Passed by Congress in 1969, NEPA requires Federal agencies to consider the environment when making decisions regarding their programs. Section 102(2)(C) requires Federal agencies to prepare an Environmental Impact Statement (EIS) before taking major Federal actions that may significantly affect the quality of the human environment. The EIS includes: the environmental impact of the proposed action, any adverse environmental effects which cannot be avoided should the proposed action be implemented, alternatives to the proposed action, the relationship between local short-term uses of the environment and long-term productivity, and any irreversible commitments of resources which would be involved in the proposed action should it be implemented.
National Marine Fisheries Service	(**NMFS** or **NOAA Fisheries**) A division of the U.S. Department of Commerce, National Ocean and Atmospheric Administration (NOAA). NMFS is responsible for conservation and management of offshore fisheries (and inland salmon). The NMFS Regional Director is a voting member of the Council.
NE	Northeast
Nearshore	"Nearshore" is defined (by the California Nearshore Fishery Management Plan) as the area from the high-tide line offshore to a depth of 120 ft (20 fm).
Nekton	Pelagic organisms that are free-swimming and so whose movements are independent of the tides, currents and waves. Such animals include fish, whales, squid, crabs and shrimps.
NEPA	National Environmental Policy Act – see above
Neritic	Inhabiting coastal waters primarily over the continental shelf, generally over bottom depths equal to or less than 183 meters (100 fm) deep.
Neuston	The distribution of nekton is limited by temperature and nutrient supply and decreases with decreasing depth. Compare benthic, plankton surface water.
NMFS	National Marine Fisheries Service – see above
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
North Pacific Fishery Management Council	(**NPFMC**) The regional fishery management council established by the Magnuson-Stevens Act to develop management plans and recommendations for managing marine fish stocks in the EEZ off Alaska.
NPDES	National Pollutant Discharge Elimination System
NS	Nearshore – see above
NSG	National Standards Guidelines – see above

O

OA	Open access. See below.
Oceanic	Inhabiting the open sea, ranging beyond the continental and insular shelves, beyond the neritic zone.
ODFW	Oregon Department of Fish and Wildlife
OMB	Office of Management and Budget
Open-access fishery	The segment of the groundfish fishery or any other fishery for which entry is not controlled by a limited entry permitting program.
Optimum yield	(**OY**) The amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems. The groundfish FMP specifies a default harvest control rule (the **"40-10" rule**) that reduces the OY of any stock found to be less than its estimated MSY stock size. If a stock is overfished, the OY provides for rebuilding to its MSY stock size, consistent with the analysis prepared for its rebuilding plan.
OSP	Oregon State Police
OSP	Optimum sustainable population (in reference to marine mammals)
Otolith	"Ear bone" of a fish; calcareous concretions in the inner ear of a fish, functioning as organs of hearing and balance. They often show seasonal or annual "rings" that can be counted to determine age.
Otter trawl	A cone-shaped net that is dragged along the sea bottom. Its mouth is kept open by floats, weights and by two otter boards which shear outward as the net is towed.
Over-capitalization	In a fishing fleet, this means more money has been invested in boats than the fishery can support. It can also refer to the ability of fishermen to increase effort without increasing the number of boats. If no new boats are added to a fishery, but each boat doubles its fishing power by carrying twice as much gear or using new technology (sonar, GPS, etc.), the new effort can have the same effect as doubling the number of boats. Other commercial fishery sectors can also become overcapitalized.
Overfished	Any stock or stock complex whose size is sufficiently small that a change in management practices is required to achieve an appropriate level and rate of rebuilding. The term generally describes any stock or stock complex determined to be below its overfished/rebuilding threshold. The default proxy is generally 25% of its estimated unfished biomass; however, other scientifically valid values are also authorized.
Overfishing	Fishing at a rate or level that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis. More specifically, overfishing is defined as exceeding a maximum allowable fishing mortality rate (or the MFMT). For any groundfish stock or stock complex, the maximum allowable mortality rate will be set at a level not to exceed the corresponding MSY rate (F_{MSY}) or its proxy (e.g., $F_{35\%}$).
Oviparous	Producing eggs that hatch outside the female's body.
Ovoviviparous	Pertaining to an animal that incubates eggs inside the mother until they hatch.
OY	Optimum yield – see above

P

PacFIN	Pacific Coast Fisheries Information Network. A database managed by the Pacific States Marine Fisheries Commission that provides commercial fishery information for Washington, Oregon, and California.
Pacific decadal oscillation	(PDO) A long-term, El Niño-like pattern of Pacific climate variability. Two main characteristics distinguish PDO from El Niño/Southern Oscillation (ENSO): first, 20th century PDO "events" persisted for 20-to-30 years, while typical ENSO events persisted for 6 to 18 months; second, the climatic "fingerprints" of the PDO are most visible in the North Pacific/North American sector, while secondary signatures exist in the tropics - the opposite is true for ENSO.
Pacific Fishery Management Council	(PFMC) The regional fishery management council established by the Magnuson-Stevens Act to develop management plans and recommendations for managing marine fish stocks (including salmon) in the EEZ off the coasts of Washington, Oregon and California.
Pacific States Marine Fisheries Commission	(PSMFC) Authorized by Congress in 1947, the PSMFC is one of three interstate commissions dedicated to resolving fishery issues. Representing California, Oregon, Washington, Idaho, and Alaska, the PSMFC does not have regulatory or management authority; rather it serves as a forum for discussion, and works for coastwide consensus to state and federal authorities. PSMFC addresses issues that fall outside state or regional management council jurisdiction.
Parturition	Birth
Patchy distribution	A condition in which organisms occur in aggregations.
PBR	Potential biological removal – see below
PDO	Pacific decadal oscillation – see above
Pelagic	Inhabiting the water column as opposed to being associated with the sea floor; generally occurring anywhere from the surface to 1000 meters (547 fm). See also epipelagic and mesopelagic.
Pelagic	Refers to the plants and animals that live in the water column or in the open waters of the ocean rather than the ocean floor (see benthic). Life is found throughout the pelagic zone, however is more concentrated at shallower depths. Pelagic organisms can be further divided into the plankton and nekton. Compare benthic. (epipelagic: living in the upper or photic layer between 0 and 200 meters; mesopelagic: living between 200 and 1000 meters).
Permit stacking	The registration of more than one limited entry permit for a single vessel, where a vessel is allowed additional catch for each additional permit registered for use with the vessel.
PFMC	Pacific Fishery Management Council – see above
Photic zone	The surface layer of the ocean that is penetrated by sunlight. The photic zone is the layer of the ocean that has been explored the most as it is relatively easy to access with conventional diving equipment. Light can penetrate down to approximately 200m which marks the end of the photic zone. Also referred to as the Sunlight Zone or the Epipelagic Zone.
Phytoplankton	Microscopic planktonic plants. Examples include diatoms and dinoflagellates
Pinniped	A member of the order of marine mammals that includes the seals, sea lions, and walruses, all having four swimming flippers.

Piscivorous	An organism that eats fish.
Planktivorous	An organism that feeds on planktonic organisms.
Plankton	Pelagic organisms that float through the water column, not attached to any substrate and unable to move against the currents and tides. Plankton can be further divided into phytoplankton and zooplankton, meroplankton and holoplankton. Compare nekton.
POP	Pacific ocean perch
Population	All individuals of the same species living in a certain area during a given time. Environmental barriers may divide the population into local breeding units with restricted interbreeding between the localized units.
Potential biological removal	(PBR) The maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.
PRA	Paperwork Reduction Act
Preferred alternative	The alternative that is identified as preferred by the authors of an environmental impact statement or environmental assessment. It is identified to indicate which alternative is likely to be selected, thereby helping the public focus its comments.
Processing	The preparation or packaging of fish to render it suitable for human consumption, retail sale, industrial uses, or long-term storage, including but not limited to cooking, canning, smoking, salting, drying, filleting, freezing, or rendering into meal or oil, but not heading and gutting unless additional preparation is done.
Production	Gross primary production is the amount of light energy converted to chemical energy in the form of organic compounds by autotrophs like algae. The amount left after respiration is net primary production and is usually expressed as biomass or calories/unit area/unit time. Net production for carnivores and herbivores is based on the same concept, except that chemical energy from food, not light, is used and partially stored for life processes. Efficiency of energy transfers between trophic levels ranges from 10-65% (depending on the organism and trophic level). Organisms at high trophic levels have only a fraction of the energy available to them that was stored in plant biomass. After respiration loss, net production goes into growth and reproduction, and some is passed to the next trophic level.
Productivity	The rate at which a given quantity of organic material is produced by organisms.
Prohibited species	Species that may not be retained, and that should not be captured or harmed. Prohibited species identified in the groundfish FMP include Pacific halibut, salmonids, and Dungeness crab.
Prohibited species catch or cap	(PSC) A PSC limit is a specified limit on the amount of the species that may be caught or killed.
PSMFC	Pacific States Marine Fisheries Commission – see above.

Q-R

Q	The selectivity of fishing gear or the ratio of fish caught by the gear to those actually present.

QSM	Quota species monitoring is a PacFIN database that monitors the cumulative landings of species managed either with individual OYs or OYs prescribed for a species complex (grouping of species in a single management unit). The GMT uses quota species monitoring to develop inseason groundfish fishery management recommendations to attempt to attain, but not exceed, prescribed OYs.
Quota	A specified numerical harvest objective, the attainment (or expected attainment) of which causes closure of the fishery for that species or species group.
R/S	Recruits per spawner
R	Recruits or recruitment**.** This is the estimated production of new members to a population as measured at a specific life stage.
R_0	Level of unfished recruitment
Rebuilding	Implementing management measures that increase a fish stock to its target size.
Rebuilding Plan	When abundance of a groundfish stock is found to have declined to 25% or less of the size it was before any fishing (or to some other early stock size), it must be rebuilt to its MSY stock size, which is typically about 40% of the unfished size. A rebuilding plan calculates how long it will take to rebuild the stock and the methods and management measures that will be used.
RecFin	Recreational Fishery Information Network. A database managed by the Pacific States Marine Fisheries Commission that provides recreational fishery information for Washington, Oregon, and California.
Recreational Fishing	Recreational fishing means fishing for sport or pleasure, but not for sale.
Recruit	An individual fish that has moved into a certain class, such as the spawning class or fishing-size class.
Recruitment	(1) Entry of new fish into a population, whether by reproduction or immigration; (2) Addition of new individuals to the fished component of a stock (because they have acquired the size, age, or location that makes them part of it.)
Regime shift	A long-term change in marine ecosystems and/or in biological production resulting from a change in the physical environment. – see also PDO above
Regulatory discard	The portion of bycatch that results from fishers complying with the regulations.
Regulatory Flexibility Analysis (or Act)	(**RFA**) Anytime an agency publishes a notice of proposed rule making, an RFA is required. It describes the action, why it is necessary, the objectives and legal basis for the action, a description of who will be impacted by the action, and a description of the projected reporting, record-keeping, and other compliance requirements of the proposed rule. The types of entities subject to the rule, and the professional skills required to prepare the report or record, must also be described.
Reproductive potential	The number of offspring possible for a female of a given species to produce if she lives to the average age.
Restricted species catch quota	(**RSQ**) A specified catch limit of an overfished stock that applies to an individual vessel or limited entry permit holder. A type of individual quota or cap.
RFA	Regulatory Flexibility Analysis, or Regulatory Flexibility Act – see below
RIR	Regulatory Impact Review – See Regulatory Flexibility Analysis.

Roller trawl	A trawl net equipped with rollers that enable the net to go over rocky areas without snagging.
Rulemaking	The process of developing Federal regulations which occurs in several steps, including publishing proposed rules in the *Federal Register*, accepting comments on the proposed rule, and publishing the final rule. An "advanced notice of proposed rulemaking" is published when dealing with especially important or controversial rules.

S

SAFE	Stock assessment and fishery evaluation. See below.
Salmonid	A member of the Salmonidae family of fishes.
Scientific and Statistical Committee	(**SSC**) An advisory committee of the PFMC made up of scientists and economists. The Magnuson-Stevens Act requires that each council maintain an SSC to assist in gathering and analyzing statistical, biological, ecological, economic, social, and other scientific information that is relevant to the development of fishery management plans.
Scoping	An early and open process for determining the scope (range) of issues to be addressed and for identifying the significant issues related to a proposed action.
***Sebastes* complex**	Rockfish assemblage, including most species of the genus *Sebastes*.
Secondary Consumer	A heterotrophic, carnivorous organism that feeds on a primary consumer. Herring feeding on zooplankton are an example of a secondary consumer. See also food chain, heterotroph, primary consumer.
Secretary	The U.S. Secretary of Commerce.
Sessile	Referring to animals that are permanently attached to a substrate.
Set gillnet	A gillnet that is anchored on both ends.
Setline	Fishing gear made up of a long main line attached to which are a large number of short branch lines. At the end of each branch line is a baited hook. When catching groundfish and Pacific halibut, setlines are typically laid on the sea-floor. When catching swordfish, shark or tuna they are buoyed near the surface. Setlines can be twenty or more miles long. They are also called longlines.
Shelf	see continental shelf, above.
Shelf survey	NMFS bottom trawl surveys of the continental shelf, designed to provide information on distribution and abundance of demersal species, and other biological resource information.
Shore-based	Refers to catcher vessels that deliver Pacific whiting to processing facilities on land. This sector of the whiting fishery, as the other sectors, has a whiting allocation.
SFA	Sustainable Fisheries Act of 1996 that amended the Magnuson-Stevens Act with stricter stock conservation standards including the prescribed rules for rebuilding overfished marine fish populations.
Simple random sampling	A sampling procedure for which each possible sample is equally likely to be the one selected. A sample obtained by simple random sampling is called a simple random sample.
Slope	see continental slope, above.

Slope survey	NMFS bottom trawl surveys of the continental slope, designed to provide information on distribution and abundance of demersal species, and other biological resource information.
Southern California bight	See California Bight
Spawning biomass	The biomass of mature female fish at the beginning of the year. If the production of eggs is not proportional to body weight, then this definition is construed to be proportional to expected egg production.
Species	(1) A fundamental taxonomic group ranking after a genus. (2) A group of organisms recognized as distinct from other groups, whose members can interbreed and produce fertile offspring
Species Richness	The number of different species that exist within a given area or community. Compare species abundance.
Species diversity	A measure of both species abundance and species richness. An area that has a large number of species and many representative individuals from each species is more diverse than an area that has only a single species. See also biodiversity; compare ecosystem diversity.
Spawning Potential Ratio	**(SPR)** the number of eggs that could be produced by an average recruit in a fished stock, divided by the number of eggs that could be produced by an average recruit in an unfished stock. SPR can also be expressed as the spawning stock biomass per recruit (SSBR)
Spawning Stock Biomass	(**SSB**) the total weight of the fish in a stock that are old enough to spawn
SSBR	Spawning Stock Biomass Per Recruit - the spawning stock biomass divided by the number of recruits to the stock, or how much spawning biomass an average recruit would be expected to produce.
SSC	Scientific and Statistical Committee – see above
STAR	Stock assessment review
STAR Panel	Stock Assessment Review Panel
STAT	Stock Assessment Team
Status quo	"No action," or the current conditions and expected conditions if no action is taken.
Stock	A grouping of fish usually based on genetic relationship, geographic distribution, and movement patterns. Stock is the practical unit of a population that is selected for management or harvesting purposes. In some casts a managed stock may include more than one species.
Stock Assessment and Fishery Evaluation (SAFE)	A SAFE document is a document prepared by the Council that provides a summary of the most recent biological condition of species in the fishery management unit, and the social and economic condition of the recreational and commercial fishing industries, including the fish processing sector. It summarizes, on a periodic basis, the best scientific information available concerning the past, present, and possible future condition of the stocks and fisheries managed in the FMP.

Stratified random sampling A sampling method in which one (1) divides the population into subpopulations (called strata), (2) obtains from each stratum a simple random sample of size proportional to the size of the stratum, and (3) uses all of the members obtained in step 2 as the sample.

Substrate A solid surface on which an organism lives or to which it is attached (also called substratum); or, a chemical that forms the basis of a biochemical reaction or acts as a nutrient for microorganisms.

Subtidal zone The benthic zone extending from the low tide mark to the outer edge of the continental shelf.

Sustainable A sustainable way of life is one in which human needs are met without diminishing the ability of other people, wild species, or future generations to survive.

SWFSC Southwest Fisheries Science Center (NMFS)

Swim bladder A sac inside the fish's body by which the fish can control buoyancy

Sympatry The common occurrence of two taxa (closely related forms) in the same geographic area.

T

TAC Total allowable catch (this term is used for Pacific halibut and for Alaska groundfish but typically not for West Coast groundfish)

Target fishing Fishing for the primary purpose of catching a particular species or species group (the target species).

Territorial sea A zone extending seaward from the shore or internal waters of a nation for a distance of twelve miles (19.3 km) as defined by the United Nations Conference on the Law of the Sea (UNCLOS). The coastal state has full authority over this zone but must allow rights of innocent passage.

Thermocline The often sharply defined boundary between surface water and deeper, cooler water. The water layer in which temperature changes most rapidly with increasing depth.

T_{MAX} The maximum time period to rebuild an overfished stock according to National Standard Guidelines

T_{MIN} The minimum time period to rebuild an overfished stock according to National Standard Guidelines

Total catch OY Total catch optimum yield. The landed catch plus discard mortality.

Trammel net An entangling net that hangs down in several curtains.

Transect A straight line placed on the ground along which ecological measurements are taken. If an ecologist wanted to sample the diversity of intertidal organisms in the intertidal, he/she would place a number of transects perpendicular to the shore and take samples at predetermined interval lengths.

Trawl A sturdy bag or net that can be dragged along the ocean bottom, or at various depths above the bottom, to catch fish.

Tribal Refers to vessels owned and operated by members of the four coastal Indian Tribes in Washington that harvest groundfish. Amounts of various groundfish, including sablefish and whiting, are set aside for harvest by Tribal fishers.

Troll	To trail artificial or natural baits behind a moving boat. The bait can be made to skip along the surface or trailed below at any depth to just above the bottom.
Trophic	Concerning feeding habits, food chains, or nutrition
Trophic level	The nutritional position occupied by an organism in a food chain or food web; e.g. primary producers (plants); primary consumers (herbivores); secondary consumers (carnivores), etc.

U

U and A	Usual and accustomed
Upwelling	The process whereby prevailing seasonal winds create surface currents that allow nutrient rich cold water from the ocean depths to move into the euphotic or epipelagic zone.
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
Viviparous	Bringing forth living young, rather than being an egg-layer. Rockfish are viviparous.
VMS	Vessel monitoring system

VWXYZ

WA	Washington
Water column	The water from the surface to the bottom at a given point.
WDFW	Washington Department of Fish and Wildlife
WOC	Washington, Oregon and California
Year-class	Refers to animals of a species population hatched or born in the same year at about the same time; also known as a cohort. Strong year classes result when there is high larval and juvenile survival; the reverse is true for weak year-classes. The effects of strong and weak year-classes on population size and structure persist for years in species with long lives. Variation in year-class strength often affects fisheries.
YOY	Young-of-the-year.
Zooplankton	Animal members of the plankton.

TABLES

Table 2.2 Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

Goals and Objectives	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce bycatch by decreasing effort and permitting larger or more flexible trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce bycatch by reducing effort and permitting larger or more flexible trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector catch/ mortality caps	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch limits (individual quotas) for groundfish species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	Y	Y	Y	Y	Y	Y
Set **overfished groundfish catch caps** by **fishing sector**	N	N	N	Y	N	Y
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	Y	Y	Y	Y*	N	N
Use **catch limits** to control groundfish bycatch	N	N	N	Y	Y	Y
Set individual vessel/permit catch caps for overfished groundfish species	N	N	N	N	Y	Y
Set groundfish **discard caps** (require increased retention)	N	N	N	N	Y	Y
Establish **IQs** for other groundfish	N	N	N	N	Y	Y
Establish bycatch **performance standards**	N	N	N	N	Y	Y
Establish a reserve for fishers who achieve performance standards	N	N	N	Y	N/Y	Y
Gear Restrictions						
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	Y	Y	Y	Y	N	Y
Time/Area Restrictions	Y	Y	Y	Y	Y	Y
Establish **long term closures for all groundfish fishing**	N	N	N	N	N/Y	Y
Establish **long term closures for on-bottom fishing**	N	N	N	N	N/Y	Y
Capacity reduction (mandatory)	N	Y(50%)	N	N	N	N
Monitoring/Reporting Requirements						
Trawl logbooks	Y	Y	100%	Y	??	??
Fixed-gear logbooks	N	N	100%	Y	??	??
CPFV logbooks	N	N	N	Y		
Commercial **port sampling**	Y	Y	Y	>Y	N/Y	Y
Recreational port sampling	Y	Y	Y	>Y	Y	>>x
Observer coverage (commercial)	10%	10%	10%+logbook	60%?	100%	100%
CPFV observers	N	N	N	Y	Y	100%
VMS	Y	Y	Y	Y	Y	Y
Post-season observer data OK	Y	Y	Y	Y/N	N	N
Inseason observer data required	N	N	N	Y/N	Y	Y
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	Y	Y	Y	Y	N	N

* Trip limits may be required for some sectors to prevent "derby fishing".

Table 4.1.0 Reasons given for discard during three years (1997-99) of the Oregon Enhanced Data Collection Project (EDCP) that reasons for discard were collected. Percentages based on recorded reasons for discard of species (market, quality, or regulation). Species discarded for an unspecified or unknown reason were not included in record count. Enviroment refers to classification given for species used in EIS analysis, not necessarily the location where the reason for discard was determined by the EDCP observer. Overfished species in bold and emphasis species in italic. Precautionary species management (p).

		1997-99			
Environment	**Species**	**Number of EDCP Records**	**Market**	**Quality**	**Regulation**
Northern Shelf	**Canary rockfish**	31	0%	3%	97%
	Lingcod	309	6%	2%	93%
	Yelloweye rockfish	0			
	Yellowtail rockfish	66	20%	9%	71%
	Arrowtooth Flounder	115	91%	9%	0%
	English sole	214	74%	25%	0%
	Petrale sole	29	100%	0%	0%
Southern Shelf	**Boccacio**	0			
	Cowcod	0			
	Chilipepper	12	100%	0%	0%
Slope	**Darkblotched rockfish**	0			
	Pacific Ocean Perch	3	0%	33%	67%
	Dover sole (p)	645	58%	16%	25%
	Sablefish (p)	1,163	9%	8%	83%
	Shortspine thornyhead (p)	514	39%	7%	54%
	Longspine thornyhead	336	82%	11%	7%
	Unsp. thornyhead	208	50%	16%	34%
Pelagic	**Widow rockfish**	41	37%	0%	63%
	Pacific whiting	962	88%	11%	2%
Nearshore	*Black rockfish*	0			
	Cabezon	0			
Grand Total		4,648	48%	11%	41%
All Species Total Including Non-GF		8,920	66%	10%	24%

Table 4.1.1 Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Harvest Levels					
ABC/OY	Low OYs often require management measures such as low cumulative landing limits under some alternatives that made lead to discard. On the other hand, higher OYs may result in higher levels of effort and catch. Depending on alternatives, higher discard may also result.	Many species limited by markets do not reach OY limits, due to the market limit and other constraints placed on fishery by overfished species OYs.	If OY's are reduced, regulatory bycatch mortality may increase for some species if trip limits are reduced. If overall effort is reduced due to restrictions, overall bycatch and bycatch mortality may be reduced.	Lower OY's should reduce fishing effort. Reducing effort should result in reduced habitat impacts.	Lower OYs required for rebuilding of some species may make it difficult to accurately track total catch under some alternatives.
Sector allocations 1/	Distributed OY may have a postive effect in reducing bycatch. Risk and consequences of encountering a "disaster tow" can be spread out among several boats within the sector.		Under a given OY, catch is allocated and distributed to fishery sectors in some alternatives. Distributed OY may have a postive effect in reducing bycatch mortality to the degree risk of bycatch can be spread and managed by the sector.		Sector allocations would work best with a robust monitoring program. With increased monitoring, There would be less incentive to discard allocated fish as it would count against the allocation.
Trip (landing) limits 2/	If landing limit increases, bycatch is reduced. Studies have shown that as trip limits decline or cumulative limits are approached, bycatch increases. As cumulative limits are reached there are stronger incentives to keep higher valued fish and discard species that are close to the limit in order to continue fishing for species having more cumulative limit remaining.	Economic factors such as price, demand, and minimum fish size needed for processing often determine market limits on the amount of fish landed. These factors can lead to discarding of fish after a market limit is reached.	If bycatch is reduced due to increased landing limit, bycatch morality is also reduced. If limits are increased due to larger OYs, bycatch and bycatch mortality may increase due to higher harvest levels.		If landing limits increase, regulatory induced discard is reduced. Reducing discard increases accuracy of estimating total catch at lower levels of fishery monitoring.
Catch limits	Vessel catch limits reduce bycatch when fishing ceases and/or there is a retention requirement. Effect is enhanced when limit is on individual boat, when applied to all groundfish, and monitoring is robust.	If all groundfish catch is retained (alternative 6), vessel catch limit will have no market induced bycatch.	Vessel catch limits should reduce bycatch mortality as there is less need to compete to catch fish (no derby fishery). Same pattern of effect as with regulatory bycatch.	Vessel catch limits may reduce hours trawled through incentives and efficencies to maintain strict catch caps under some options. Reducing trawl hours should reduce habitat impacts.	Catch limits may provide more flexibility by relaxing or eliminating landing limits and reducing discarded catch of those species that are not market limited. Thus, accountability is improved, if full retention is required and/or observer coverage is significantly

Table 4.1.1 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Gear Regulations 4/	Regulatory induced bycatch may be reduced by allowing modified gear or alternative gear types that are more selective for non-overfished species and less selective for overfished species.	Allowing modified or alternatives gears that are more selective for marketable species may reduce market induced bycatch. Gear changes to select against overfished species may interact with market induced bycatch both positively and negatively.	Making gears less efficient or more selective may result in some species or sizes being avoided, thus reducing bycatch mortality.	Gear modifications may reduce impacts to habitat. Smaller roller gear requires fishers to avoid high relief habitat. Other alternatives allow use of fixed gear to take unused portions of OY. In the latter case, habitat interactions are different, but likely reduced.	Flexible gear regulations may permit experimentation, and use of alternative and more selective gears to access unused portion of OY. Coupled with observers, species selective gears should reduce discarded fish and improve accountability.
Time/area restrictions 5/	Time/area closures eliminates regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, regulatory bycatch could increase outside the closure.	Time/area closures eliminates non-regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, non-regulatory bycatch could increase outside the closure.	Bycatch mortality would be reduced within the closed area. Bycatch mortality could increase outside of the closed area if fishing effort increases.	Habitat impacts would be reduced or eliminated within closed areas. Habitat impacts could increase outside of closed areas if effort increases outside the closure.	Accountability would be increased through VMS verification of fishing location
Capacity Reduction	Capacity reduction could occur through a buyback program or through sales of IQs. Reduced effort should allow more flexibility in vessel landing limits that would likely reduce regulatory induced bycatch.	If overall effort is reduced as a consequence of capacity reduction, bycatch of species with low or no value would be reduced. Fewer boats may induce buyers to relax market limits (supply and demand response) and effort could increase. Non-marketable or low valued fish would still contribute to bycatch.	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished however, offsetting positive effects.	Reduced effort should have a positive impact in reducing habitat impacts Fewer boats could result in increased hours fished however, offsetting positive effects.	

Table 4.1.1 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Data Reporting					
Logbooks					
Observers					Increased observer coverage under some alternatives would increase accountability by ensuring retention, if required, or accurately accounting for discarded fish
Vessel monitoring system 6/	VMS can directly reduce regulatory bycatch. Compliance with area closures to protect overfished species, for example, would be assured.		VMS can directly reduce regulatory bycatch mortality. Compliance with area closures to protect overfished species, for example, would be assured.		VMS increases accountability by verifying fishing location.
Enforcement					

1/ PFMC, 2003d.
2/ Pikitch, 1988, Methot, 2000.
3/ Larkin, 2003.
4/ Hanna, 2003 and Davis, 2003.
5/ PFMC, 2001.
6/ PFMC, 2003e.

Table 4.1.2 Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Harvest Levels				
ABC/OY	Abundance of overfished species should increase as stocks are rebuilt, those a above MSY could be reduced. *Any changes in population abundance and structure may affect forage available for other animals (birds, mammals, etc.).*			
Sector allocations				
Trip (landing) limits 1/	Present trip limit management attempts to maintain ratios of species in some sectors of the multi-species groundfish fishery. Ratio management may reduce discard but might result in long-term changes in abundance of individual species.		Present trip limit management attempts to maintain ratios of species in some sectors of the multi-species grounfish fishery. Ratio management may result in effort shifting, increasing and/or decreasing bycatch of individual species.	
Catch limits			Catch limits provide flexibility and accountability to manage bycatch. A reduction in derby style fishing should allow fishers to more effeciently pick fishing times and locations to minimize take of species with small catch or bycatch limits.	
Individual quotas 2/			Similar effect as described above under catch limits, but with more flexibility if IQs can be purchased.	

Table 4.1.2 (continued). Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Gear Regulations 3/	Allowing modified or alternatives gears that are less selective for overfished or other groundfish (undersized fish for example) should contribute to increased abundance of target species. If these changes also allow increased selection and catch per unit effort on non-overfished species, abundance of these species could decrease.	Gears modified to reduce bycatch of target species may have different impacts on habitat. The direction of impact is unknown.	Gear restrictions may have a positive impact at reducing regulatory bycatch of overfished species. If effort and target fishing increases on healthier stocks, bycatch of non-overfished species may increase.	Some gear modifications will make fishing gear less efficient, increasing cost per unit of value of catch.
Time/Area Closure 4/	Abundance (biomass) inside area closures should increase through growth. To the degree density dependence occurs, recruitment may be limited inside but increase outside of reserves.	Incentives for fishing outside of closed areas may result in effort shifts. Effort shifting may free up some kinds of habitat from impacts but increase those impacts elsewhere.	Area closures could result in effort shifting. While overfished species bycatch might be reduced, bycatch of market limited species might be increased, depending on alternatives.	
Capacity Reduction	Longer term, capacity reduction, if it results in reduced effort, contributes to a reduction in overall mortality and bycatch mortality which will in turn increase abundance.	Response to capacity reduction would be to reduce habitat interactions with fishing gears. Latent capacity exists even with a 50% reduction in fleet size. Thus, there is the potential for effort increase even though capacity is reduced. This would tend to offset any benefit and gear impacts on habitat could rebound.	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished however, offsetting positive effects. Less effort may allow more flexibility in choice of fishing location - reducing spatial or temporal concentrations of bycatch.	

Table 4.1.2 (continued). Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Data Reporting				
Logbooks				
Observers	Increased observer coverage may reduce fishing behaviors that lead to regulatory induced discard. This would have a positive indirect effect in reducing bycatch, reducing unaccounted for fishing mortality, and positively influencing abundance. Increased observer coverage should increase the quality of data used in stock assessments. Estimates of abundance should therefore be improved.	Increased observer coverage may provide better information on habitat - especially if observers collect data on bycatch of benthic invertebrate communities.	Increased observer coverage should provide more accurate data on distributional changes in bycatch.	Increased observer coverage will add to cost of management and fishing operations.
Vessel Monitoring Systems (VMS) 5/		VMS ensures compliance with fishing locations. Habitat protection within closed areas would be enhanced.		VMS add to cost of fishing and management operations. To the degree compliance and catch accounting are improved, future fishing opportunities and economic stability should be preserved.
Enforcement				

1/ Hastie, 2003.
2/ Larkin, 2003.
3/ Hanna, 2003 and Davis, 2003.
4/ PFMC, 2001.
5/ PFMC, 2003e.

Table 4.1.3 Management tools and potential actions using each tool that have potential to reduce bycatch or bycatch mortality, and potential direct and indirect impacts of each action.

				Potential Effective Uses												
	D = Direct effect d = minor direct I = Indirect effect i = minor indirect		Potential bycatch reducing actions:	Reduce catch in excess of vessel limits?	Reduce proportion of overfished species?	Reduce encounters with overfished species?	Reduce fishing in high relief seafloor areas?	Reduce catch proportion of on-bottom species?	Reduce catch proportion of off-bottom species?	Reduce catch proportion of small fish?	Reduce catch of unwanted finfish species?	Reduce potential for "ghost fishing"?	Reduce catch of marine mammals?	Reduce catch of seabirds?	How easily enforced/ monitored?	Compliance Costs (to vessel)
Species associations most impacted				**Overfished**	**Overfished**	**Overfished**	**Overfished rockfish**	**Overfished rockfish and lingcod, some of flatfish**	**Widow rockfish** and **Pacific whiting**, *yellowtail rockfish*	*Flatfish, rockfish, sablefish*	*Halibut, salmon, skates, rays, and sharks*	*Sablefish*				
Type of bycatch most impacted				Regulatory	Regulatory	Regulatory	Regulatory	Regulatory	Regulatory	Non-regulatory	Non-regulatory	Non-regulatory	Regulatory	Regulatory		
		Alternatives														
Harvest Levels																
	ABC/OY	1-6	larger OYs	i	I	d		d	d		i					low
	sector allocations	4		i	I	i		d	d	I	i	I				low
	vessel landing limits	1-4	larger trip limits	d	D	i	I	D	D	I	d				easy	med
	vessel catch limits	5,6	individual species caps	D	D	D	I	D	D	I	D				difficult	high
	individual quotas	5,6		D	D	D		D	D	I	D				difficult	high/low
Gear Restrictions																
Trawl	mesh size	1-6	Increase mesh size	D						D	D				med	high
	footrope diameter/length	1-6	diameter	D		d	D	D	D						diff/med	high
	net height		lower net height	I	D	D			D		D				diff	high
	codend	1-6	Increase mesh size, restrict overall size	D											med	high
	design: on-bottom or pelagic		require pelagic trawl		D	D	D	D	D		i				med	high
	bycatch reduction devices		require								D					
Line	number of hooks		reduce number	D		d					i	D			dif	low
	hook size	1	increase size/ decrease		d					D	D				dif	low
	line length		reduce length	D		d						D			dif	low
	soak time	1-6	retrieval requirement	I	i	d					i	D			Dif	low
	bycatch reduction devices		require											D		
Pot/trap	number of pots		reduce number	D		d					D	D			med	low
	pot size										i	D			med	med
	escape panel in net/pot	1-6	require								D	D			med	low
	soak time	1-6	retrieval requirement	I	i	d				i	i	D			Dif	low
Time/Area Restrictions																
	seasons	1-6	close sensitive time/area	d	d	d		i	i	d	D		d	d	easy	low
	area closures	1-6	depth based mgt.	d	D	D	D	i	i	d	D	D	D	D	med	high
	depth closures	1-6		d	D	D	I	i	i	D	D	I	d	d	difficult	high
	marine reserves	6	semi-permenant to permanent	d	D	D	D	i	i	d	D	D	D	D		high
Capacity/number of participants				d			I				i				easy	
	permits/licenses/endorsements	2	reduce number	I	I	d	I	I	I	I	i	D			easy	
	IQs	5,6	establish IQ system													
	limited entry	2	no open access	I	I	d					i	D			easy	
Capacity (vessel restrictions)																
	vessel size	1-6		I		N									Easy	high
	engine power			I		N	I				I				med	high
	vessel type			I		N	I								Easy	high

Table 4.3.0a Summary of bycatch factors by stock status, species and environment. Overfished groundfish species referenced in Chapter 4 analysis in **bold** and emphasis groundfish species are in italics.

Environment	Species	Status	Total Catch Attainment	Primary Reason for Discard	Bycatch mortality source 2/
Northern Shelf	**Canary rockfish**	Overfished	Catch = OY	Regulation	Barotrauma
	Lingcod	Overfished	Catch < OY	Regulation	Gear or handling trauma
	Yelloweye rockfish	Overfished	Catch = OY	Regulation 1/	Barotrauma
	Yellowtail rockfish	At or above MSY	Catch < OY	Regulation	Barotrauma
	Arrowtooth Flounder	At or above MSY	Catch < OY	Market	Gear or handling trauma
	English sole	At or above MSY	Catch < OY	Market	Gear or handling trauma
	Petrale sole	At or above MSY	Catch < OY	Market	Gear or handling trauma
Southern Shelf	**Boccacio**	Overfished	Catch = OY	Regulation 1/	Barotrauma
	Cowcod	Overfished	Catch = OY	Regulation 1/	Barotrauma
	Chilipepper	At or above MSY	Catch < OY	Market	Barotrauma
Slope	**Darkblotched rockfish**	Overfished	Catch < OY	Regulation 1/	Barotrauma
	Pacific Ocean Perch	Overfished	Catch < OY	Regulation	Barotrauma
	Dover sole (p)	Precautionary	Catch = OY	Market	Gear or handling trauma
	Sablefish (p)	Precautionary	Catch < OY	Regulation	Handling, temperature
	Shortspine thornyhead (p)	Precautionary	Catch = OY	Regulation	Gear or handling trauma
	Longspine thornyhead	At or above MSY	Catch < OY	Market	Gear or handling trauma
Pelagic	**Widow rockfish**	Overfished	Catch < OY	Regulation	Barotrauma
	Pacific whiting	Overfished	Catch = OY	Market	Gear or handling trauma
Nearshore	*Black rockfish*	At or above MSY	--	Regulation 1/	Barotrauma
	Cabezon	Precautionary ?	--	Regulation 1/	Handling

1/ Reason given assumed based Oregon Enhanced Data Collection Program (EDCP) observations on similar overfished or emphasis species.
2/ All species have unseen mortality associated with stress of capture and escape from fishing gears.

Table 4.3.0b Summary of biological characteristics of selected groundfish species and linkage to bycatch. Overfished species in bold and emphasis species in italic. Precautionary species management (p). Possible reasons for increased vulnerability to fishing include aggregating behaviors of rockfish associated with preferred bottom habitats, schooling behavior of pelagic or semi-pelagic fishes, and spawning concentrations. Species having a wider dispersion may have decreased vulnerability.

Environment	Species	Reasons for Concentration	Location	Migrations	Longevity 1/	Productivity Index 2/
Northern Shelf	**Canary rockfish**	Aggregating behavior	Rocky-shelf		84 years	Very low
	Lingcod	Spawning	Shelf	Local, spawning	16 years	Low
	Yelloweye rockfish	Aggregating behavior	Rocky-shelf		118 years	Very low
	Yellowtail rockfish	Schooling behavior	Semi-pelagic		64 years	Very low
	Arrowtooth flounder	Dispersed	Non-rocky-shelf		27 years	Low
	English sole	Dispersed	Non-rocky-shelf		17 years	Low
	Petrale sole	Dispersed, spawning	Non-rocky-shelf	Local, spawning	19-25 years	Low
Southern Shelf	**Boccacio**	Aggregating behavior	Rocky-shelf		40-50 years	Very low
	Cowcod	Aggregating behavior	Rocky-shelf		55 years	Very low
	Chilipepper	Aggregating behavior	Rocky-shelf		35 years	Low
Slope	**Darkblotched rockfish**	Aggregating behavior	Slope		105 years	Very low
	Pacific Ocean Perch	Aggregating behavior	Slope		100 years	Very low
	Dover sole (p)	Dispersed	Non-rocky slope	Local, seasonal	53-58 years	Very low
	Sablefish (p)	Dispersed	Non-rocky slope		55+ years	Very low
	Shortspine thornyhead (p)	Dispersed	Non-rocky slope		80-100 years	Very low
	Longspine thornyhead	Dispersed	Non-rocky slope		45 years	Very low
Pelagic	**Widow rockfish**	Schooling behavior	Semi-pelagic		60 years	Very low
	Pacific whiting	Schooling behavior	Pelagic	Large scale, spawning	23+ years	Low
Nearshore	*Black rockfish*	Schooling behavior	Rocky-nearshore		50 years	Low to very low
	Cabezon	Spawning	Rocky-nearshore	Local, spawning	13+ years	Low

1/ Love (1991) and Love et al. (2002).
2/ Productivity index based on life history parameters from Musick et al. (2000).

Table 4.3.1 Alternative1: Status quo management. Relative rank of tools used to reduce bycatch and bycatch mortality. **Overfished speci** and *emphasis species* in italic. Precautionary species management (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area closures
			None	Yes	Soft sector scorecard	Pacific whiting EFP	Yes	None	RCAs
Northern Shelf	**Canary rockfish**	1	3	4	4	2	2	3	3
	Lingcod	1	3	4	4	2	2	3	3
	Yelloweye rockfish	1	3	4	4	2	2	3	3
	Yellowtail rockfish	1	3	4	4	2	2	3	3
	Arrowtooth flounder	1	3	4	4	2	2	3	3
	English sole	1	3	4	4	2	2	3	3
	Petrale sole	1	3	4	4	2	2	3	3
Southern Shelf	**Boccacio**	1	3	4	4	2	2	3	3
	Cowcod	1	3	4	4	2	2	3	3
	Chilipepper	1	3	4	4	2	2	3	3
Slope	**Darkblotched rockfish**	1	3	4	4	2	2	3	3
	Pacific Ocean Perch	1	3	4	4	2	2	3	3
	Dover sole (p)	1	3	4	4	2	2	3	3
	Sablefish (p)	1	3	4	4	2	2	3	3
	Shortspine thornyhead (p)	1	3	4	4	2	2	3	3
	Longspine thornyhead	1	3	4	4	2	2	3	3
Pelagic	**Widow rockfish**	1	3	4	4	2	2	3	3
	Pacific whiting	1	3	4	4	2	2	3	3
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3
	Cabezon	1	3	4	4	2	2	3	3
	Range of Alternative Scores	1	1-3	1-4	1-4	1-2	1-3	1-3	1-3

Table 4.3.2. Alternative 2: Reduce groundfish bycatch by increasing trip limit size (reduce commercial trawl fleet 50%). Relative rank of reduce bycatch and bycatch mortality. Overfished species in **bold** and emphsis species in *italic* . Precautionary species management (reflect change in rank due to fisheries or species characteristics that influence scoring and comparison to other alternatives (see Chapte alternative's effect on emphasis species).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/ closı
			None	Larger trip limits	Soft sector scorecard	None	Yes	50% reduction in effective effort	RC.
Northern Shelf	**Canary rockfish**	1	3	2	4	2	2	1	3
	Lingcod	1	3	2	4	2	2	1	3
	Yelloweye rockfish	1	3	2	4	2	2	1	3
	Yellowtail rockfish	1	3	2	4	2	2	1	3
	Arrowtooth flounder	1	3	3	4	2	2	1	3
	English sole	1	3	3	4	2	2	1	3
	Petrale sole	1	3	3	4	2	2	1	3
Southern Shelf	**Boccacio**	1	3	2	4	2	2	1	3
	Cowcod	1	3	2	4	2	2	1	3
	Chilipepper	1	3	3	4	2	2	1	3
Slope	**Darkblotched rockfish**	1	3	2	4	2	2	1	3
	Pacific Ocean Perch	1	3	2	4	2	2	1	3
	Dover sole (p)	1	3	2	4	2	2	1	3
	Sablefish (p)	1	3	2	4	2	2	1	3
	Shortspine thornyhead (p)	1	3	2	4	2	2	1	3
	Longspine thornyhead	1	3	3	4	2	2	1	3
Pelagic	**Widow rockfish**	1	3	2	4	2	2	1	3
	Pacific whiting	1	3	2	4	2	2	1	3
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3
	Cabezon	1	3	4	4	2	2	3	3
	Range of Alternative Scores	1	1-3	1-4	1-4	1-2	1-3	1-3	1-

Table 4.3.3. Alternative3: Reduce groundfish bycatch by increasing trip limits (reduce commercial season). Relative rank of tools used to reduce bycatch and bycatch mortality. Overfished species in **bold** and emphasis species in *italic*. Precautionary species management (p). Shaded areas reflect change in rank due to fisheries or species characteristics that influence scoring and comparison to other alternatives (see Chapter 4 text describing alternative's effect on emphasis species).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip Limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area closures	Monitoring program
			None	Larger trip limits	Soft sector scorecard	None	Yes	None	RCAs and shortened season	10% Observer coverage, 100% logbook coverage, verification
Northern Shelf	**Canary rockfish**	1	3	3	4	2	2	3	3	3
	Lingcod	1	3	3	4	2	2	3	3	3
	Yelloweye rockfish	1	3	3	4	2	2	3	3	3
	Yellowtail rockfish	1	3	3	4	2	2	3	3	3
	Arrowtooth flounder	1	3	3	4	2	2	3	3	3
	English sole	1	3	3	4	2	2	3	3	3
	Petrale sole	1	3	3	4	2	2	3	3	3
Southern Shelf	**Boccacio**	1	3	3	4	2	2	3	3	3
	Cowcod	1	3	3	4	2	2	3	3	3
	Chilipepper	1	3	3	4	2	2	3	3	3
Slope	**Darkblotched rockfish**	1	3	3	4	2	2	3	3	3
	Pacific Ocean Perch	1	3	3	4	2	2	3	3	3
	Dover sole (p)	1	3	3	4	2	2	3	3	3
	Sablefish (p)	1	3	3	4	2	2	3	3	3
	Shortspine thornyhead (p)	1	3	3	4	2	2	3	3	3
	Longspine thornyhead	1	3	3	4	2	2	3	3	3
Pelagic	**Widow rockfish**	1	3	3	4	2	2	3	3	3
	Pacific whiting	1	3	3	4	2	2	3	3	3
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3	3
	Cabezon	1	3	4	4	2	2	3	3	3
	Range of Alternative Scores	1	1-3	1-4	1-4	1-2	1-3	1-3	1-3	1-5

Table 4.3.4. Alternative4: Reduce groundfish bycatch by establishing sector caps. Relative rank of tools used to reduce bycatch and bycat
Overfished species in **bold** and emphsis species in *italic*. Precautionary species management (p). Shaded areas reflect change in rank du
fisheries or species characteristics that influence scoring and comparison to other alternatives (see Chapter 4 text describing alternative's e
emphasis species).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area closures
			Catch ratios- allocate to sector with reserve	Yes	Sector Caps	None	Yes	None	RCAs
Northern Shelf	**Canary rockfish**	1	2	2	3	2	2	3	3
	Lingcod	1	2	2	3	2	2	3	3
	Yelloweye rockfish	1	2	2	3	2	2	3	3
	Yellowtail rockfish	1	2	2	3	2	2	3	3
	Arrowtooth flounder	1	2	3	3	2	2	3	3
	English sole	1	2	3	3	2	2	3	3
	Petrale sole	1	2	3	3	2	2	3	3
Southern Shelf	**Boccacio**	1	2	2	3	2	2	3	3
	Cowcod	1	2	2	3	2	2	3	3
	Chilipepper	1	2	3	3	2	2	3	3
Slope	**Darkblotched rockfish**	1	2	2	3	2	2	3	3
	Pacific Ocean Perch	1	2	2	3	2	2	3	3
	Dover sole (p)	1	2	2	3	2	2	3	3
	Sablefish (p)	1	2	2	3	2	2	3	3
	Shortspine thornyhead (p)	1	2	2	3	2	2	3	3
	Longspine thornyhead	1	2	3	3	2	2	3	3
Pelagic	**Widow rockfish**	1	2	2	3	2	2	3	3
	Pacific whiting	1	2	2	3	2	2	3	3
Nearshore	*Black rockfish*	1	2	2	3	2	2	3	3
	Cabezon	1	2	2	3	2	2	3	3
	Range of Alternative Scores	1	1-3	1-4	1-4	1-2	1-3	1-3	1-3

Table 4.3.5. Alternative 5: Reduce groundfish bycatch by establishing individual transferable quotas (RSQ or IFQ). Relative rank of to bycatch and bycatch mortality. Overfished species in **bold** and emphsis species in *italic* . Precautionary species management (p). Sh change in rank due to fisheries or species characteristics that influence scoring and comparison to other alternatives (see Chapter 4 te alternative's effect on overfished and emphasis species).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip Limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/ closu
			Yes with OY Reserve	None	Individual Vessel RSQ and IFQs	Retain Overfished	Flexible	RSQ & IFQ sales	Areas cl bottom
Northern Shelf	**Canary rockfish**	1	1	1	1	1	3	2	1
	Lingcod	1	1	1	1	1	3	2	1
	Yelloweye rockfish	1	1	1	2	2	3	2	1
	Yellowtail rockfish	1	1	1	2	2	3	2	1
	Arrowtooth flounder	1	1	1	2	2	3	2	1
	English sole	1	1	1	2	2	3	2	1
	Petrale sole	1	1	1	2	2	3	2	1
Southern Shelf	**Boccacio**	1	1	1	1	1	3	2	1
	Cowcod	1	1	1	1	1	3	2	1
	Chilipepper	1	1	1	2	2	3	2	1
Slope	**Darkblotched rockfish**	1	1	1	1	1	3	2	1
	Pacific Ocean Perch	1	1	1	1	1	3	2	1
	Dover sole (p)	1	1	1	2	2	3	2	1
	Sablefish (p)	1	1	1	2	2	3	2	1
	Shortspine thornyhead (p)	1	1	1	2	2	3	2	1
	Longspine thornyhead	1	1	1	2	2	3	2	1
Pelagic	**Widow rockfish**	1	1	1	1	1	3	2	2
	Pacific whiting	1	1	1	1	1	3	2	2
Nearshore	*Black rockfish*	1	1	1	2	2	3	2	1
	Cabezon	1	1	1	2	2	3	2	1
	Range of Alternative Scores	1	1-2	1-4	1-4	1-2	1-3	1-3	1-

Table 4.3.6. Alternative 6: Reduce groundfish bycatch by large area closures and gear restrictions, RSQs, and IFQs, with 100% retention of gr
Relative rank of tools used to reduce bycatch and bycatch mortality.Overfished species in **bold** and emphsis species in *italic* . Precautionary s
management (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area closures
			Yes, with OY reserve	Relaxed	Individual Vessel RSQ and IFQs	Retain All Groundfish	Yes	RSQ & IFQ sales	Areas closed to all groundfish fishing
Northern Shelf	**Canary rockfish**	1	1	1	1	1	1	2	1
	Lingcod	1	1	1	1	1	1	2	1
	Yelloweye rockfish	1	1	1	1	1	1	2	1
	Yellowtail rockfish	1	1	1	1	1	1	2	1
	Arrowtooth flounder	1	1	1	1	1	1	2	1
	English sole	1	1	1	1	1	1	2	1
	Petrale sole	1	1	1	1	1	1	2	1
Southern Shelf	**Boccacio**	1	1	1	1	1	1	2	1
	Cowcod	1	1	1	1	1	1	2	1
	Chilipepper	1	1	1	1	1	1	2	1
Slope	**Darkblotched rockfish**	1	1	1	1	1	1	2	1
	Pacific Ocean Perch	1	1	1	1	1	1	2	1
	Dover sole (p)	1	1	1	1	1	1	2	1
	Sablefish (p)	1	1	1	1	1	1	2	1
	Shortspine thornyhead (p)	1	1	1	1	1	1	2	1
	Longspine thornyhead	1	1	1	1	1	1	2	1
Pelagic	**Widow rockfish**	1	1	1	1	1	1	2	1
	Pacific whiting	1	1	1	1	1	1	2	1
Nearshore	*Black rockfish*	1	1	1	1	1	1	2	1
	Cabezon	1	1	1	1	1	1	2	1
	Range of Alternative Scores	1	1-3	1-4	1-4	1-2	1-3	1-3	1-3

Table 4.5.1 Monitoring tools and effects on improving accountability and cost impacts of each tool. Effects scaled as follows: Y (definitely, substantially), y (probably, moderately), n (probably not, minor), and N (no, none); L = lower cost, M = moderately higher cost, H = highest cost.

Monitoring/Reporting Requirements	Alternatives	Program	Identify fishing locations	Identify fishing depths	Provide tow by tow data	good data quality	Increase quantity and timeliness of data	Identify groundfish discards	Provide groundfish biological data	Provide non-groundfish data	Provide other non-finfish data	Provide mammal and seabird data	Ease of enforcement	Administrative Costs	Compliance Costs (to industry)
fish tickets	1-6	state	N	N	N	y	Y	N	N	y	N	N	Y	L	L
logbooks	1-2,4-6	state	y	y	y	y	n	N	N	N	N	N	Y	M	M
logbooks	3	federal	y	y	y	y	y	y	N	N	N	N	Y	M	M
observers															
commercial 10%	1-3	federal	Y	Y	Y	Y	n	Y	Y	Y	Y	Y		H	M/H
commercial 60%	4	federal	Y	Y	Y	Y	y	Y	Y	Y	Y	Y		H	M/H
commercial 100%	5,6	federal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		H	M/H
CPFV	4-5	(state)	Y	y	-	Y	Y	Y	Y	Y	Y	y		H	M/H
sport		n/a			-		-							HH	
port sampling															
commercial	1-6	state	y	y	N	Y		n	y	N	N	N		M	L
CPFV	1-6	state	y	y	-	Y		n	y	y	N	N		M	L
sport	1-6	state	y		-				y?	y?				M/H	L
VMS	1-6	federal	Y	y	N	Y	Y	N	N	N	N	N	Y	L	M
mandatory retention	5,6	federal				Y	Y	y	y	n	n	N	N	H/M	M/H
Enforcement cost			H	H	H			H		H	H				

Table 4.5.2 Monitoring alternatives and rank of effects on improving accountability, and cost impacts of each alternative.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
RELATIVE RANK OF ALTERNATIVES BY EFFECTIVENESS AT IMPROVING ACCOUNTABILITY, EASE OF ENFORCEMENT, REDUCING COMPLIANCE COSTS	10% Commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, 100% log coverage, log verification, VMS.	60% commercial and recreational (CPFV) observer coverage, increased commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and increased recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.
Indentify fishing locations (VMS)	1	1	1	1	1	1
Identify fishing depths (VMS)	1	1	1	1	1	1
Provide tow by tow data	2	2	1	1	1	1
Provide good quality data	4	4	3	2	1	1
Increase quantity of data	5	4	3	2	1	1
Allow inseason use of data	3	3	3	2	1	1
Identify groundfish discards	5	4	3	2	1	1
Provide groundfish biological data	6	5	4	3	2	1
Provide non-groundfish biological data	3	3	3	2	1	1
Provide non-finfish biological data	3	3	3	2	1	1
Provide mammal and seabird data	3	3	3	2	1	1
Ease of enforcement	5	4	3	2	1	1
Keep administrative costs low	2	3	4	5	6	6
Keep industry compliance costs low	2	3	4	5	6	6
Rank of location	2	2	1	1	1	1
Rank of quality, quantity, timeliness	5	4	3	2	1	1
Rank of groundfish biological data	6	5	4	3	2	1
Rank of non-groundfish biological data	3	3	3	2	1	1
Rank of ease of enforcement	5	4	3	2	1	1
Rank of cost	1	2	3	4	5	5
Number of first place scores	2	2	4	4	15	17
Number of last place scores	15	8	5	0	3	3
Overall Rank	6	5	4	3	2	1

Table 4.6.1 Relative rank of bycatch reduction methods (tools) for each alternative used to reduce bycatch and bycatch mortality, and address accountability issues.

RELATIVE RANK OF ALTERNATIVES BY BYCATCH REDUCTION TOOL TYPE	Alternative 1 Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	Alternative 2 Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	Alternative 3 Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	Alternative 4 Reduce all groundfish bycatch by establishing sector caps	Alternative 5 Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	Alternative 6 Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	1	1	1	1	1	1
Set **overfished groundfish catch caps** by **fishing sector**	2	2	2	1	2	2
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	4	2	3	2	1	1
Use **catch limits** to control groundfish bycatch	3	3	3	2	1	1
Set individual vessel/permit catch caps for overfished groundfish species	3	3	3	3	2	1
Set groundfish **discard caps** (require increased retention)	2	2	2	2	1	1
Establish **IQs** for other groundfish	2	2	2	2	1	1
Establish bycatch **performance standards**	3	3	3	2	1	1
Establish a reserve for fishers who achieve performance standards	3	3	3	2	1	1
Gear Restricitons						
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	2	2	2	2	3	1
Time/Area Restrictions	3	3	3	3	2	1
Establish **long term closures for all groundfish fishing**	3	3	3	3	2	1
Establish **long term closures for on-bottom fishing**	2	2	2	2	1	1
Capacity reduction (mandatory)	3	1	3	3	2	2
Monitoring/Reporting Requirements						
Trawl logbooks	2	2	1	2	2	2
Fixed-gear logbooks	2	2	1	2	2	2
CPFV logbooks	2	2	2	1	1	1
Commercial **port sampling**	3	3	3	2	1	1
Recreational port sampling	3	3	3	1	2	1
Observer coverage (commercial)	5	4	3	2	1	1
CPFV observers	3	3	3	2	2	1
VMS	1	1	1	1	1	1
Post-season observer data OK	3	3	3	2	1	1
Inseason observer data required	3	3	3	2	1	1
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	2	2	2	2	1	1
Discount fish ticket records of overfished species landings due to the low likelihood they accurately reflect actual catch and mortality.	2	2	2	1	1	1
Number of first place scores	2	3	4	5	16	22
Number of last place scores	23	20	18	12	3	3
Overall Rank	5	4	4	3	2	1

* Trip limits may be required for some sectors to prevent "derby fishing".

Table 4.6.2 Alternatives ranked by their effectiveness at reducing bycatch, enforcing and monitoring bycatch measures, and reducing compliance costs to industry.

RELATIVE RANK OF ALTERNATIVES BY POTENTIAL BYCATCH REDUCTION, EASE OF ENFORCEMENT AND COST	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector caps	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
Reduce catch in excess of vessel limits?	5	4	5	3	2	1
Reduce proportion of overfished species?	5	3	4	2	1	1
Reduce encounters with overfished	5	3	4	2	1	1
Reduce fishing in high relief seafloor	5	3	4	2	2	1
Reduce catch proportion of on-bottom	5	3	4	3	2	1
Reduce catch proportion of off-bottom	6	4	5	3	2	1
Reduce catch proportion of small fish?	3	3	3	3	2	1
Reduce catch of unwanted finfish species?	3	3	3	3	2	1
Reduce potential for "ghost fishing"?	1	1	1	1	1	1
Reduce catch of marine mammals?	2	1	2	2	2	2
Reduce catch of seabirds?	2	1	2	2	2	2
How easily enforced/ monitored?	5	4	3	2	1	1
Compliance Costs (to vessel)	1	2	3	4	5	6
Rank of Groundfish Bycatch Reduction	6	4	5	3	2	1
Rank of Other Bycatch Reduction	2	1	2	2	2	2
Rank of Enforcement	5	4	3	2	1	1
Rank of Cost	1	2	3	4	5	6
Number of first place scores	2	3	1	1	4	10
Number of last place scores	11	2	4	4	2	3
Overall Rank	6	4	5	3	2	1

Table 4.10.1 OY, catch and discard of selected groundfish species. Overfished species in **bold** and emphasis species in *italic* . Precautionary species management *(p)* .App

Environment	Species	No Action 2002 OY	Council 2003 OY	2002 Landed Catch	Discard Proportion	Source	2002 Total Catch	Total Catch Attainment >75%?	2002 Catch Exceeds OY?
Northern Shelf	**Canary rockfish**	93	44	48	0.16	GMT	56	No	No
	Lingcod	577	651	205	0.19	GMT	244	No	No
	Yelloweye rockfish	14	22	1	0.19	GMT	1	No	No
	Yellowtail rockfish	3,146	3,146	1,200	0.16	GMT	1,392	No	No
	Arrowtooth flounder	5,800	5,800	2,086	0.09	Wallace, 2002	2,274	No	No
	English sole	3,100	3,100	1,500	0.12	Sampson, 1993	1,680	No	No
	Petrale sole	2,762	2,762	1,797	0.12	Samson, 1998	2,013	No	No
Southern Shelf	**Boccacio**	100	20	28	0.16	GMT	32	No	No
	Cowcod	5	24	0	0.16	GMT	0	No	No
	Chilipepper	2,032	2,032	161	0.16	GMT	187	No	No
Slope	**Darkblotched rockfish**	168	172	103	0.16	GMT	119	No	No
	Pacific Ocean Perch	350	377	125	0.16	GMT	145	No	No
	Dover sole (p)	7,440	7,440	6,378	0.05	Sampson, 2001	6,697	Yes	No
	Sablefish (p)	4,596	6,794	3,926	0.10	GMT	4,319	Yes	No
	Shortspine thornyhead (p)	955	955	835	0.30	GMT	1,086	Yes	Yes
	Longspine thornyhead	2,656	2,656	1,900	0.09	GMT	2,071	Yes	No
Pelagic	**Widow rockfish**	856	832	352	0.16	GMT	408	No	No
	Pacific whiting (incl.discard)	129,600	148,200	129,993	0.07	NMFS	129,993	Yes	Yes
Nearshore	*Black rockfish*	1,115	1,115	--	0.16	GMT	--	?	Yes
	Cabezon	--	--	--	--	--	--	?	?

Exhibit D.11.b
Supplemental Attachment 3
November 2003

Preliminary Draft

Economic Analysis for the

West Coast Groundfish Bycatch PEIS

Prepared for the
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Contents

Tables:

Figures:

1.0 Introduction to the Socioeconomic Impact Assessment

This section presents qualitative examination of the social and economc impacts of the alternatives that have been developed to resolve bycatch issues. The section begins by examining definition of bycatch and the decision processes in deciding whether to retain or discard fish once brought on board. The section continues by define the various components of the human environment and the variable use to measure effects. The section ends with a discusion of the incentives facing fishers to catch unwanted fish and unmarketable fish as well as the incentives they face to either retain or discard those fish.

1.1 Definitional Issues

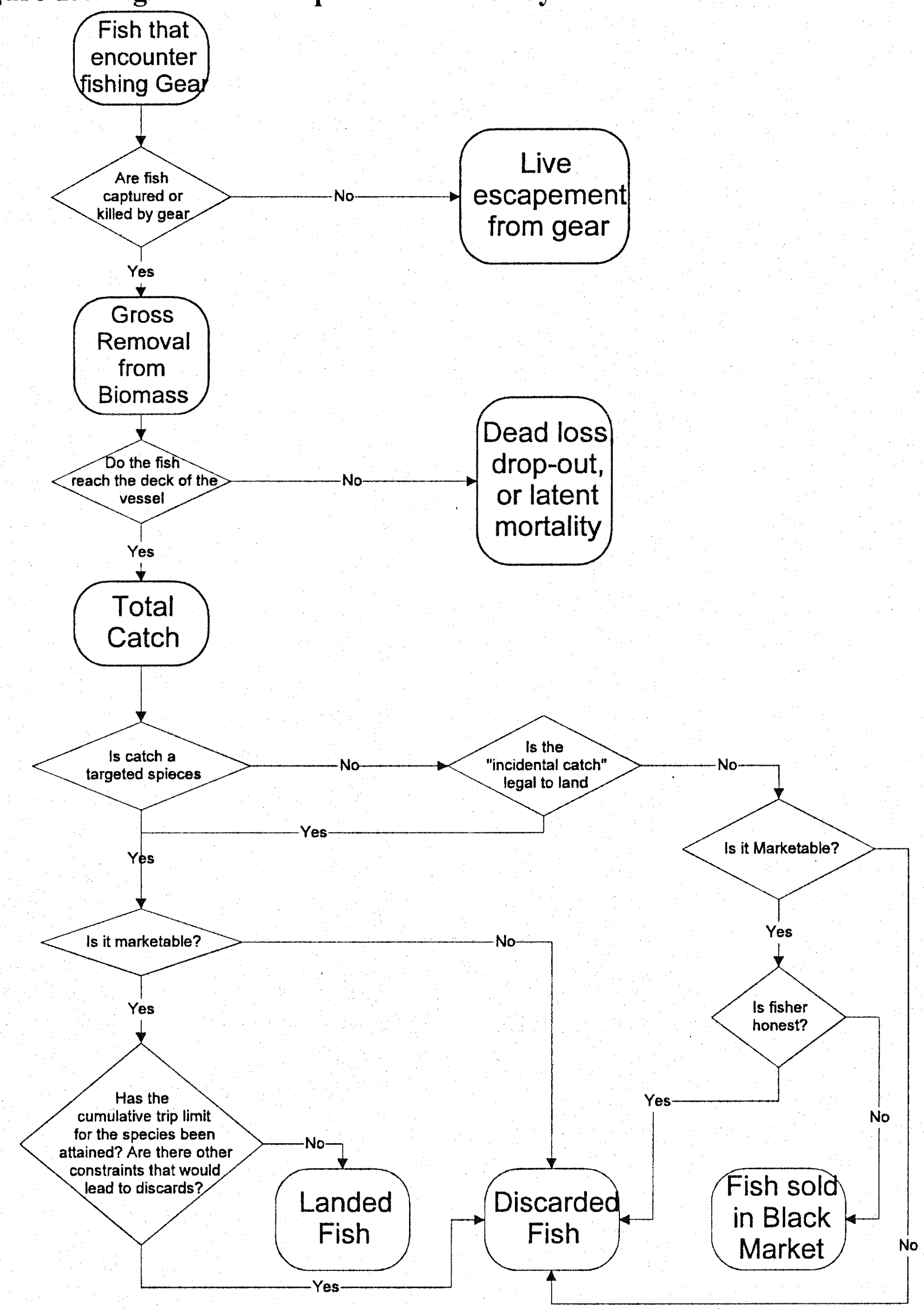
A variety of terms have been used in the literature related to wastage in fisheries and there have been many attempts at definition. The term "bycatch" has been used in scientific and popular literature for more than half a century and has been subject to a variety of interpretations, some of which are overlapping or contradictory. The Magnuson-Stevens Act (MSA) defines the term "bycatch" to mean fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. As a result of this legal definition, the term bycatch, as applied to fisheries in the U.S. Exclusive Economic Zone (EEZ), is used synonymously with discards and vice versa. The MSA specifies that "fish" means finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds. The MSA further specifies that the term "bycatch" does not include fish released alive under a recreational catch and release fishery management program.

Figure 1 illustrates the meaning of the term bycatch and other catch-related terms as they are defined and used in the Magnuson-Stevens Act and Pacific Coast Groundfish FMP. Some fish encounter fishing gear but escape alive. However, there will almost always be some unobserved mortality resulting from injury when fish encounter fishing gear—higher unobserved mortality is likely with trawl gear, but some unobserved mortality occurs with all gears. The latent or "pass-through" mortality of fish escaping from a trawl net may be quite high depending on the design and manner in which the gear is fished as well as its mesh size (Henry 1990). There may also be mortality associated with gear that is lost or abandoned — the bycatch resulting from this "ghost fishing" is typically referred to as "dead-loss."

The "total catch" is that quantity taken by the fishing gear and which reaches the deck of the fishing vessel. Total catch can be further sub-divided into "targeted catch" and "non-targeted catch" (also referred to as "incidental catch") bearing in mind that the same species can move from one category to another depending on size, market demand, season or other criteria. A captured fish can be retained and sold or discarded. "Discards" are that portion thrown away at sea (for one reason or another). The remainder is the "landed catch" or "retained catch" (i.e., that which is brought ashore).

As will be discussed later, there are circumstances in which fishermen will discard fish even though they are marketable. Discarding these fish may be the result of fisheries management measures directly (e.g., prohibited species regulations), incentives created by management measures (e.g., a cumulative trip limit or quota constraint) or may occur in unregulated fisheries (e.g., due to a vessel hold constraint). In most cases, fish that are non-marketable because they are either damaged or are a non-commercial species are discarded. Fish that are illegal to land (due to restrictions imposed by fisheries management) are in most cases discarded, although some of this fish may be sold on the black market, if the fisher has a dishonest tendencies.

Figure 1. Diagrammatic representation of bycatch and other catch-related terms.



Source: Adapted from Hoagland et al. (1996) and Pascoe (1997)

1.1.1 Components and Variables Comprising the Human Environment

As noted above, the socioeconomic effects of the alternative programs may be extensive. The effects analysis will be organized according to various socioeconomic components of the human environment that potentially will be affected. The following is a list of the components and examples of the specific impact assessment variables that will be considered. Note that data for many of the variables do not exist and the discussion will qualitative.

Table 1. Components and Impact Variables in the Human Environment

Component of the Human Environment	Impact Assessment Variables
Incentives and disincentives regarding bycatch	Costs of landing and discarding fish including "internal" and "external" costs.
Commercial harvesters	Gross ex-vessel revenue and operation expenses (average costs); distributional effects among commercial harvesters such as changes in level of dependence and involvement (fleet size and composition), production level of different sectors, effects on other fisheries.
Buyers and processors	Gross product revenue and operation expenses (average costs)
Consumers of groundfish products	Product prices, quality and availability
Recreational, charter and tribal fisheries	Value of the recreational experience; fulfillment of subsistence needs; revenues and costs
Communities	Employment and income
Fishing vessel safety	At-sea fatalities and injuries
Management and enforcement costs	At-sea and dockside monitoring costs; administration costs
Harvesting and processing capacity	Reductions in excess capacity

1.1.2 Economic Dimensions of the Bycatch Issue

1.1.2.1 Incentives and Disincentives to Discard

Before trying to analyze the effectiveness of measures to reduce bycatch it is important to understand the reasons why discarding occurs and why it may become a problem. Fish are discarded for a number of reasons, but the MSA definition of bycatch suggests that the driving forces behind the practices of discarding can be divided into two major categories — economic and regulatory.

In many cases, the process of discarding is an economic activity associated with other fishing activities (Pascoe 1997). There is an economic incentive to discard those fish for which the price received does not compensate the operator of the fishing business for the costs involved in their catching, handling and sending to market (Pascoe 1997). From a production perspective, unintended catches and discards is simply an input to the production of fish that are retained and marketed.

In short, it is often a business decision to discard. Fish may have a low market value or be completely non-marketable for several reasons: they may be of the wrong species, size or sex; they may be damaged (caused by gear or predation in nets or mis-handling, etc.); or they may be incompatible with the rest of catch (e.g., slime, abrasion or rapid spoilage could cause damage to target species) (Clucas 1997).

Within the category of economic discards there are two distinctly different types (Clucas 1997). The so-called "trash fish" sometimes caught in trawling operations is an example of the first type. It is almost invariably of lower value than the target and therefore typically discarded whenever caught. For example, if spiny dogfish sharks caught in commercial bottom trawl nets have any value at all, they are several times less valuable than target species. These discards may also include marine life generally considered inedible, such as corals and sponges.

The other type of economic discards is more situation-specific and occurs when certain attributes of a fish (size, sex or physical condition) make it more marketable and therefore more valuable than another. This type of discarding for economic reasons is also referred to as high grading. In general, high grading occurs when the price differential between high- and low-valued fish is greater than the cost of discarding and replacing the catch. For example, there is an incentive to high grade if a landing limit forms a binding constraint to the quantity of fish that can be retained and sold. It is rational in such cases to discard low-valued sizes and also low-valued species in order to utilize the landing limit for the more valuable-sized fish or the more valuable species. The incentive to high grade is enhanced if the cost to catch additional fish is very low. For example, if an operator chooses to high-grade by discarding 25 percent of his marketable catch, he will end up having to catch 33 percent more fish than he would have if he did not engage in high-grading. The incentive to high grade may vary from trip to trip, depending on the various catch rates and catch compositions. For some trips, it may not be rational to discard at all if the landing limit is not reached. However, some fishermen may discard part of their catch early during the trip in anticipation of catching more valuable fish. In other cases, fishermen may chose to store lower valued fish and discard these only when the landing limit is reached.

The category of regulatory discards includes fish harvested in a fishery which fishermen are required by regulation to discard whenever caught. Such regulations remove the incentive to target the fish in question by eliminating the economic benefits.[1] For example, it is unlawful for any person to retain any species of salmonid or Pacific halibut caught by means of fishing gear authorized under the Pacific Coast Groundfish FMP, except where a Council approved monitoring program is in effect. State regulations prohibit the landing of crab incidentally caught in trawl gear off Washington and Oregon. Regulatory discards also include fish that could otherwise be legally retained and sold but have been caught in a prohibited season, by a prohibited gear, or on a prohibited fishing grounds and therefore must be discarded. In addition, regulatory discarding occurs in multi-species fisheries where quotas or total allowable catches are given which do not match the actual composition of the catch (Clucas 1997). This means that a vessel may reach the limit for one particular species in a mixed catch while there is still an unfulfilled quota of other species. As landing limits are approached there is a strong incentive for the vessel to high grade and discard species that are close to the limit in order to continue fishing for species having more limit

[1] Some fishers may weigh the economic benefits of disobeying the regulations against the probability and costs of getting caught. Even heavy fines and penalties may be viewed as a business cost that determined violators are willing to bear.

remaining. This is the type of discard most often found in the West Coast groundfish fisheries.

1.1.2.2 Costs of Bycatch

The economic losses or costs associated with the act of discarding can also be divided into a number of categories. The categories presented below are drawn largely from Clucas (1997) and Pascoe (1997). It is important to note that many of the costs listed are not unique to the problem of discarding — they would occur regardless if the fish are discarded or retained. For example, the costs associated with fishery interactions would not be eliminated if there were a total ban on discards. Consequently, the problem is more accurately framed as the costs of catching fish that are unwanted (for economic or regulatory reasons) rather than as the costs of discarding per se.

1.1.2.2.1 Costs associated with catching, sorting and throwing the unwanted or prohibited catch over board

Extra costs associated with capture and subsequent discarding include higher fuel consumption in active fishing operations (such as trawling), longer on-deck times for target species whilst the catch is sorted, leading to a reduction of quality and therefore value of the fish, employment of extra crewmembers required to sort and remove the unwanted catch from the target catch, greater "wear and tear" on the fishing gear and vessels employed, and other such examples (Clucas 1997). For at-sea processors, lower factory throughput efficiencies and higher processing crew costs due to the additional time required to separate discards from the retained catch may be the direct result of the presence of discards in the catch. These various costs differ across fisheries and fishing operations. For example, the costs of removing fish from gear may be relatively small for trawl gear as the fish do not need to be physically detached from the gear (Pascoe 1997). Moreover, estimating the economic costs of sorting and discarding fish is difficult due to the problems in determining the opportunity cost of the crew's time (Pascoe 1997). The crew may be otherwise inactive if not sorting the fish.

1.1.2.2.2 Foregone catch as a result of mortalities imposed on recruits to the target fisheries

An economic loss also occurs where discard induced mortalities affect immature individuals or non-legal sexes of the target species (Clucas 1997). The taking of undersized or juvenile fish can produce a number of negative economic effects (Pascoe 1997).[2] Catching undersized fish results in potential growth overfishing and recruitment overfishing. With growth overfishing, the juvenile fish could be taken at a later date at a larger more valuable size. Hence, the overall potential yield of the fishery (and similarly, the value of the

[2] Catching juveniles of a target species may represent an economic loss in terms of foregone economic yield-per-recruit for the misbehaving fishery whether or not they are discarded (Alverson et al. 1994). The losses are higher if they are discarded because there are no short-term benefits.

yield) is reduced. With recruitment overfishing, the taking of juvenile fish reduces the potential spawning stock size, resulting in lower levels of future recruitment. The lower level of future recruitment can be a direct cost to all participants in the fishery in the form of foregone income (Pascoe 1997).

Discarding over-quota fish (whether as the result of a global quota, individual quota or trip limit) also produces costs (Pascoe 1997). A proportion of these fish could have potentially been caught in the next year, reducing the costs of fishing in order to achieve next year's quota. These costs are again incurred by all fishers in the fishery, including the fisherman who discarded the over-quota catch.

Reducing the potential level of landings can also affect consumers through a reduction in consumer surplus (Pascoe 1997). Consumer surplus is the area under the demand curve and above the price received. A loss in consumer surplus can occur through a reduced quantity of landings which increases the price to consumers. The loss is related to the responsiveness of price to quantity landed (the price flexibility). If prices are inflexible with respect to quantity landed, then varying the quantity landed will not affect the price received. Consumer surplus in such cases is zero for all levels of landing. However, if prices do respond to the quantity landed, then a reduction in landings will result in an increase in price and a loss of consumer surplus.

1.1.2.2.3 Foregone catch resulting from mortalities imposed on target fisheries by fisheries targeting other species

A third economic loss occurs when a fishery discards fish of economic importance to another fishery. The result can be a indirect cost to persons involved in the harvesting, processing, marketing or consumption of the species discarded by the target fishery (Pascoe 1997). This fishery interaction situation can be compounded by quota systems which permit individual fishermen to only land specific species (Clucas 1997).

It is important to note that discard mortalities induced by a fishery on species of value to other commercial or recreational fisheries are also often associated with high social costs. For obvious reasons, these sorts of mortalities often spawn bitter conflict between fishery participants and lead to political infighting over resource allocation and bycatch removal quotas (Alverson et al. 1994).

1.1.2.2.4 Costs of endangered or threatened species bycatch

Apart from the negative effects on the fishing industry and fish consumers, bycatch can have a negative effect on others in society who may value the species being discarded and therefore may experience some loss through the death of the animals following discarding (Pascoe 1997). If a bycatch species is severely depleted, threatened or endangered, the cost to society may be especially high. For example, where the species reaches a threatened status, there may be a loss of existence value as there is a possibility that the population may collapse and the species become extinct (consequently, this bycatch is referred to as "critical bycatch" (Hall 1995 cited in Pascoe 1997)).[3] While the value of threatened or endangered species is difficult to measure, an indication of the non-market value of such species can be gauged by the reaction of individuals to their death as a result of any discarding.

1.1.2.2.5 Disruption of marine food chains and ecosystems

A fifth economic loss may occur when the bycatch of one species has a negative effect on the status of other species through predator, prey, or other biological interactions. These modifications of biological community structures in ecosystems can have indirect effects on fishery resources.

Ecosystem level impacts of bycatch can also negatively affect non-fishery resources. The result of the adverse effects of bycatch on ecosystems and associated species may be that some members of society experience a loss of existence value and other values derived from the preservation of nature. It is important to note, however, that bycatch reduction will not necessarily have a positive impact on components of marine ecosystems. For example, measures to reduce discards in some fisheries would reduce the food supply of scavenging seabirds and could have a severe impact on the ecological balance in wildlife communities (Furness 1999).

1.1.2.2.6 Bycatch monitoring

A sixth stream of costs associated with discards is the money that is spent each year on monitoring the level of bycatch. The main problem facing many fisheries managers is not the fact that discarding takes place *per se*, but that the level of discarding is not known (Pascoe 1997). Discarded fish represent catches that are not documented in landing statistics, but are nevertheless real removals from the stock (Pascoe 1997). In the case of unrecorded high grading, not only would actual mortality rates be higher than apparent mortality rates, but the age and size distribution of landed catch would be different from the size distribution of the initial harvest (prior to discards) (National Research Council 1999). Without information on bycatch it is difficult for fishery managers to calculate the size of a species' population and offer accurate advice toward the conservation of that stock. As a result, attempts to a manage a particular fishery may be based on incorrect assumptions and may allow unwittingly for the overexploitation of that resource.

1.1.2.2.7 Ethical concerns regarding "waste" in fisheries

From an economic perspective the discarding of fish is a problem only if it precludes higher valued uses of fish. It is important to note, however, that there may be societal concerns related to the discarding of fish that lie outside the economic-utilitarian paradigm. Specifically, some individuals may consider discarding fish to be wasteful and morally wrong. According to this viewpoint, fish that cannot be utilized should not be harvested. There are a number of variants of this philosophy. For example, some people may hold the

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[3] Existence value is the value emanating from the satisfaction of knowing that a particular species survives in a natural state

view that nature has rights; to exploit nature is just as wrong as to exploit people (Nash 1989). Other persons may contend that non-human species are intrinsically valuable, independent of any use they may be to humans (Callicott 1986). The latter conviction may be related to religious principles, such as a belief in the sacredness of all or certain life forms. Still other individuals may simply have an undefined sense that uselessly killing life forms is improper behavior and should be avoided.

All of these "moral arguments" are inconsistent with the economic paradigm of trade-offs between money and preservation of species or ecosystems because they present individuals with the moral imperative that we ought to preserve plants and animals (Stevens et al. 1991). While many of the costs associated with bycatch can be thought of as economic costs and can be quantified, at least in principle, the value that some people assign to eliminating waste in fisheries can not be expressed in monetary terms. These values are presented by their proponents as moral imperatives and, thus, do not lend themselves to analyses of economic tradeoffs. As Costanza et al. (1997) and Pearce and Moran (1994) note, concerns about the preferences of future generations or ideas of intrinsic value translate the valuation of environmental assets into a set of dimensions outside the realm of economics. Nevertheless, these ethical concerns can have economic implications. For example, it can be costly to harvesters and processors if consumers object to the waste and refuse to purchase related products. The importance of product differentiation in some fisheries through labels, such as the "dolphin-safe" labeling of canned tuna or "turtle-safe" labeling of boxes of shrimp, is an indication of the economic effect these ethical standards can have (See Roheim (2003) for a discussion of the market impacts of ecolabeling of seafood).

1.1.2.3 Bycatch Costs as Externalities

As discussed above, a fishermen will continue catching and discarding unwanted fish up to point at which the costs of this practice begin to have a negative effect on the profitability of his fishing operation. However, of all the costs discussed above only the costs associated with catching, sorting and throwing the unwanted or prohibited catch over board are fully borne by the individual discarding the fish. The act of catching juvenile fish also affects the potential future benefit to the fisherman him or herself, but it affects all other fishermen in the same fisheries as well. The costs are the product of the activity of all fishermen in the fishery and are therefore outside the control of the individual (Pascoe 1997). The vessel captain who chooses to invest in fishing practices that reduce bycatch because he is concerned about overfishing may be placed at a competitive disadvantage if other captains do not follow suit. The "free-riders" that do not minimize discards will likely be able to increase their relative share of higher-value species and fleet-wide profits.[4]

The other costs of bycatch previously described are also not only imposed (if imposed at all) on the individual taking and discarding the fish. These costs are external to fishermen's

[4] A "free-rider" is a term used by economists to denote an individual who benefits, at no personal cost, from the efforts of others. In this analysis, the free-rider receives the benefits (e.g., a sustainable fishery) that may accrue to the fleet from a decrease in discards without incurring the costs of bycatch reduction.

account of costs in the sense that they do not appear in their ledgers and, therefore, are not considered when fishermen calculate whether a particular fishing strategy is profitable. These circumstances, in which certain costs are external to (i.e., do not influence) the fisherman's production decision (Pascoe 1997), result in the individual fisherman making inadequate efforts to control bycatch. Basically, due to the existence of external costs, individual fishermen receive the wrong signals or incentives and make the wrong decisions from the perspective of society as a whole, as well as from the perspective of the fishermen as a group (NMFS 1996). The result is that the level of bycatch will be higher than the socially optimal level.

Economic theory says that profit-maximizing operations will use an input up to the point that the cost for an additional unit of the input is equal to the revenue that additional unit produces. Since society has not been able to develop a method to charge the fishing vessel for its use of discarded fish, the profit maximizing vessel operator will treat the unwanted fish as a non-binding constraint in his production. In other words, while the fishing vessel operator treats fish that are eventually discarded as a free good, society places a higher value on those fish, creating conflict between fishers and society.

From an economic perspective, the propensity of the fishing industry to discard fish is not so much a failure of the fishing industry to act responsibly as it is a consequence of the various costs and revenues tradeoffs that businesses make when determining how best to produce the goods that society values. The fact that discards often don't play an explicit role in the profit and loss calculation of fishermen is primarily a failure of society to organize its markets and regulations in a way that charges fishing operations a price that represents the value society places on that resource. This perspective can be used to develop solutions that could lead to changes in the way that fishing vessels treat their incidental catch.

2.0 Analysis of the Potential Economic Effects of Bycatch Reduction Alternatives

This section will provide an economic analysis of the six alternative programs (including the status quo) intended to minimize bycatch. The analysis will also examine the effects of monitoring/reporting elements necessary for the effectiveness of each program. The socioeconomic consequences (both unintended as well as the intended) of these programs may be far-reaching. However, data that can be used to predict the positive and negative socioeconomic effects of alternative management measures to reduce bycatch in the West Coast groundfish fisheries are limited. Data showing landings of groundfish are collected and are available for fishery management. However, data collected on discarded fish are extremely limited. Other issues driving a qualitative rather than quantitative analysis, include the fact that many of the proposed measures have never been tested. A second reason is the lack of *ex-post* assessments of the socioeconomic effects of those bycatch measures that have been implemented. A final reason is that the specific management measures in the programs other than the status quo are not well defined. Due to these limitations, precise estimates of the associated effects of the bycatch reduction alternatives are not possible. Therefore, the current impact analysis will focus on providing a qualitative description of the economic issues, the cause and effect relationships, and the direction and general magnitude of the anticipated economic impacts of each alternative.

2.1 Alternative 1: The Status Quo

This section contains a brief overview of the status quo management as seen from an economic perspective. The section then goes on to examine the various incentives and disincentive to reduce bycatch including catch of unwanted fish as well as discards. This discussion is followed by a review of how specific components of the human environment are affected by the status quo management regime. It should be noted that because the bycatch issue appears to be less significant in Pacific Whiting fishery, the current analysis focuses primarily on non-whiting groundfish fisheries. Future drafts will be augmented with additional information directly relevant to the whiting fishery.

2.1.1 Reveiw of Management Measures in the Status Quo

ACCEPTABLE BIOLOGICAL CATCH (ABCs)[5] are set for about 30 species where sufficient data exist. In other cases, ABCs may refer to complexes or broad categories (for example, there is a grab bag "other fish" category). ABCs are not management targets, however the ABC compared to the pristine or "unfished" biomass determines how the OPTIMUM YIELD (OY) may be set. The OY limits the total amount that can be caught during the year. If the ABC is larger than 40 percent of the pristine biomass (B40%), the OY may be set equal to or less than ABC. A stock whose current biomass is between 25 percent and 40 percent of the pristine biomass, is in the "precautionary zone" and a default OY harvest policy is applied

[5]Text in Small Cap Font indicate terms that will be defined in the glossary.

(based on what is known as the 40-10 policy). If the ABC is below 25 percent of the pristine biomass (B25%), a stock is overfished.

Once (the total catch) OY for a species is calculated, then tribal, recreational, Limited Entry and Open Access allocations are calculated, then discard estimates are applied. In the case of sablefish, the Limited Entry allocation is subdivided into trawl and non-trawl allocations, then discard rates are applied to each allocation. Discard estimates are based on the most recent observer data, the Oregon observer pilot program (Enhanced Data Collection Program, or EDCP) in the late 1990s and incidental catch data from a scientific investigation of the gear in the mid-1980s [Pikitch,]. A model, developed by Dr. James Hastie of NOAA Fisheries-NWFS (HASTIE MODEL), applies the best estimate of coincidental catch ratios of overfished species and various other species, by area, gear type and depth.

Using the HASTIE MODEL, and with the primary focus on preventing overfished species OYs from being exceeded, cumulative 2-month trip limits (TRIP LIMITS) are set for each species/complex. Unless otherwise specified, the trawl TRIP LIMITS apply to limited entry longline and pot gears. Vessels participating in Open Access fisheries, Tribal fisheries, and recreational fisheries are also constrained by separate TRIP LIMITS, and if the total catch of a given species open access, tribal or recreational fisheries exceed Landings OYs, NOAA Fisheries may prohibit additional landings of those species.

If a Limited Entry vessel reaches its the TRIP LIMIT for a particular species, it may not land any more of that species, regardless of whether it's overfished or not, until the next 2-month period begins. The vessel is not precluded from continuing to fish for other species; however, catch of any species for the which the TRIP LIMIT has been met must be discarded.

Although there is no requirement for vessels to report discarded fish, vessels are required to sort all of their catch at-sea (or prior to landing). Furthermore, all landed fish must be reported to state managment agencies on fish-tickets.

In recent years, an observer program has been implemented to provide estimates of discards. Observer coverage is designed to cover 10-15 percent of landed weight not including landings in the whiting fishery. Observers are assigned to a vessel for a 2-month period. Observers ride all trips during the period, including non-groundfish targeted trips. There is also a port sampling program that samples some landings, and beginning in 2003 an electronic VESSEL MONITORING SYSTEM (VMS) with satellite links is required. The VMS system shows the precise location of limited entry vessels at all times.

In general, vessels are not allowed to land prohibited species nor are they required to report how many are caught and discarded. An exception to this is in the shore-based whiting fishery, where an EXPERIMENTAL FISHING PERMIT (EFP) requires catcher vessels to retain all fish, including prohibited species—which are turned over to the State.

In order to encourage a more steady flow of fish to processing facilities and other markets, limited entry vessels have been allowed to choose to be in one of two “platoons”. The “A-platoon” can begin fishing on their TRIP LIMIT at the beginning of the two-month period, while the “B-platoon” waits 15 days before beginning. Regulations allowing the platoon system are scheduled to be eliminated beginning in 2004, due primarily to enforcement concerns relating to implementation of additional areas closed to fishing.

The status quo management regime also includes a set of closed fishing areas and marine protected areas. Commercial fishing in these areas is limited or completely prohibited. A primary purpose of the closed areas is the enhancement of stock rebuilding programs for overfished species. Many of the closed areas have been established where the abundance of overfished species is high relative to the abundance of other target species not designated as overfished.

2.1.2 Effects on Fishers Incentives to Reduce Bycatch

In general, the status quo with its cumulative trip limits provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards, particularly compared to unregulated open access, or many limited access fisheries that are managed with a "race for fish" allocation system. The cumulative bi-monthly trip limits in the status quo could also be called bi-monthly individual non-transferable quotas, and in fact many of the benefits typically associated with individual quota systems can be acheived under the status quo. Each limited entry permit holder is effectively guaranteed access to his trip limit in each bi-monthly period, and there is very little that one fisherman can do to directly effect the catch of others particularly within the two-month period.

In a typical "race for fish" management regime each vessel competes against the others to catch its share of the overall quota of fish. In the West Coast Groundfish fishery the cumulative trip limits have eliminated the "race for fish." Because fishermen do not have to race against each other for a limited fleet-wide harvest quota, they do not necessary face an economic penalty by slowing their fishing practices to minimize unwanted catch (fishes with low value or overfished species). For example, taking the time to move out of an area when a vessel experiences high catches of unwanted species is possible without the threat that other harvesters will cut into its share of the total quota. Similarly, taking shorter tows and sets to check for incidence of unwanted or overfished species does not penalize a vessel in terms of the amount of fish it may eventually catch. Finally, under the cumulative trip limit system harvesters have more flexibility to use gears that minimize unwanted catches—long foot-rope trawls, for example, or trawls with large mesh escape panels may be tried without fear that the reduced catch per effort will reduce their overall catch or revenue. In "race for fish" situations these "bycatch" reduction methods are very likely to result in less catch and therefore less revenue for the conscientious harvesters.

Notwithstanding the fact that the the cumulative trip limit system and the other regulations implementing the Groundfish FMP have removed, many of the disincentives to reduce unwanted catches and discards that are present in a "race for fish" situation, the incentives and disincentives that remain part of the status quo may be insufficient to lead to socially optimal levels of catch and bycatch.

As indicated in the previous section, a fishing vessel can be assumed to operate in a way so as to maximize profits within the regulations and constraints of the environment in which it operates. To do so, it will use inputs up to the point where an additional unit of the input is equal to the revenue that additional unit produces. Since, under the status quo, there is no mechanism that forces vessel operators to explicitly deal with the costs of bycatch, there are no economic incentives to reduce bycatch. If the operator does take some action to reduce "bycatch" those actions are more likely a response to societal pressures rather than a response to economic imperatives. Without an economic imperative, bycatch minimization is likely to be practiced only when it doesn't significantly affect the operator's bottom line.

An effective way to examine the various incentives and disincentives regarding bycatch under the status quo is to work through the various decision processes that face the vessel's operator, and at each point examine how the status quo management regime may be a positive or negative influence on the amount of unwanted catch and discards.

Decision Point: Which gear should I use when I fish?

Decision Point: Should I "pre-sell" my fish to a processor, or should I fish on speculation that I can find a buyer?

Decision Point: When should I fish?

Decision Point: For which species should I fish?

Decision Point: Where to fish?

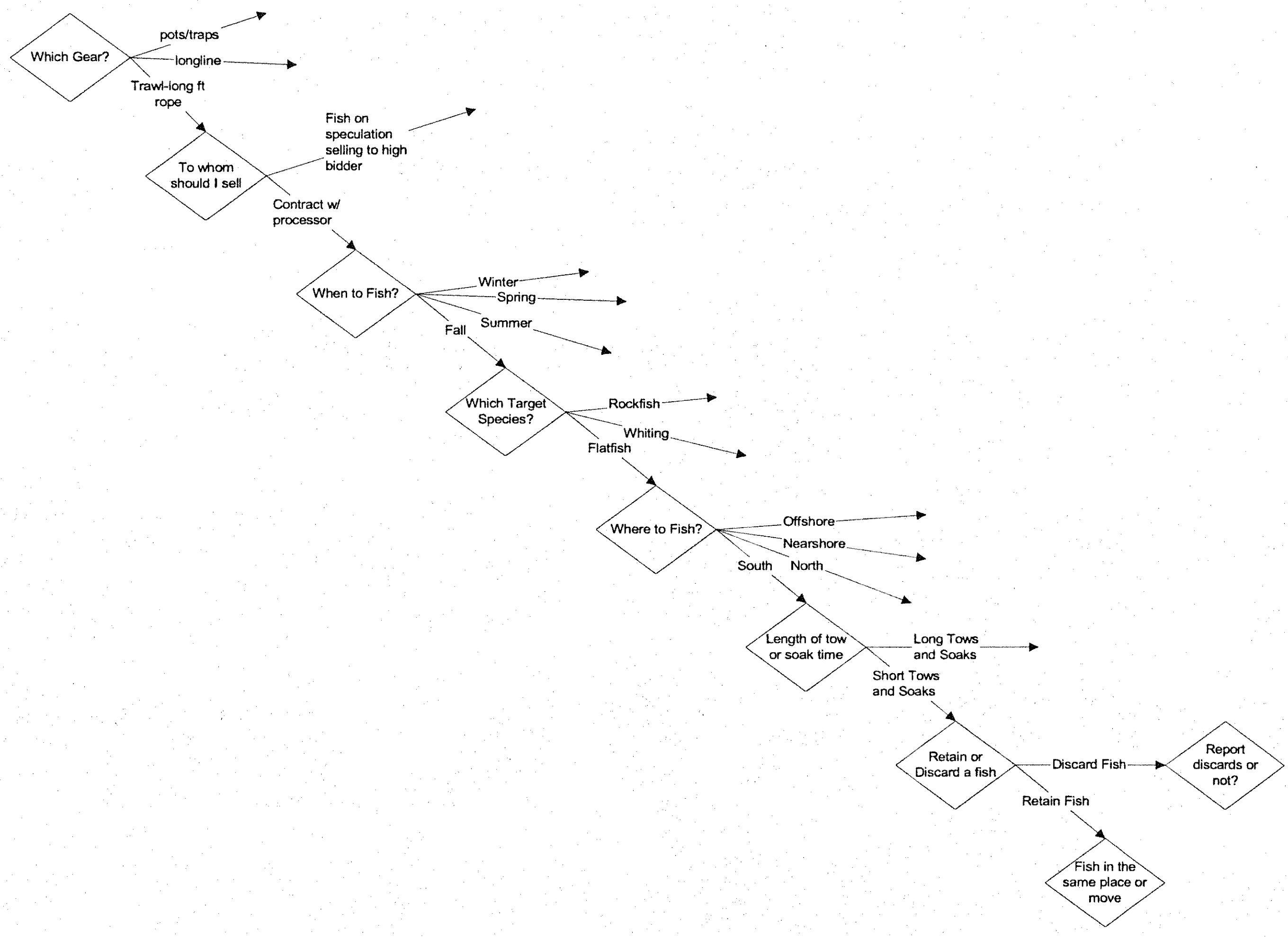
Decision Point: How long should tow or set gear?

Decision Point: Should I keep this particular fish or discard it?

Decision Point: Should I fish again in the same place or should I move to a different location?

This series of decision points is depicted graphically in the following figure. By looking at each decision point and the incentives and disincentives provided by the management regime, it is possible to gain some understanding of the behaviors of fish harvesters with respect to bycatch.

Figure 2. Harvester Decisions Affecting Bycatch



Decision Point: Which gear should I use when I fish?

The limited entry system under the status quo management regime largely determines which general gear type any vessel is allowed to used. While the limited entry system has the positive effect of limiting the amount of effort on the grounds and has made the cumulative trip limit system possible, it may also reduce the likelihood that a given operator will try different gear types (switching from trawl to fixed gear for example), that could reduce unwanted catches. A vessel that does not have a fixed gear limited entry permit may not be precluded from participating in the relatively lucrative sablefish fishery. Without the ability to fish sablefish, trawl permit holders are unlikely to forego the higher catch rates of other species that can be attained with trawl gears. In the end however, the constraint on easily changing gears to use more selective gear types is likely to have a smaller negative impact of bycatch than the postive impact derived from the limited entry systems restrictions on the amount of gear being used.

As indicated earlier in this section, the current cumulative trip limit system has effectively eliminated the race for fish in the limited entry sectors. Therefore the vessel operators may be more willing to try gears that reduce unwanted catches, for example trawl with longer foot ropes, or trawls equipped with large mesh escape panels. The decision to use these gears will primarily depend on whether changing to the more selective gear does not significantly reduce net revenues for the operator.

Decision Point: Should I "pre-sell" my fish to a processor, or should I fish on speculation that I can find a buyer?

While this decision point is not directly regulated by the FMP, a primary goal of the FMP is to maintain a year-round groundfish fishery. Anecdotal and empirical evidence indicate that a significant portion of groundfish landings are scheduled so as to maintain a steady flow of fish to processors. From a harvester's perspective, the certainty of knowing in advance that your fish will be bought, and in general what will be paid, is likely to outweigh the higher prices that could be obtained by fishing without a contract.[6] Furthermore because there is no race for fish, harvesters do not suffer direct economic consequence by meeting processor scheduling demands. From the processors perspective, keeping a relative steady flow of fish into the plant significantly lowers costs compared to more uneven flows that could occur without scheduling deliveries.

Decision Point: For which species should I fish?

The decision about which species to target on a given trip will depend on several issues, the most important of which is the demand for a given species by the processors and buyer to whom the fish will be delivered. If the processor is not buying thornyheads for example, then it is unlikely that the vessel operator will target them. If the processor is focusing efforts on flatfish and asks that a priority be given to flatfish, then the vessel is likely to focus on flatfish to the extent his trip limit allows. It is probable that there is some coordination of targets between the operator and the processor/buyer before the trip begins. Other factors that drive the target decision will of course be the amount of a given species that remains unharvested within the individual's cumulative trip, and the catchability of various species in the particular area and time of year the vessel is operating.

Decision Point: When to Fish?

Clearly the status quo management system has an impact on timing decisions. In an ideal situation, vessels and processors would perhaps focus on the particular species during the time of year in which it generated the most value for both the processor and the harvester.

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[6] There is an increasing amount of economic literature regarding the relative strength of bargaining power between harvesters and processors and the relationship between bargainging power and the management regime. (See Love and Sylvia, Matulich, NPFMC). In general it is believed that harvesters have more bargaining power and therefore greater independence from processors with increased property rights over their catch. Cumulative trip limits fall somewhere between an intense race for fish where processor bargaining strength is high and ITQs for harvesters where harvester bargaining power is high. Under the status quo it appears likely that neither harvesters nor processors have an excessive share of bargaining power.

For example, species may aggregate during spawing seasons and values during that time may be higher depending on consumer preferences. Fishing during times when fish are aggregated may result in very pure catches with little unwanted catch. While the cumulative trip limits, by spreading out fishing evenly across the year, will allow some targeting during peak fishing periods, the amount of effort that can be applied is probably less than optimal with respect to bycatch. In other words, if there are times during the year when fishing a particular species is most effective, the trip limit system will allow at most 1/3 of the total harvest (assuming the peak period straddle two of the 2-month periods—February and March for example) to be taken during that time.

Decision Point: Where to fish?

The decision of where to fish again will depend on demands of the market and the target that is chosen. If there are several potential areas where a given species can be found, then the cumulative trip limit system and the fact that the harvester is not racing for fish against other vessels will provide the harvesters the option choose an area where overfished species are less likely to occur. That is not to say that the decsion is driven by the need to minimize catch of overfished species. The costs of fishing a particular area will also be considered, and the costs and potential returns are likely to be the primary factors in choosing an area. If two areas with similar financial potential are available, then the area with the lower the probability of encountering overfish species is likely to be chosen. In other words the status quo brings bycatch minimization into the decision process, but does not give it equal weight as a factor such as the likely cost and revenue generated in fishing a particular area.

Decision Point: How long should I tow or set gear?

As with the question of where to fish, the status quo regime succeeds in making this a relevant decision point for harvesters. The length of time a unit of gear is fished can have a significant effect on bycatch. Long tows with trawl gear and sets of fixed gear with long soak times are more likely to experience "disastrous" catches of non-target species. Shorter tows and soak times provide the harvester with precise feedback on the type of fish that are being caught—feedback that cannot be attained even with the best electronic sensors. Because harvesters do not have to fear the loss of their share of the harvest—as is likely under an intense race for fish—vessels can take the time to check their catch more often. This is in all likelihood, one of the single best improvements the cumulative trip limit system provides over a race for fish regime. Of course, checking catches more frequently is more costly than letting the gear fish longer, and therefore harvesters will weigh the negative consequence of catching overfished species against the additional cost of retrieving gear. While catching overfished species has an indirect cost—one that could be felt in the future if the actual catch of overfished species were reported—it does not impose an immediate and direct cost to the harvester. Therefore while the system provides harvesters the ability to minimize discards, there may not be sufficient incentives and disincentives in the system to overcome the direct cost of actions to reduce bycatch.

Decision Point: Should I keep a particular fish or discard it?

The decision to keep a fish or discard is oftened view as the critical decision point in determining the amount of bycatch in a fishery. However, the fact that a fish is thrown back has very little direct influence on the stock of overfished species—a dead fish is after all a dead fish, whether it is sold in a store or eaten by a scavenger in the ocean. Therefore, the problem with "bycatch" occurs in the catch of unwanted fish, which is not directly affected by the decision to retain or discard. Furthermore, much of the uncertainty surrounding estimates of catch results not from the fact that fish are discarded, but rather that they are not reported. If there were a verifiable way to report discards, then much of the uncertainty issues caused by discard would be eliminated. There would remain of course the issue that society may view discards as wasteful.

Notwithstanding the discussion in the previous paragraph, the decision to discard a fish or retain it can be a complex decision, depending on the value of the fish, trip limit amounts remaining, reporting requirements, the presence of an observer, and the likelihood that keeping the fish may affect future earnings (see Figure 1). Under the status quo there is no mechanism for harvesters to report discards, so the option to report discards is generally moot.[7]

In general we can classify catch under four types:

1. Catch of DESIRABLE SPECIES—these include all species (whether groundfish or not) that are not overfished, that garner a sufficient market price, and that can be legally landed.
2. Catch of OVERFISHED SPECIES—these include all overfished species that can be legally landed. It is assumed of these species have relatively high market prices.
3. Catch of PROHIBITED OR SENSITIVE SPECIES—these include prohibited species (crab, salmon etc) that cannot be legally landed. It also includes marine life about which society is sensitive such as seabirds, marine mammals, corals etc.
4. Catch of UNDESIRABLE SPECIES and other marine matter—this includes fish species that have little market value, and other matter such as rocks, kelp, etc that may be brought on board.

The decision to discard catches in types 3 and 4 is straight forward—in the case of PROHIBITED OR SENSITIVE SPECIES it is mandatory to discard, and in the case of UNDESIRABLE SPECIES there is no reason to consider retention. However, the decision to retain or discard catches of the first two types is more complex and in the case of OVERFISHED SPECIES can involve speculation on the activities of others in the fleet—an activity that in economic theory is known as "gaming".

For DESIRABLE SPECIES, the decision to retain or discard is primarily a matter of available trip limit amounts. If a vessel's landings of the species in the 2-month period are less than the cumulative trip limit, then it is likely the catch will be landed. There may be some cases where a vessel high-grades fish of a DESIRABLE SPECIES, if there is a significant difference between individuals. For example larger fish or females may fetch significantly higher prices than smaller fish or males. If the price difference is large enough, the operator may be

[7]Log-books in experimental fisheries have a place to report discards, but standard log books do not allow the reporting of discarded fish. (Glock, Jim. Personal Communication, October 2003.)

able to generate higher revenue by discarding lower value fish now and incurring the cost of catching additional fish later. In certain situations, fish may have a higher value later in the trip-period than early on—for example, if fish with roe are in peak conditions in late February, then fish caught in early January may be discarded. In any of these decisions, the presence of an observer on board is likely to skew the decision toward retention, particularly if there is a possibility that the amount of observer coverage could increase if there is widespread evidence of high-grading.

The decision to retain or discard OVERFISHED SPECIES has varying levels of complexity depending on the specific situation. If the vessel has already landed the trip limit amount for that species—then the decision to discard is again straight forward. If the operator can land the fish within his trip limit and there is an observer on board, then the only reasonable decision is to retain the fish.[8] If, however, an observer is not on board, there are significant incentives to retain the fish and there are also significant incentives to discard.

Assuming that the operator can land the OVERFISHED SPECIES under his trip limit and that no observer is present, the following incentives for retention are present:

- Higher revenue for the trip
- An increased sense of virtuousness for the doing the right thing for the resource

Assuming that the operator can land the OVERFISHED SPECIES under his trip limit and that no observer is present the following incentives for discarding the fish are present:

- Greater probability that trip limits for species will increase if no one else lands the fish and estimates of actual catch are skewed downward
- The possibility of higher revenues in the long run
- Everyone else in the fleet is doing it
- Very low probability of being caught doing the resource "wrong"

In general, the fleet as a whole is likely to be better off if everyone discards most of their OVERFISHED SPECIES, except when an observer is on board. If all catches of OVERFISHED SPECIES were discarded when observers are not present, then there would be clear evidence that the fleet was under-reporting. However, if all vessels retain small amounts—under their trip limits but less than are actually caught—then it may appear as though actual catches are less than they really are, and there would be less of a case to use the estimates from observers. If it appears that catches are reduced, then there may be a greater possibility of that OYs will increase. However, if it appears that the fleet as a whole is retaining significantly less than they could, gameplaying individuals may actually increase their retention rates assuming that their own retention would not affect the fleetwide average. In the end, it is not known whether this type of fleet dynamic is occurring.

Decision Point: Should I fish again in the same place or should I move to a different location?

[8] Because the fish will be counted by the observer in either case, the operator will be better off receiving some value for the fish now—discarding the fish will likely lead to low trip limit amounts.

After the gear is retrieved and the deck is cleared, a final decision faces the operator—should he fish in the same area again, or should he move to a different location. The decision is influenced by the species composition of the last unit of effort, the likelihood that other more optimal grounds can be located, and the estimated cost of moving to those grounds. If moving to other areas is unlikely to significantly reduce revenues or significantly increase costs, and there is a possibility that less catch of overfished, prohibited or sensitive species occurs, then it is likely the vessel will move. If the move causes a significant decline in net revenues the move is less likely.

The fact that the cumulative trip limits have effectively eliminated the race for fish within each 2-month period makes it more feasible to move. Under an intense race for fish, any time not fishing is revenue lost, and therefore moving to avoid bycatch is unlikely.

2.1.3 Effects on Commercial Harvesters

This section provides a brief overview of economic conditions of fish harvesters under the status quo. Much of the information is taken from two sources—Ecotrust Doc and PSMFC docs, both of which relied heavily on data from Pacfin. The overview describes the groundfish harvests in terms of landed pounds from major species groups and provides a brief summary of participation by limited entry and open access vessels in the the 2-month cumulative trip limit periods since 1999.

Table 2 shows ex-vessel revenues in the West Coast Groundfish fisheries by sector (excluding Pacific Whiting) for the years 1999-2001. In general, revenues increased in 2000 by 9 percent from 1999 levels, then dropped by 16 percent in 2001 and another 16 percent in 2002. The declines were more felt to a greater extent in the limited entry fisheries than in the open access fishery, with non-trawl revenues falling by a greater percentage than trawl revenues. Overall limited entry non-trawl revenues are down over 37 percent from 2000.

Table 2. Ex-Vessel Revenue of Non-Whiting Groundfish by Sector, 1999-2001

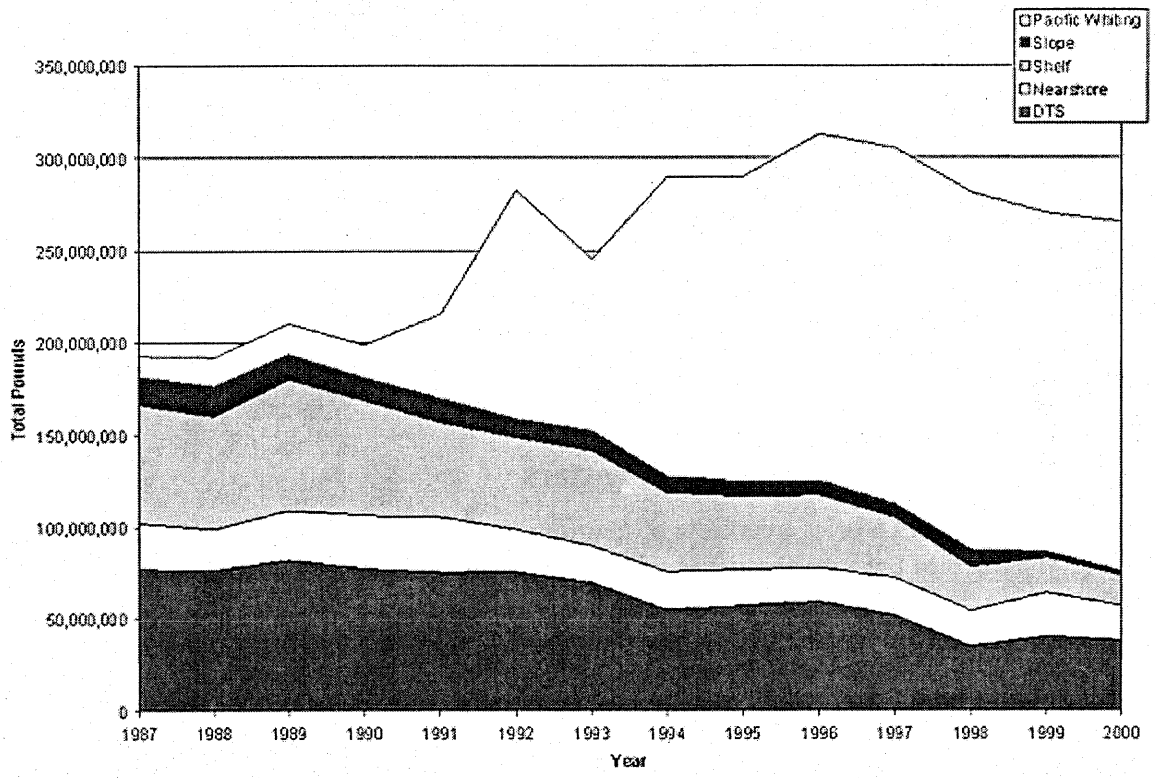
	1999	2000	2001	2002
Sector	**Ex-vessel Revenue ($1,000)**			
Limited Entry Non-Trawl	9,814	10,946	8,693	6,852
Limited Entry Trawl	32,634	34,032	28,257	24,010
Open Access (All)	7,762	8,732	8,254	7,161
Total For Year	**50,210**	**53,710**	**45,205**	**38,023**

Source: Data provided on request by PacFin, October 2003.

Note: Data exclude all landings of Pacific Whiting.

Since 1987 the total amount of groundfish landed in West Coast groundfish fisheries has increased from under 200 million pounds to a peak in 1996 of over 300 million pounds. The increase is due largely to landings of Pacific Whiting. Landings of other West Coast groundfish, primarily rockfish and deepwater flatfish species have declined by nearly 50 percent in during the same 14-year period. This general decline in groundfish catches other than whiting, has been driven by declining stocks of major target species primarily rockfish—several of which have been declared overfished.

Figure 3. West Coast Groundfish Lanidngs by Species Group, 1987-2000



Source: Ecotrust, 2003–used with permission.

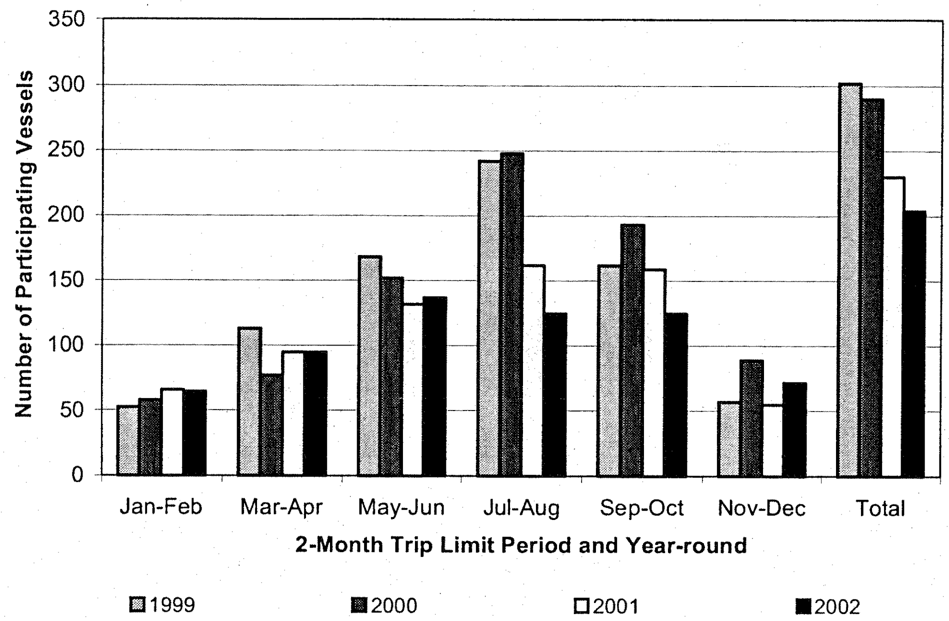
The general decline in many rockfish of the species coupled with the goal of a year-round fishery led to the implementation of limited entry and trip limits—the two primary management tools used in the West Coast groundfish fishery. Over the years the trip limits evolved to cumulative trip limits over 2-month long periods. An important measure of the impact of limited entry and cumulative trip limits on the commercial harvesters can seen in the participation patterns of the various harvest sectors. Figures 4-6 show the number of vessels by general sector that have participated in each of the 2-month periods since 1999.[9] This figures also show number of unique vessels that participated during each year.

Figure 4 shows limited entry fixed-gear vessel participation since 1999. During the 4-year period the number of unique limited entry vessels participating in the groundfish fishery declined from 302 in 1999 to 204 in 2002. Declines in participation have been most noticeable during the summer months—in the July-August period the number of participating vessels declined from 242 to 142. The fact that participation in the shoulder seasons has not declined over the 4-year period, suggests that the decline is primarily involves "part-time" vessels, and that "full-time" participant are continuing to participate. While additional data and analysis are needed to confirm this, the data may imply that the

[9]The data in the figures was supplied by PacFin by special request. The vessel counts do not include vessels that participated exclusively the Pacific Whiting fisheries.

ability to stack permits and fish multiple trip-limits during periods of periods of declining stocks facilitates a rational reduction in fleet capacity.

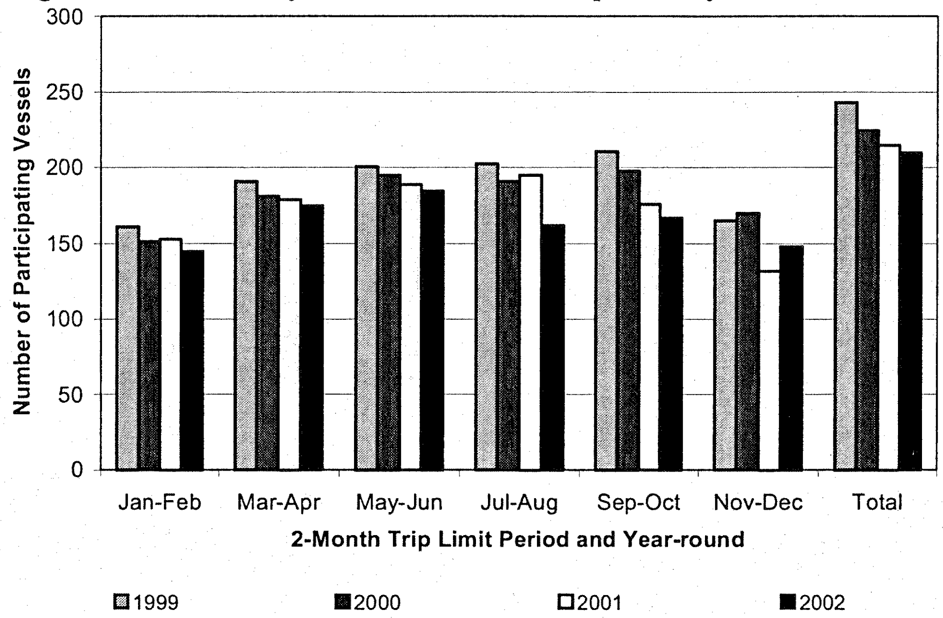
Figure 4. Limit Entry Fixed-Gear Vessel Participation by Period and Year



Source: Developed by Northern Economics from data supplied by PacFin, October 2003.

Figure 5 shows limited entry trawl vessel participation—vessels participating exclusively in the Pacific Whiting fishery are not included in the figure. Participation patterns in the non-whiting trawl fishery appear quite different than the pattern seen in the fixed gear fisheries. In particular the data demonstrate much more regular levels of participation spread out evenly over the six 2-month periods. While there has been a decline in participation during the 4-year period, the decline is relatively much smaller.

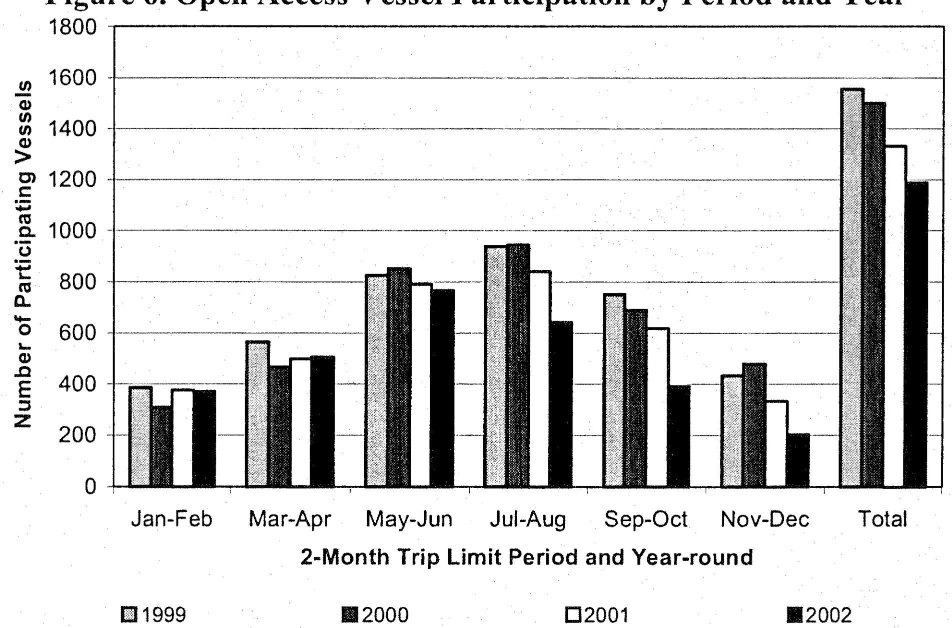
Figure 5. Limit Entry Trawl Vessel Participation by Period and Year



Source: Developed by Northern Economics from data supplied by PacFin, October 2003.
Note: Data do not include vessel that participated exclusively in the Pacific Whiting fishery.

Figure 6 shows participation in the open access portion of the West Coast groundfish fisheries. The pattern here is very similar to that seen in the limited entry fixed gear fishery with higher levels of participation during the summer months, but some level of participation throughout the year. Overall the decline in the unique vessels participating is less than pronounced than the decline seen in the limited entry fixed gear fishery.

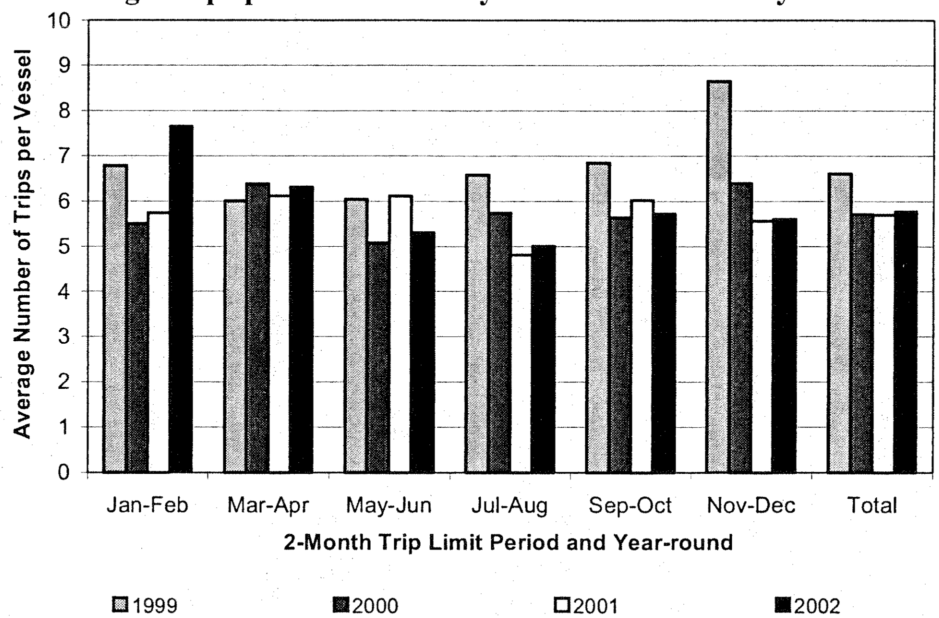
Figure 6. Open Access Vessel Participation by Period and Year



Source: Developed by Northern Economics from data supplied by PacFin, October 2003.

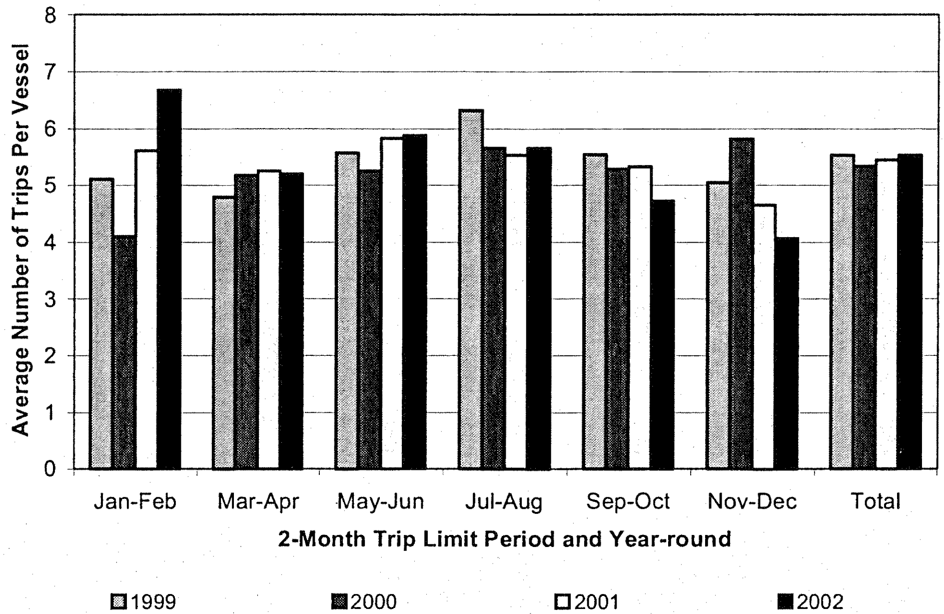
Figures 7-9 show the average number of distinct fishing trips of vessels participating in the same three general sectors within each 2-month trip limit period. The number of trips within each period is believed to be an indicator of the nature of the constraint the declining trip limits have on participating vessels. It is presumed that, if the number of trips that vessels take within a trip limit period is low, then there is a greater likelihood that discards will occur, and that higher trip limits amount will lead to significant reductions in discards. For example if vessels are able to take only one trip during the 2-month period, then it is likely that discards due to trip limit overages are occuring for many of the species. If vessels are taking more 3 or more trips during a period, then discards due to overages are likely to be a much smaller percentage of total landings. In fact, the data show that in the limited entry sectors trips per vessels have remained relatively constant throughout the 4-year period—ranging in most cases between 5 and 6 for both sectors. While these data suggest that the size of trip limits particularly of target species may not be a major factor leading to higher bycatch levels, additional analysis of trip level data of individual vessels is necessary before definitive conclusions can be reached.

Figure 7. Average Trips per Limited Entry Fixed Gear Vessel by Period and Year



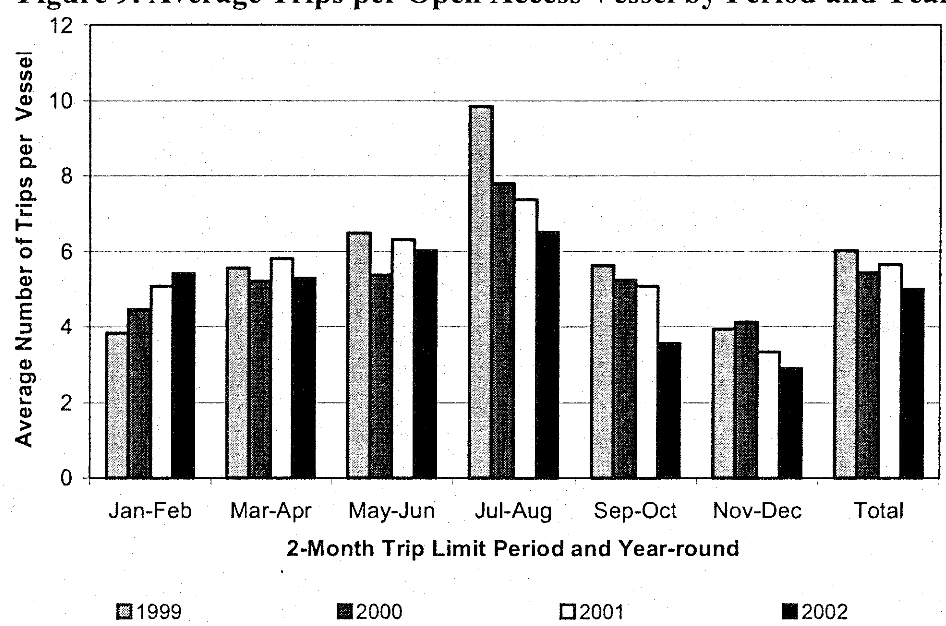
Source: Developed by Northern Economics from data supplied by PacFin, October 2003.

Figure 8. Average Trips per Limited Entry Trawl Vessel by Period and Year



Source: Developed by Northern Economics from data supplied by PacFin, October 2003.

Figure 9. Average Trips per Open Access Vessel by Period and Year



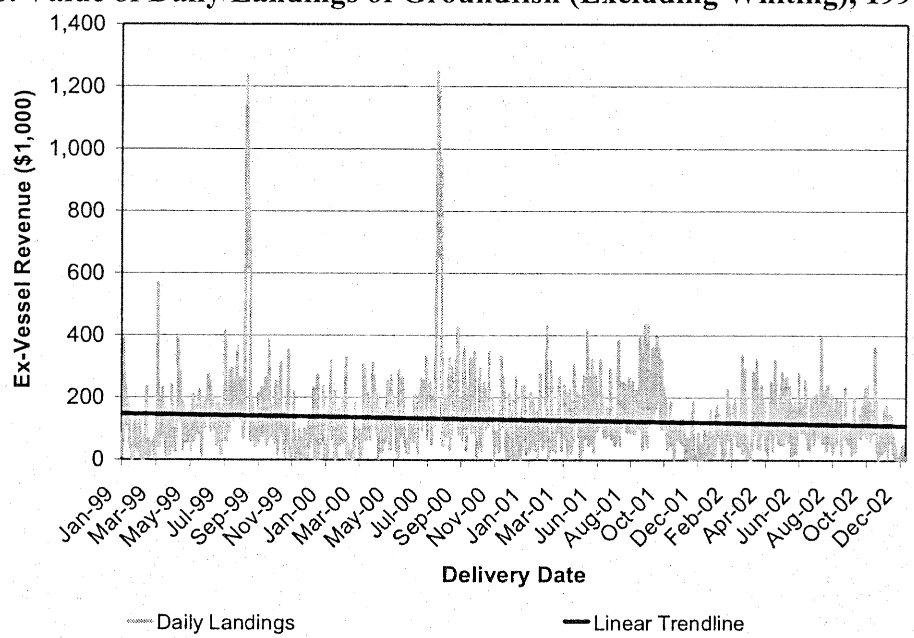
Source: Developed by Northern Economics from data supplied by PacFin, October 2003.

2.1.4 Effects on Buyers and Producers

One of the primary goals of the West Coast Groundfish FMP is to ensure an steady flow of fish to buyers and processors throughout the year. This section examines flows of non-whiting groundfish to buyers and processors, and attempts to determine the impact of 2-month cumulative trip limit system. The analytical hypothesis is that if there are significant and regular spikes of product that coincide with the beginning of the 2-month period, following by periods of little activity, then the management regime is not meeting the goal of providing a year-round fishery.

Figure 10 shows ex-vessel value of West Coast groundfish landings excluding whiting from 1999-2002. While the data reflect a general downward trend in revenues, it also shows that overall there appear to be a relatively steady flow of groundfish landings. In other words it appears that the management regime has been relatively successful in maintaining a steady flow of product to buyer. It should be noted that additional analysis of more detailed data could reveal that these fishery-wide data mask considerable variation in product flow to individual buyers. Therefore the general conclusion should be considered preliminary.

Figure 10. Value of Daily Landings of Groundfish (Excluding Whiting), 1999-2002



Source: Figure developed by Northern Economics using data provided by PacFin, October 2003.
Note: The figure shows excludes values of Pacific Whiting landings.

2.1.5 Effects on Communities, Consumers, and the General Public

These sections were not completed in time for inclusion in this draft. Future drafts will contain information on these components of the human environment

2.1.6 Effects on Management and Enforcement Costs

The costs of enforcing area closures have been declining due to the decreasing costs of technologies such as vessel monitoring systems (VMS) (Carter 2003). A VMS is an automated real-time, satellite-based tracking system operated by NOAA Fisheries and the U.S. Coast Guard that obtains accurate position reports from vessels at sea. Typically, NOAA Fisheries certifies the VMS system hardware and software aboard each vessel and assigns each VMS unit a unique identification number. The cost of VMS transmitting units has decreased as new technologies have emerged. At this time VMS units cost around $800 per vessel. Transmission costs are estimated to be $1.00 to $5.00 per day depending on the length of the fishing trip.

VMS has proven to be an effective, cost-saving technology for the monitoring and enforcement of large restricted areas over great distances. Major administrative and enforcement uses of VMS include 1) near-continuous tracking of vessel position, thereby allowing the USCG and NOAA Fisheries to enforce area closures; 2) notification of vessel operators when they are approaching a closed area; and 3) daily transmission by vessel operators of catch and effort data to NOAA Fisheries. In addition to enhancing government enforcement capability, VMS may yield benefits for the fishers on equipped vessels, such as increased navigational capacity and secure, low-cost communications. An additional benefit of VMS is the ability of skippers to send a distress signal that also transmits the vessel's location - a feature that may become more important as the establishment of MPAs may send some vessels further offshore, thereby increasing safety risks.

2.1.7 Effects on Fishing Vessel Safety

The 13th Coast Guard District of the US Coast Guard is responsible for all search and rescue operations off the Washington and Oregon State coasts. The 13th District is on average involved in some 3,000 such missions each year off the Washington and Oregon coasts and saves around 250 lives each year. These missions are predominately for commercial and recreational fishing incidents. Assuming a conservative value for a human life of $4 million (Kite-Powell and Colgan, 2001), losses of life, in particular, from the status quo alternative could result in significant economic losses to society.

2.2 Alternative 2: Capacity Reduction and Increased Trip Limits

This alternative examines the economic effects of increased size of trip limits, achieved by reducing the trawl fleet by 50 percent from the number that landed groundfish during 2002. Capacity reduction would most likely take place in the form of a vessel buy-back program resulting in a reduction in effective effort. Effort reduction should create larger shares of catch for the remaining members of the fleet and increase the efficiency of other tools to reduce bycatch and bycatch mortality of groundfish.

2.2.1 Effects on Fisher's Incentives to Reduce Bycatch

According to the Pacific Fisheries Management Council the value of fish discarded for regulatory reasons may have exceeded four and one half million dollars in 2000. This amount is nearly 10 percent of the value of fish landed in that year. In a study of West Coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch, 1988). This result suggests that if trip limits were increased systematically with a reduction in fleet capacity, that we should see a decrease in the rate of bycatch. In addition, a reduction in the fleet size helps to clarify the identity of the group of fishermen and can enable them to deal collaboratively and constructively with bycatch problems. A smaller fleet size can also help in developing interest in the fishery's future and increase the willingness of participants to deal with problems that are in the long-term best interest if the fishery (Young, 2001).

Generally, capacity reduction in most forms reduces the need for other controls that may lead to regulatory bycatch in particular. Non-regulatory bycatch may also be reduced if there are fewer boats to supply market demands.

2.2.2 Overview of Economic Effects on the Fishing Industry

A smaller fleet that is appropriate for the sustainable yield of the groundfish resource will provide benefits for fishermen, for fishing communities, and for everyone concerned with the use and health of our ocean resources (Young, 2001). These benefits may be difficult to estimate in monetary terms. However, while the magnitude of these benefits is questionable, the direction of the change is obviously positive.

Although we don't know the exact relationship between trip limits and discarded fish, we do know that as trip limits increase discards decrease. This would benefit everyone in the fishery. Fishermen could retain and get paid for the fish that they have already caught, processors would have more fish for their plants, and local communities would see increases in income and potentially tax revenues (Young, 2001).

2.2.2.1 Effects on Commercial Harvesters

The Pacific Fisheries Management Council Science and Statistical Committee estimates that the Pacific groundfish trawl fleet would need to be reduced 60%-90% to achieve maximum economic efficiency, where the marginal costs of production are equal to the marginal revenue. The proposed 50% fleet reduction would nonetheless eliminate some (not all) of the extra capacity in the fishery and restore the fleet to some minimum level of profitability. In economic parlance, this implies that commercial harvesters would be able to capture at least some portion of their producer surplus or economic rent (which under prior regulation schemes has not been feasible). In part this increase in profitability is derived from the reduction in excess capital and labor that is embodied in an overcapitalized fleet. If excess capital is removed from the fishery and trip limits are increased, we would expect to see increases in net revenues to harvesters. The increase in trip limits will lead to increases in retention of fish caught. Higher catch levels (assuming prices remain constant) implies increases in revenues to harvesters remaining in the fishery. Liepzig (2001) estimates that the benefit to the Pacific coast trawl fleet as a result of capacity reduction and increase in catch that the remaining participants could share is 69.5%. In addition, while overall total landings will stay the same, this management regime would lead to overall reduction in the variable costs to fishermen. These cost savings are in part based on the reduction in the number of times an individual vessel comes up against its trip limit with the subsequent need to invest crew time in sorting and dumping of fish caught over the limit. Finally, the National Marine Fisheries Service estimates that for every $1.00 paid in fees (a suggested tax to match Federal funds to support a buyback program) that fishermen remaining in the fishery will receive $6.80 in additional catch in all the groundfish (trawl) fishery. (Summary of the Results of the Groundfish Buy-Back Program 9/30/2003). Another similar analysis reported in Liepzig (2001) estimates a return for each dollar spent in fees by the trawl fishery coastwide at $22.42. This represents significant economic benefits to members of the Pacific Coast trawl fleet.

The magnitude of total economic benefits to be accrued to the Pacific coast Trawl fishery from the this alternative depend largely on from what port vessels retiree and where vessels remain in service. As indicated by Pacific Fisheries Management Council (2004), there is an uneven distribution of the number of vessels, vessel landings, and ex-vessel values along the Pacific Coast. Therefore, if a predominance of vessels retires from areas of low ex-vessel value, net economic value increases to society may be higher than would be the case if vessels from ports where ex-vessel values were relatively greater were to retire. In addition, the distribution of wealth among those remaining in the fishery and among the communities in which they reside will depend on where (in terms of what port) vessels were retired and where vessels remain.

2.2.2.2 Effects on Buyers and Processors

Under the current regime, processors have significant control over the prices paid to harvesters. This is a result of the makeup of the Pacific fishery processing sector. Currently there is one large single player that controls 60 percent of the LIMITED ENTRY??? Permits. Obviously, it is to their economic advantage to offer the lowest price possible so as to maximize their profits. In addition, processors will attempt to minimize costs by operating as efficiently as possible. One method of controlling costs is to schedule vessel deliveries or landings so as to assure an even flow of product into the processing unit. The latter implies that capital does not remain idle: a capital cost to the processor. Reduction in excess fishing capacity with higher trip limits theoretically will have no affect on the total amount of fish that harvesters will deliver to processors. As a consequence, it is unlikely that we would see any sort of price effect on producers (unless harvesters can coordinate and through collective bargaining demand a higher price from processors). However, with fewer vessels in the fishery, processors would have fewer boats to schedule for landings, with related reductions in time spent unloading vessels resulting in cost savings to the processor.

2.2.3 Effects on Communities

Fishing communities include not only the people who fish, but those who depend on directly related, fisheries-dependent services and industries (PFMC, 2003). In commercial fishing this may include boatyards, fish handlers, processors, and ice suppliers. If reduction in fleet capacity with higher trip limits is successful in increasing net revenues or profits to fishermen within the industry, there will be additional positive economic impacts on the local communities where they land, reside, and work. If fishermen's net revenue increases (as is expected) then we anticipate greater spending on basic goods and services. Increased spending on the part of the fishermen stimulates the local economy, generating more income, jobs, and taxes throughout the community. The magnitude of this economic impact will vary across communities depending on where (which ports) vessels have withdrawn from or remain in the fishery.

If the size of the groundfish fleet is reduced effectively and the result is, as suggested, positive economic benefits (in terms of increases in revenues to fishermen), communities in which these fishermen reside may also avoid certain social costs. With higher trip limits, fishermen may be employed more of the year so they may draw less unemployment compensation. In addition, instances of alcoholism and spousal abuse may decline putting less strain on limited social service support networks (Young, 2001). Note that in the year 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon, and Washington to mitigate the effects of the groundfish disaster. With improvement in the economic situation of individual fishermen, such costs to society could be avoided to some degree (Young, 2001).

2.2.4 Effects on Consumers of Groundfish Products

Because the decrease in fleet capacity is partnered with an increase in trip limits, it is assumed that actual fish landings from remaining harvesters will remain at a similar level to the current regime. Under these conditions, we would expect to see little impact on consumers of groundfish as the price per unit would not likely change. As it currently stands in the Pacific groundfish market, demand for the two species most often purchased fresh (rockfish and sole) is highly elastic. That is, there are numerous substitutes for these products and if the price were to increase for these species consumers would quickly substitute to some other fish or protein product.

2.2.5 Effects on Recreational, Charter and Tribal Fisheries

According to PFMC (2003) four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish. They may take half of the harvestable surplus of groundfish available in the tribes' usual and accustomed fishing areas. West Coast treaty tribes have formal allocations for sablefish, black rockfish, and Pacific whiting. There are also several groundfish species taken in tribal fisheries for which the tribes have no formal allocation, and some species for which no specific allocation has been determined. Tribes annually recommend trip limits for these species to the Council, who try to accommodate these fisheries. Based on treaty rights and the custom of the Council to allocate levels of harvest from the top of total allowable catch, it is highly unlikely that this management alternative will have any economic impact on tribal fisheries.

On the Pacific coast groundfish are both targeted and caught incidentally by recreational fishers. While the contribution of groundfish catches to the overall incentive to engage in a recreational fishing trip is uncertain, it seems likely that the possibility or frequency of groundfish catch on a trip adds to overall enjoyment and perceived value (PFMC, 2003). The net economic value of a recreational fishing trip is a function of expected catch (species, number, and size), attractiveness of the location and distance traveled by the fisher. Currently most recreational fishing along the Pacific coast targets nearshore groundfish species such as black rockfish and cabezon. Proposed capacity reduction under Alternative 2 will largely affect shelf and slope fisheries, thus having limited impact on stocks of fish most frequently targeted by the recreational fleet. As such it is unlikely that Alternative 2 will result in significant changes in recreational effort and or quality of the trip taken.

2.2.6 Effects on Fishing Vessel Safety

Low earnings on the part of individual harvesters limit funds for maintenance and safety equipment. Poor maintenance, bad weather and a desperate need to fish may to lead to significant incidence of injury and losses in life and capital (Young, 2001). Increases in net revenue to harvesters will most likely lead to reductions in injury and loss of life because of the harvesters enhanced ability to take fewer risks and use their best judgement in times of uncertainty.

2.2.7 Effects on Management and Enforcement Costs

Regardless of the type of management measures employed, they must be enforced and monitored to ensure they have the desired outcome. With an excessively large fleet, violations of relatively restrictive management measures are likely and, as a result, enforcement costs will be high. The same pressures that induce managers to maintain high quotas create incentive for fishery scientists to urge more and more precise stock assessments. This leads to expensive data collection and analysis systems. The NMFS and PSMFC spent nearly $6 million on these activities in 1999 (the states and PFMC spent additional money). The NMFS reports that it would need nearly $13 million additional dollars in order to satisfy its highest priority needs in responding to the current groundfish crisis. If granted, today's research and monitoring costs would be about $20 million, nearly half the value of the non-whiting groundfish fishery.

A capacity reduction program that results in a smaller, but profitable, fleet is important in fostering stewardship among fishermen. If fishing is profitable, and tenure in the fishery is assured, fishermen can afford investments in the future of the resource (Young, 2001). A profitable fleet can contribute to management, research and monitoring expenses that help assure the long-term stability of the fish resource. In addition, a smaller fleet may result in a certain amount of self-policing (such as is found in the current Maine lobster fishery). Self-enforcement may reduce to some extent the need for Federal and state enforcement programs including reductions in the need for on-board observers.

The current management regime results in a management process that is contentious, difficult and expensive. As fishers in an overfished fishery attempt to maintain a livelihood, the constant pressure to continue fishing sometimes leads managers to set quotas at levels that push or exceed the frontiers of fishery science. A smaller fleet with some assurance of their ability to continue fishing profitably will not have the same incentives to push for maximum quotas as today's overcapitalized fleet does. Theoretically, they should be able to operate under more conservative and less expensive management measures without risking their own economic profitability (Young, 2001).

2.3 Alternative 3: Increase Groundfish Trip Limits by Reducing Fishing Time

This section examines the economic effects of the use of measures to reduce bycatch by increasing groundfish trip limits and reducing fishing time (shortening the season by 50%). While this alternative assumes the season would be shortened for fishing vessels, some form of platooning would be used to even out the flow of fish harvest and production throughout the year. Unlike Alternative 2, the number of commercial fishery participants would not be reduced. This mix of measures complicates an analysis of the economic impacts of Alternative 3 as the economic effects of reductions in fishing time or seasons (an indirect effect on fishing effort) may offset increases in trip limits (a direct effect on fishing effort).

Note that proposed methods of reducing fishing time are not specified in this alternative but are critical to its effects (Bycatch Reduction DEIS, 2003) and subsequent economic impacts. As noted, for example, in the DEIS, if the current 2-month periods are reduced to 1 month, larger vessels would not be affected much, and trip limits might not be much larger than current, because actual fishing time per vessel is already less than one month. In addition, how the seasons are allocated across the fleet (two platoons fishing every other two months, one month, or two weeks, etc) will have a significant effect on whether harvesters (in particular) are positively or negatively affected by this alternative management scheme.

2.3.1 Effects on Fisher's Incentives to Reduce Bycatch

This alternative attempts to control bycatch by inducing harvesters to modify fishing effort and gear efficiency. As indicated in the analysis of Alternative 2, discard rates have been found to vary inversely with the size of the trawl trip limits imposed (Pikitch, 1988). Higher trip limits theoretically result in less bycatch as harvesters legally can retain more of their actual catch (assuming that they are already meeting capacity). There is an associated disincentive to catch beyond the limit based largely on the harvesters' desire to avoid the costs of sorting and extra handling of fish that will not contribute to their net revenue.

The effects on discards of reduction in the fishing season to six months of the year is directly related to the type of catch or effort restrictions with which they are combined and the area to which they apply. In this case, the season limit is combined with trip limits and area/depth management. Timing or the section of time periods when fishing will be permitted is critical to how the management strategy influences incentives or disincentives to reduce bycatch. Improper delineation of changes in distribution can decrease the effectiveness of the management regime. Closures of time and or area strata can result in transfer of effort and associated discard mortality to open strata such as in the Gulf of Mexico shrimp fishery (Turner, 1990 Dewees, C. M. and E. Ueber. Effects of Fishery Management Schemes on Bycatch, Joint Catch and Discards: Summary of a National Workshop, California Sea Grant College). Bycatch becomes an even more complex problem when seasons are imposed on single species within an assemblage. The trip limit on sablefish, which is caught jointly with Dover sole and thornyhead rockfish, is an example.

Under Alternative 3 if fleet response to the shortened season is to seek alternative fisheries rather than increase effort during season openings, bycatch and bycatch mortality may be reduced due to a reduction in overall harvest levels.

2.3.2 Effects on Commercial Harvesters

A combination of higher trip limits and 50% reduction in fishing season might lead to an overall reduction in fishing costs. With larger trip limits, harvesters would take fewer trips (reducing the average cost per trip) and theoretically would be discarding less (reducing costs associated with sorting and extra handling of fish). However, it is unclear what actual economic effects a shortened season would have, as there is uncertainty as to the timing of open season for particular vessels. According to PFMC (2003) groundfish has historically provided West Coast commercial harvesters with a relatively steady source of income over the year, supplementing the other more seasonal fisheries. Although groundfish contributed only about 17% of total annual ex-vessel revenue during 2000, seasonally groundfish played a more significant role, providing one-fifth to one-third of monthly ex-vessel revenue coast wide during April and the three summer months. Flatfish harvest supplied between 3% and 9% of monthly ex-vessel revenue throughout the year, and rockfish contributed an additional 2.5% to 6.8% to monthly ex-vessel revenue. Along the more northern parts of the coast, groundfish is particularly important just before the start of the December crab fishery. The latter suggests that the impact of a 50% reduction in seasons on harvesters of groundfish is critically linked to when seasons are set on what part of the fleet. It is easy to imagine that set season reductions in some portion of the fleet could lead to significant reductions in net revenue to individual players.

2.3.3 Effects on Buyers and Producers

While increases in trip limits will likely have positive economic impacts on buyers and processors, shortened seasons may have the opposite effect. Higher trip limits theoretically will have no affect on the total amount of fish that harvesters deliver to processors. As a consequence, it is unlikely that we would see any sort of price effect on producers. However, with vessels taking larger and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, depending on the timing and length of a particular platoon's seasons, a 50% reduction in the overall fishing season may result in increased costs to processors due to the fact that they may not be able to as easily control the flow of product throughout a year, leaving capital idle during season closures. This latter point may not be valid if in fact the management regime is effective in encouraging platooning that allows an even flow of harvest throughout the year.

Another effect that seasons may have on processors is the flooding of the market for certain species when a season is open. This results in waste due to spoilage, lack of processing capacity or limited refrigeration/freezer space. At the other end of the spectrum is the loss of markets when the season for a certain species is closed and product demanded in the marketplace is not available.

2.3.4 Effects on Consumers of Groundfish Products

Because the 50% reduction in seasons is partnered with an increase in trip limits, it is assumed that actual fish production will remain at a similar level to the current regime. Under these conditions, we would expect to see little impact on consumers of groundfish as the price per unit would not likely change. As it currently stands in the Pacific groundfish market, demand for the two species most often purchased fresh (rockfish and sole) is highly elastic. That is, there are numerous substitutes for these products and if the price were to increase for these species consumers would quickly substitute to some other fish or protein product.

There is a possibility, however, of some reduction in consumer surplus if platooning does not result in an even flow of product throughout the year. In this case, there may be some quality issues that affect the consumer negatively. One of the traditional purposes of closing or limiting seasons is to enhance the quality and value of the product by allowing fishing only when the target species is in prime condition or at optimum size. Dungeness crab on the West Coast has been managed by using season restrictions (along with sex and size restrictions) to protect crab during molting and mating. Quality and market demand also played a role in determining the season opening in this case. However, given oceanographic conditions vary from year to year, a rigid opening date can still lead to the harvest of crabs with low meat yields. The joint catch of a high percentage of low quality crabs is usually rejected by processors and consumers leading to waste. Delaying the season or instituting sliding openings would ensure improved quality for consumers (depending on the species under consideration), but can cause operational and negative economic impacts for both fishermen and processors.

2.3.5 Effects on Communities

Fishing communities on the West Coast depend on commercial and/or recreational fisheries for many species. Community patterns of fishery participation vary coastwise and seasonally, based on species availability as well as the regulatory environment, and oceanographic and weather conditions (PFMC, 2003). As such, the impact of this alternative on coastal communities is highly uncertain. If higher trip limits are successful in increasing net revenues or profits to fishermen within the industry, there will be additional positive economic impacts on the local communities where they land, reside, and or work. With expected increases in net revenue to fishermen, we anticipate greater spending on basic goods and services. Increased spending on the part of the fishermen will stimulate the local economy, generating more income, jobs, and taxes throughout the community. In addition, there will be a general sense of increased comfort and well being on the part of community members. The magnitude of this economic impact will vary of course depending on the magnitude of the economic affect of the alternative on harvesters. The effects of a 50% season reduction on communities is less certain. The choice in length of seasons and which portion of the fleet can fish during the season will all effect where gains and or losses are incurred. In addition, if the reduction in season leads to losses in the economic value to recreational fishers, entities that depend on recreational fishing (such as tackle shops, small marinas, lodging facilities catering to out-of-town anglers, and tourism bureaus advertising charter fishing opportunities) may be negatively affected as fishers either choose not to fish or choose substitute sites from which to fish. If expenditures of recreational fishers decline within a community or region, there would be a direct loss in revenue to recreational fishing-related businesses and thus a direct loss in economic activity or income.

2.3.6 Effects on Recreational, Charter, and Tribal Fisheries

According to PFMC (2003) four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish. They may take half of the harvestable surplus of groundfish available in the tribes' usual and accustomed fishing areas. West Coast treaty tribes have formal allocations for sablefish, black rockfish, and Pacific whiting. There are also several groundfish species taken in tribal fisheries for which the tribes have no formal allocation, and some species for which no specific allocation has been determined. Tribes annually recommend trip limits for these species to the Council, who try to accommodate these fisheries. Based on treaty rights and the custom of the Council to allocate levels of harvest from the top of total allowable catch, it is highly unlikely that this management alternative will have any economic impact on tribal fisheries.

Recreational fishing contributes substantially to fishing communities bringing in dollars and also contributing to tourism in general. On the Pacific coast, recreational fishers both target and incidentally catch groundfish. While the contribution of groundfish catches to the overall incentive to engage in a recreational fishing trip is uncertain, it seems likely that the possibility or frequency of groundfish catch on a trip adds to overall enjoyment and perceived value (PFMC, 2003). The net economic value of a recreational fishing trip is a function of expected catch (species, number, and size), attractiveness of the location, and distance traveled by the fisher. Currently, most recreational activity on the Pacific coast targets nearshore groundfish species such as black rockfish and cabezon. Proposed increases in commercial trip limits under Alternative 3 will largely affect shelf and slope fisheries, thus having limited impact on stocks of fish most frequently targeted by the recreational fleet. As such, it is unlikely that Alternative 3 will result in significant changes in recreational effort and or quality of the trip taken. However, recreational fishing effort on the Pacific coast is closely related to weather (especially in the northern part of the region), with relatively more effort occurring in the milder months of summer, and relatively less in winter. Depending on when commercial effort is at its greatest, it is possible that recreational fishers could be negatively affected in terms of the species mix and or reduction in the quality of the individual experience (as related to number of fish caught).

2.3.7 Effects on Fishing Vessel Safety

The effect of Alternative 3 on safety is uncertain. Low earnings on the part of individual harvesters limits funds for maintenance and safety equipment. Increases in net revenue to harvesters resulting from increases in trip limits will most likely lead to reductions in injury and loss of life because harvester's enhanced ability to take fewer risks and use their best judgment in times of uncertainty. On the other hand, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish. With the limit set on how long out of the year (and when) they can fish, potentially forcing harvesters to venture out in extreme weather or take other undue risks. This could lead to greater incidence of vessel accident or personal injury. The adverse effects on safety of human life will obviously be greater for smaller vessels.

If the outcome of this alternative is net declines in revenues in the fishing industry, vessel owners and captains will find it harder and harder to find, hire, and keep qualified crew. While there are many skilled and capable crew members working on West Coast commercial fishing boats, many who once would have been attracted to the industry are discouraged by increasing regulations and by the apparent lack of a promising future. Conversely, the industry may attract people who are unable to find work elsewhere and who lack necessary skills and training. Some such individuals are itinerant and do not stay long enough in the industry to be full-trained or invested in vessel operations including safety. Such individuals are at greater risk of bodily harm to themselves and may unintentionally cause accidents by loading vessels improperly or generally create unsafe conditions.

2.3.8 Effects on Management and Enforcement Costs

Reduction in bycatch through the use of seasons with different geographic areas (as is the case under Alternative 3) in managing a fishery with more than two species has been identified as one of the most difficult problems facing managers (Richards, 1990 in Dewees and Ueber). In the Pacific Coast multispecies groundfish fishery, in which trawlers harvest different assemblages of fish (up to 20 species in some cases), defining the boundaries of these assemblages (e.g., deep water, shallow water, rocky area assemblages, or water temperature, etc.) can be costly and time consuming. The natural abundance and distribution of each species will vary. Richards (1990) suggests that enforcement of these combined types of regulations is nearly impossible or prohibitive due to the cost. In addition, a compressed season would mean that the percentage of total trips covered by observers and thus cost of the observer coverage would increase as compared to the status quo.

2.4 Alternative 4:

This alternative would use continue to use vessel trip limits (as under the "no action" Alternative 1) but would also place specific limits on the amount of groundfish that could be caught by each sector. When a sector reaches any catch limit, further fishing by that sector would be prohibited. In short, each sector of would be responsible and accountable for all groundfish caught. Nine fishing sectors are identified under the current regulations: limited entry trawl; limited entry longline; limited entry pot; three whiting sectors (catcher processors, motherships and shore-based); open access; tribal; and recreational. However, it is possible under this alternative that these sectors would be subdivided to create additional sectors.

2.4.1 Effects on Fisher's Incentives to Reduce Bycatch

Under this alternative vessels could continue to discard, but unlike the status quo the amount of fish discarded would be recorded and counted against each fishing sector's catch limit. When a sector reaches its limit, all boats in that sector must stop fishing. However, one sector's harvest in excess of the limit does not affect the fishing opportunity of other sectors. As a further economic incentive to fish more selectively, this alternative reserves a portion of the groundfish OY for the sector with the lowest bycatch.

While it is clearly in the best interest of all vessels within a sector to reduce the catch of unwanted fish, there may be economic factors that lower the incentive of individual vessels to undertake actions to be more selective in what they catch. The problem is that a vessel captain who undertakes actions to reduce bycatch bears the full costs of deploying more selective gear, searching for cleaner fishing grounds, etc. While some benefits of minimizing the capture of unwanted fish (e.g., less handling time) accrue solely to the individual that incurs these costs, the benefits of avoiding closure of the fisheries to the sector are spread across all vessels. The "free-riders" that do not adopt more selective fishing methods may develop a competitive advantage over those that do by incurring fewer operating costs and/or increasing their share of the catch limit. If the free-rider problem results in a noticeable redistribution of profits across the sector, no one will be motivated to invest in fishing practices that reduce the catch of unwanted fish.

On the other hand, if vessel owners can overcome the free-rider problem, cooperative patterns of behavior may emerge. For example, vessel owners and captains within a particular sector may be willing to exchange fishing information, such as the location of bycatch "hotspots" (Gauvin et al. 1996). Vessels would be expected to move away from high bycatch areas, and peer pressure could be exerted on those who are reluctant to move. The limited-entry, fixed-gear fleet would likely be successful in engaging in such forms of cooperation because the fleet size is small. Of course, under such an informal arrangement, there is always the temptation to break the rules. If some contribute to the joint effort while others free-ride, the provision of the collective benefit will be less than optimal (Ostrom 1990).

If the major sectors are subdivided to the point that each sector consists of a relatively small number of participants with common interests, the negotiation of voluntary cooperatives might be feasible. The formation of cooperatives could further facilitate collective efforts by industry to reduce bycatch. For example, contractual arrangement among cooperative members may restrict the harvest of target species in areas of high bycatch to member vessels with low bycatch rates as an incentive to promote cleaner fishing practices. Cooperative members could rely on civil law to enforce contract terms. The catcher-processor sector of the Pacific whiting fishery utilizes a cooperative structure to limit salmon incidental catch.

2.4.2 Effects on Commercial Harvesters

Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch-reducing fishing tactics. A reduction in harvest and gross revenues could result from early attainment of overfished species sector caps. On the other hand, catches of more desirable species, like yellowtail rockfish, currently harvested below cumulative catch limits due to constraints associated with overfished species, may be more accessible if sector bycatch reduction efforts are successful. In addition, the total amount of fish available for harvest is expected to increase. Currently, the annual OY is set below the ABC to account for the expected bycatch. Under Alternative 4, this reduction would not be necessary discarded fish could be counted towards the ABC in-season because the level of bycatch would be measured accurately.

The economic effects on commercial harvesters may vary by sector depending on the mechanism for allocating catch limits. For example, managers may consider gear impacts, efficiency, and other factors in determining the percentage allocation of harvest for each sector. Sectors consisting of vessels that use relatively "clean" fishing methods and generate overall gains for the fisheries (e.g., produce a higher value product, have a lower impact on the juvenile stock, result in minimal habitat disturbance) could receive a larger allocation.

Such preferential allocations may induce each sector to engage in rent-seeking behavior. Lobbying efforts to acquire the maximum allocation possible may be costly. Fishers may sacrifice valuable time fishing to attend Council meetings, and industry associations may acquire the services of lawyers and lobbyists to help the association influence decisions on the allocation of catch limits (Anderson 1992).

The allocation of catch limits to individual sectors could lead to cooperative patterns of behavior besides those discussed previously. In particular, sector members may form private agreements allocating transferable harvesting privileges as was done by catcher processors in the Pacific whiting fishery. The allocation of transferable privileges through private agreement generates benefits for commercial harvesters similar to those that might be generated under an individual transferable quota (ITQ) program (See Alternative 5 effects on commercial harvesters). However, the distribution of fishing privileges and the system for trading, selling or enforcing them is decided by the parties to the agreement.

Sullivan (2000) states that the ability to negotiate private agreements allocating harvesting privileges depends on certain conditions being met, including 1) a relatively small number of participants, with a sufficient community of interest to make negotiations feasible; 2) an adequate system for gathering fishery harvest data, and adequate data verification and transparency to monitor compliance and enforce it in cases of non-compliance; 3) significant barriers to prevent new participants from entering after shares have been negotiated, or else "free riders" are almost certain to be predators on the fishermen who rationalize their harvest; 4) an opportunity to attain additional value through an allocation agreement; and 5) for antitrust law reasons, when the arrangement includes one or more vertically integrated producers operating in a U.S. fishery, assurance that the relevant fishery sector's target species or incidental catch allocation(s) will be limited and fully harvested.

Once an agreement is negotiated, the parties to the agreement must have internal rule-making capability and sanctioning authority to deter those who are tempted to break the rules (Ostrom 1990). Quota shares could be created by using contracts and relying on civil law to enforce contract terms, including penalties (e.g., expulsion from the agreement) for vessels that exceed their quota holdings.

Leal (2002) states that one advantage private harvesting agreements have over an ITQ program is avoidance of the expensive rent-seeking behavior that often accompanies allocation of ITQs. Although this process may not be free from controversy, it appears to be easier for the individual participants to allocate individual shares than to have the government do it.

On the other hand, Leal (2002) notes that private harvesting agreements may also have some disadvantages in comparison to ITQs. A new entrant can simply buy or lease ITQs from a quota owner willing to sell or lease. In contrast, with a private harvesting agreement, the transfer of shares to a new entrant will require becoming a party to the agreement. In addition, ITQs are likely to remain in force, especially once they acquire value through the secondary market. By contrast, the durability of private agreements depends on the willingness of parties to maintain the agreement. Even when the arrangement has no sunset provisions, or requires a majority of members to rescind it, members may not retire as many redundant vessels or invest in as much of the product enhancement capital as they would under a system of ITQs.

2.4.3 Effects on Buyers and Processors

The economic effects on buyers and processing companies are uncertain because of the uncertainty as to whether vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters can develop incentives to adopt bycatch-reducing fishing tactics, higher catches in the groundfish fisheries are expected. An increase in landings is likely to eliminate upward pressure on ex-vessel prices (unless harvesters can coordinate and through collective bargaining demand a higher price from processors), and greater throughput over constant fixed costs will result in lower average costs for processing facilities.

2.4.4 Effects on Consumers of Groundfish Products

This alternative is expected to have little impact on consumers relative to the No Action Alternative, as the price per unit, product availability and product quality are not likely to change substantially.

2.4.5 Effects on Communities

This alternative is not expected to have a significant economic impact on communities. The groundfish fisheries would continue to benefit fishing communities and the sustained participation of these communities in the groundfish fisheries would be unaffected.

2.4.6 Effects on Recreational, Charter and Tribal Fisheries

This alternative may have a negative economic effect on recreational fishers relative to the No Action Alternative. If the sector catch limit is exceeded, a closure of the recreational fishery will occur. The ability of NOAA Fisheries to detect excessive catches within the sector will be enhanced by an onboard Commercial Passenger Fishing Vessel (CPFV) observer program and expanded port/field sampling program. A closure of the recreational fishery would result in fewer fishing experiences for private anglers and charter fishing patrons. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants.

This alternative may also have an adverse economic effect on tribal fishers, especially if the tribal Pacific whiting fishery is closed as a result of early attainment of overfished species sector caps. There has been some catch of canary rockfish, widow rockfish and dark-blotched rockfish in this fishery. In most recent years, whiting provided the lion's share of harvest tonnage and a major portion of ex-vessel revenue. Consequently, the economic impacts of a fishery closure could be severe. However, given the experience of tribes in self-management with respect some aspects of the groundfish fisheries, their ability to avoid a fishery closure through cooperative efforts to control the catch of overfished species is expected to be relatively high.

2.4.7 Effects on Fishing Vessel Safety

The safety of human life at sea under this alternative is not expected to change significantly from the No Action Alternative.

2.4.8 Effects on Management and Enforcement Costs

As catch limits are allocated over an increasing number of sectors, NOAA Fisheries will be required to manage increasingly small blocks of fish. It will be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. Under Alternative 4, a logbook requirement for all commercial vessels and 60% commercial and recreational (CPFV) observer coverage are used to monitor the harvest in each sector and ensure that catch caps are not exceeded. It is estimated that the cost of an additional NOAA Fisheries-certified observer is about $900 per deployment day for each vessel. The installation of video cameras on board vessels to document activities at sea has the potential to substantially reduce monitoring costs.

In addition to these daily deployment costs, the increase in the number of observers and its associated increase in the amount of data collected is expected to raise overall annual costs of the groundfish observer program. This budgetary increase can be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. With transferability, it will also be necessary to keep track of the current amount of quota owned or leased by each participant. Though computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the observer program have not been estimated.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data system (personal communication, Russell Porter, Field Programs Administrator, PSMFC, Oct. 30, 2003).

2.4.9 Effects on Harvesting and Processing Capacity

If this alternative results in an increase in landings, a reduction in excess harvesting and processing capacity is expected as catches and throughput increases. Additional reductions in excess capacity may occur if vessel owners within sectors successfully negotiate private agreements allocating harvesting privileges (See Alternative 5 discussion on capacity reduction).

2.5 Alternative 5: Right Based Systems

This analysis examines the economic effects of using bycatch reduction measures such as:

- allocating shares of the total allowable catch for species or species groups to individuals or groups
- conveying an exclusive right to catch a given quantity and species of fish in a specific location during a specific period of time (Sutinen et al. 1992)

Collectively, these measures are referred to as "rights-based" approaches. The primary focus of this analysis are the economic effects of implementing transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (ITQs) for other groundfish species. However, this analysis will also briefly examine the potential economic effects of implementing group-based quota systems. The allocation of portions of the total allowable catch to fisheries cooperatives is one form of such a system (See Alternative 4 discussion on commercial harvesters). Another way to implement group-based quota systems is to modify an ITQ program to allow communities or other groups to enter into the market for quota shares. An example of such an approach is the measures the North Pacific Fishery Management Council approved in 2002 that would allow eligible fishing villages in the Gulf of Alaska to acquire ITQs for sablefish and halibut.

2.5.1 Effects on Fishers' Incentives to Reduce Bycatch

Reductions in the catch of unwanted fish under an ITQ program are expected to be achieved more easily than under the status quo because vessels will be more willing to accept the reductions in target species catch rates that they may incur by fishing at different times. Reduced catch rates will no longer equate with a smaller share of total catch since the vessel is assured of its "right" to harvest a fixed or proportional share of the total allowable catch for the entire year. Fishers under this alternative also have more flexibility in their choice of boat/gear configurations and fishing methods over the course of a fishing season.[10] For example, gear endorsements may be modified to allow trawl vessels to use nontrawl gear or to covert their trawl endorsement to a new category of longline, pot or generic gear endorsement. This relaxation of regulations will allow fishers to modify their fishing operations and/or gear to better utilize their quotas and could facilitate the adoption of more selective fishing strategies.

A potential negative effect of an ITQ program is that fishers may have a heightened incentive to high grade: by throwing less valuable fish overboard, they can save their quota

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[10]Wilen (1990) states that changes in the incentive structure that follow the implementation of an ITQ program can, in turn, result in dramatic changes in existing boat/gear configurations and fishing methods as fishers adopt a more selective fishing strategy. Under this alternative, certain regulations would be relaxed to allow fishers to modify their fishing operations and/or gear to better utilize their quotas. For example, gear endorsements could be modified to allow trawl vessels to use nontrawl gear, or to covert their trawl endorsement to a new category of longline, pot or generic gear endorsement.

for more valuable fish. Under this alternative vessels could high grade, but unlike the status quo the amount of fish discarded by each vessel would be recorded and counted against the vessel's limit. When a vessel reaches any catch limit, further fishing by that vessel would be prohibited until it acquired additional RSQ or ITQ shares. This measure provides strong economic incentives to reduce the catch of unwanted fish because it "internalizes" the external costs of discarding that fish in the private returns of individual fishers. Consequently, it would be worthwhile for each fisher to take steps to improve the selectivity of their fishing gear and techniques and avoid "troublesome" areas in the process. As a further economic incentive to fish more selectively, this alternative reserves a portion of some or all of the total allowable catch limits for overfished species for vessels with the best bycatch performance. Performance could be based on low incidental catch and/or bycatch rates or other factors.

2.5.2 Effects on Commercial Harvesters

Current vessel owners as a group are likely to benefit from an ITQ program that allocates freely transferable and leaseable quota shares to vessel owners on the basis of catch histories. The overall increases in profitability for vessel owners will vary from fishery to fishery but are expected to be substantial in most cases.

However, not all vessel owners will benefit equally, and the relative benefits will depend on the formula that relates catch history to allocations. This formula is clearly of fundamental importance to individual operators in the industry, as it will affect both their wealth, through changes in the value of their fishing rights, and their income as affected by their catch (Geen et al. 1993). For example, the replacement of a limited entry-based management system with ITQs may lead to significant changes in the distribution of wealth among fishers. Under limited entry schemes, the value of the tradeable license (or unit of fishing capacity) need bear no relation to the catch and, hence, the earning potential of the fishing operation to which the license is attached. Rather, the market value of the license will reflect the potential catch and earnings of the most efficient operators in the fishery. In contrast, the value of the ITQ holding of an individual operator is determined by the market value per ton of the quota and the specific amount of fish catch assigned to that operator. Therefore, if the ITQ allocation system is based on, or heavily weighted toward, individuals' historic catches, the value of the ITQ assets of many average or low-catch operators may be substantially less than the value of their fishing rights under the previous management regime. However, when there has been a long history of cumulative catch limits as in the status quo, the amount of variation within the fleet is likely to be significantly diminished.

In addition, if a substantial portion of the initial quota shares in an ITQ program are allocated to other groups (e.g., crew, processors or community groups), vessel owners could potentially suffer an initial financial loss since they would have to purchase quota to undertake their historical level of fishing. Whether or not other gains in cost reduction or increased prices might offset the costs of acquiring quota could only be determined after the structure of the ITQ program and the allocation formula were determined, and even then it would be difficult to assess.

Moreover, the level and distribution of the benefits and costs of an ITQ program will vary by fishery and sector. The extent of the gains will depend on the degree to which the race for fish had been leading harvesters and processors to sacrifice quality, produce lower value products, use more costly production processes, endure higher bycatch rates, or maintain excess capital and labor in order to increase production. Experience with ITQ programs in other fisheries suggests that improvements in the economic performance of the groundfish fisheries due to increased value and reduced costs may be substantial. However, because landing limits have been used in the West Coast groundfish fisheries to smooth out fishing and landings over the year, these fisheries already experience some of the typical gains from ITQs that result from elimination of the race for fish phenomenon, such as longer fishing seasons, mitigation of market gluts and opportunities to improve product quality.

Nevertheless, an ITQ program is expected to increase the value of production in the West Coast groundfish fisheries for a variety of reasons. Currently, the annual OY is set below the ABC to account for the expected bycatch. Under Alternative 5, this reduction would not be necessary discarded fish could be counted towards the ABC in-season because the level of bycatch would be measured accurately. Consequently, the total amount of fish available for harvest would increase. Further, increases in the value of production may be achieved as the harvest volume increases in fisheries that were previously constrained by landing limits. For example, some fishers may successfully modify gear and/or purchase enough canary rockfish RSQ to take advantage of yellowtail rockfish ITQ.

The costs of harvesting are also expected to fall for a variety of reasons. Individual vessels will have the opportunity to select the least-cost combination of fishing inputs. At the industry level, costs will fall because production is expected to shift over time toward the most cost-effective harvesting operations. Fixed costs will be reduced by consolidating harvesting operations and retiring or selling off vessels. The cost savings will depend both on the constraints put on the transfer and consolidation of harvesting privileges and on the level of excess capacity prior to implementation of remedial measures. It is also important to note that many of the efficiency gains from the adjustment of the fleet following the introduction of an ITQ program may be lost if departing fishers shift their effort toward other fisheries which themselves are overcapitalized. One additional potential benefit to vessel owners from an ITQ program is that private banks and government agencies may come to treat ITQ shares as having financial value that may allow them to serve as collateral for loans, thereby improving the ability of quota holders to obtain financing for capital investments.

Implementing ITQs presents special difficulties for fisheries such as the West Coast groundfish fisheries in which multiple species are often caught together. Matching quota to actual harvests is problematic because of uncontrollable factors such as ocean temperature and other environmental factors that can lead to variations in the mix of species caught from place to place and over different periods. Moreover, "disaster tows" can occur in which the dominant species is other than the target species. In theory, ITQs can address the problem through quota trading. That is, either by purchase or lease of additional quota (Dewees 1990). In some cases, however, the fisher may be unable to buy or lease more quota. This might be because the total allowable catch has been taken or the trading price for quota is greater than the fisherman is able to pay. (The prices of RSQ shares may become especially high as the fishing season progresses due to the constraints they may impose on harvests of target species.)

Pascoe (1997) describes a number of contingency systems that have been used to address these problems in multi-species fisheries with varying success. A permissible quota over-run is used as a bycatch management option in New Zealand and British Columbia (Larkin et al. 2003; Wheeler et al. 1992 cited in Pascoe 1997). A permissible quota over-run policy allows fishermen to exceed their quota holding in a given year in return for a reduction in their quota the following year. In New Zealand, permissible quota over-runs are limited to 10% of the original quota for all species. Another system used in New Zealand allows fishers to land species for which they do not hold quota and record it against the quota held by another fisher. This is effectively an informal quota leasing arrangement, as the catchers of the fish usually pay the holders of the quota for the use of their quota (Baulch and Pascoe 1992 cited in Pascoe 1997).

The need for such contingency systems can also indicate an inadequacy in the formal quota trading system. For example, if all quota purchases or leases are required to be recorded by NOAA Fisheries, the transaction costs might be high due to bureaucratic inefficiencies. An alternative would be to allocate quota to a cooperative and allow its members to internally distribute the quota shares and develop a system for leasing and selling shares. When the quota trading system is decided by fishers themselves, transaction costs can be substantially lower.

In general, cooperatives can be expected to provide the same net benefits to vessel owners as an ITQ program. However, the rules governing cooperatives will be important in determining the distribution of benefits between harvesters and processors. For example, it has been argued by some fishing vessel owners in the Alaska pollock fishery that the rules for inshore cooperatives established under the American Fisheries Act have actually hurt independent vessel owners financially. Rules for these cooperatives restrict the ability of vessels to transfer between cooperatives and require members of a cooperative as a group to deliver 90 percent of their catch to one processing firm associated with that cooperative. Compared with cooperative rules that would allow for free movement of vessels between cooperatives, the present inshore cooperatives shift the balance of power in price negotiations toward the processors. Halvorsen et al. (2000) reported that variations on the current rules that would allow smaller groups of fishing vessels to form cooperatives and easier movement between plants would tend to shift the balance of market power to catcher vessel owners. This shift, in turn, would increase their share of any net benefits resulting from increased efficiency and product value that might occur as a result of rights-based management. In short, the overall gains to vessel owners that might be expected in terms of increasing the value of catch and decreasing harvesting costs are likely to be smaller with cooperatives than with ITQs if the ability of vessel owners to form and transfer between cooperatives and to freely choose their point of delivery is limited.

The impacts of community quota programs on vessel owners is even less clear. Some vessel owners might gain if communities, in turn, grant them catch rights that enable them to slow down and choose fishing times; however, there is the potential that others might be harmed financially if their current ability to harvest resources is curtailed and they need to buy or lease catch rights from communities. Even if a community grants catch rights at no charge, the profitability of the vessel owners could still be undermined if their freedom to choose which buyers they sell their fish to is limited by the community.

2.5.3 Effects on Buyers and Processors

Owners of processing plants (other than catcher processors) have not been granted allocations of shares in prior ITQ programs in the United States, although such allocations may be granted under the Alaska crab fisheries rationalization program. Arguments have been made (e.g., Matulich 1996) that ITQ programs may lead to expropriation of quasi-rents from processors.[11] This could result if excess processing capacity exists and there are no alternative uses for processing equipment. It is also possible that plant owners would share in the overall economic gains that could be made through fishery rationalization. The degree to which that would be true would depend on the level of excess capacity and the degree to which plant owners are engaged in competition with each other to gain market share. If processors are somehow guaranteed shares, they would naturally be more likely to benefit or less likely to suffer harm from implementation of an ITQ program.

As noted above, the structure of cooperatives in which harvesting agreements are negotiated can also affect the benefits that accrue to owners of processors from rights-based management. In general, processors can be expected to benefit more from a cooperative structure in which the ability of vessel owners to form and transfer between cooperatives, to sell or lease catch rights, and to freely choose their point of delivery is limited, though the absolute distribution of profits created by the move to cooperatives in any particular fishery is not clear.

Community fishery quotas might also provide protection to processors in small communities if the communities restrict the landing locations of their quotas. However, if the program worked similarly to the current western Alaska CDQ program, communities could lease out quota to operations that processed elsewhere and local processors might be preempted.

In summary, rights-based systems have the potential to reduce the competitiveness of markets and shift the balance of market power between harvesters and processors. Care must be taken to minimize threats to competitive markets and to avoid, or at least be aware of, shifts in market power that may result in income transfers between sectors. Ex-vessel markets for fish may already be quite thin in the West Coast groundfish fisheries. Consolidation of harvest and processing sectors will make these markets thinner yet. The number of buyers competing for fish may be reduced to a few or a sole buyer in some cases if restrictions were to be placed on where fish can be delivered. The possible result would be a shift in income from harvesters to processors.

On the other hand, without restrictions on where or to what plants fish can be delivered, income transfers may move in the other direction. The temporal spreading of fishing may

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[11]Quasi-rent is the difference between the selling price and the variable costs of a product.

cause processors to bid up prices in an attempt to lower average costs by increasing the amount and duration of their processing. As Matulich (1996) points out, there is the potential under certain conditions that the quasi-rents of processors may be expropriated by harvesters in this process. The possibility also exists that harvesters with sufficient shares of the total allowable catch might have enough market power to make monopoly profits by reducing output below the catch limit. However, the danger of monopolistic practices is low, as West Coast groundfish are sold in regional, national and international markets where they must compete with similar species produced in other regions of the world as well as with other seafood products.

2.5.4 Effects on Vessel and Processing Crews and Communities

Prior rights-based systems implemented in U.S. fisheries have not allocated initial quota shares to vessel crews or other employees of fishing or processing companies. If any of these individuals were allocated shares under an ITQ program, they would be expected to make financial gains similar to those made by vessel owners receiving shares.

If crew members are not allocated shares, it is uncertain whether they could expect their long-term earnings to rise or fall with an ITQ program. In the Alaska halibut and sablefish ITQ fisheries, crew members have sometimes been expected to contribute toward the cost of quota shares used, but increases in the value of production have led to higher crew incomes. Whether crew members and other seafood industry employees are likely to share in the net gains in profitability that result from an ITQ program or other rights-based system implemented in the West Coast groundfish fisheries will depend on the supply and demand for labor, and this is likely to vary by fishery and area.

One impact that is likely in any type of rights-based system is a decrease in the number of crew members and processing workers employed, and an increase in the term of employment of the individuals who remain in the fishery. This is a natural consequence of the consolidation of fishing and processing activities to fewer vessels and plants that operate over a longer period of time. As a form of compensation for the loss of employment opportunities in the Alaska sablefish and halibut fisheries, the North Pacific Fishery Management Council made the provision that the only persons who could purchase IFQ shares that were not initial recipients had to be "bona fide" crew members with at least 150 days of fishing experience. With this provision, crew members who might otherwise lose their jobs can establish themselves in the fishery, and because the owner of the quota shares is required to be onboard when the IFQs are fished, these crew members can guarantee themselves a position (Hartley and Fina 2001b). Moreover, crew members who purchase quota shares increase their value as crew, as their quota shares add to the overall harvest limit of the vessel on which they work (Ginter and Muse 2002).[12]

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[12]Both crew members and vessel owners have been assisted in purchasing sablefish and halibut IFQ shares by the North Pacific IFQ loan program, a financing mechanism authorized by the MSA in 1996. The MSA specifies that 25 percent of the fees collected by NOAA Fisheries to manage the sablefish and halibut IFQ program must be deposited in a U.S. Treasury Department account and made available for appropriation to support the loan program. To date, however, the

On the other hand, rights-based systems could lead to the preemption or reduction of fishing, processing, and shoreside support activities in some traditional fishing communities unless restrictions are implemented to inhibit or prohibit a geographic redistribution of landings. This would be a natural consequence of consolidation in the industry as excess capital is scrapped or allowed to degenerate without replacement and production is shifted to more efficient operations. Even if reductions in harvesting and processing capacity were uniform across communities, one would expect a decrease in economic activities in fishery support sectors due to reductions in harvesting and processing capital. ITQ programs and cooperative programs can be designed to reduce or prevent this. Doing so could entail some sacrifice in overall efficiency gains, but this must be weighed against the social benefits of preserving traditional fishing communities.

Granting quota shares to community groups would be an alternative and more transparent way to assist traditional fishing communities in remaining involved in the fisheries or in providing them financial resources to develop new industries. Moreover, such group-based systems may lead to a more optimal concentration and reallocation of quota shares in the sense that broader social considerations could be internalized (Gréboval and Munro 1999).

In conclusion, constraints on the restrictions on the use, transfer and accumulation of ITQs may prevent preemption of communities or fishery sectors. However, the social benefits of these measures should be weighed against the efficiency losses. The greatest increase in profits for the overall industry is likely to come from a system with a minimum of constraints on transferability and use of quota shares. For the industry as a whole, increases in profitability can be achieved by shifting harvesting and processing from less efficient operations to more efficient ones. Gains in economic efficiency may be made by concentrating production in fewer operations, especially if there are firms with excess harvesting or processing capacity as continues to be the case in most sectors of the West Coast groundfish fisheries. Furthermore, it is possible, but by no means certain, that there are economies of scale that would favor larger firms and lead to greater concentration of the industry. At the same time, however, one must recognize that it is this potential for increasing profits by shifting and concentrating harvest and processing operations that poses the threat of preemption of sectors and communities.

2.5.5 Effects on Consumers of Groundfish Products

Because landing limits in the groundfish fisheries already maintain a year-round season, consumers are already experiencing some of the typical gains from ITQs, such as the availability of fresh fish in markets throughout the year.

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program has largely been supported by a Congressional appropriation. The MSA specifies that the loan program is to provide aid in financing the 1) purchase of individual fishing quotas in that fishery by fishers who fish from small vessels; and 2) first-time purchase of individual fishing quotas in that fishery by entry level fishers. Currently, the program has approximately $5 million available for financing quota share purchases. In FY 2002, 39 loans were issued, mostly to vessel owners and crew members who fish from small (< 60 ft. LOA) vessels.

Consumers could be negatively affected if a rights-based system leads to a decrease in the competitiveness of markets. Such a decrease could result in higher seafood prices without accompanying increases in quality, which, in turn, would reduce consumer surplus. The likelihood of this occurring depends both on the level of consolidation that might occur and the elasticity of demand for the particular species.

2.5.6 Effects on Recreational, Charter and Tribal fisheries

This analysis of the economic effects of Alternative 5 on the recreational and charter fishing sectors draws from Anderson's (1992) discussion of the possibility of creating ITQs for both recreational and commercial fishers.

Anderson notes that an advantage of fishery management with ITQs is that it is possible to simultaneously create tradable quota shares for various sectors, including the recreational, charter and commercial fishing sectors. There are many options that could be developed. With full trading of ITQ shares permitted between sectors, users could determine the most desirable allocation of the stocks based on their willingness to pay for shares of the resource. For example, recreational harvesters could increase their share of total catch by purchasing ITQ shares from commercial harvesters or commercial harvesters could buy recreational ITQ shares.

An obstacle to establishing the initial allocation of quota shares for the recreational sector is that individual recreational landings are typically difficult to document. Anderson suggests that recreational ITQ shares could be given away on an equal basis through a lottery. Entities such as fishing clubs or state/local government agencies could also receive shares if is decided these groups were proper representatives of recreational fishers. Part of the initial recreation allocation could also be assigned to non-ITQ bag limit fishing.

Alternative 5 is not expected to have a minimal economic effect on tribal groups. The claim of tribal groups to sablefish, black rockfish and Pacific whiting has already been negotiated and they currently receive an allocation of these groundfish resources based on that claim. That allocation would not change under this alternative. There are several groundfish species taken in tribal fisheries for which the tribes have no formal allocation. To accommodate these modest tribal fisheries, the tribes could be allocated group quota shares for these species based on historical tribal landings.

2.5.7 Effects on Fishing Vessel Safety

As with a number of effects previously discussed, the gains in fishing vessel safety that are typically attributed to rights-based systems are currently realized under the status quo. These fishing safety benefits include reduced pressure to fish under dangerous conditions. At the same time, it is important to recognize that rights-based management does not necessarily guarantee improvements in safety for fishers. Under an ITQ program, for example, market opportunities may still encourage fishers to fish at times or in places that are unsafe. For example, some fishers may still choose to fish in bad weather if the best price for catch is offered during and immediately after storm periods.

2.5.8 Distribution Issues with Rights-Based Management

As noted previously, the economic and social impacts of expanded use of rights-based management in the West Coast groundfish fisheries will be determined largely by the initial allocation of quota shares. Whether shares of the total allowable catch are allocated to individuals, cooperatives or communities, the basis for determining the allocation will undoubtedly be controversial. The allocation mechanisms are likely to vary significantly, depending on the type of rights-based system or systems implemented.

During the development of an ITQ program, a wide variety of allocation mechanisms and formulas should be considered. Although past ITQ programs in the United States have allocated quota shares to vessel owners based on catch histories, other options should also be examined, such as those that attempt to incorporate objectives that maximize net benefits to society. For example, the criteria for initial allocation of quota shares could include a vessel's acceptance of conservation goals (National Research Council 1999). Further, retention of shares could be contingent on the vessel's ability to pass a regular performance review.

When allocating quota shares it is important to bear in mind that granting shares to individuals free of charge is likely to result in those individuals receiving substantial windfall gains. These windfall gains may be construed as a transfer of wealth from the public to certain individuals since exclusive withdrawal rights to publicly owned resources are being gifted. Whether and to whom this wealth should be gifted is an important question that should be carefully considered.

It has been argued that vessel owners have invested their labor and risked their capital (and often their lives) to develop fisheries, and, in return, they should be given preferential access to those resources. The problem with this position is that vessel owners as a group are only one element of a diverse collection of stakeholders who might be viewed as possessing a "right" to benefit from resources harvested in federally-managed fisheries (or from other resources directly or indirectly affected by those fisheries). Possible other stakeholders include, but are not limited to, skippers who are not vessel owners, vessel crew, processors, and individuals in communities that support fishing and processing operations. Clearly, there are equity reasons for considering whether and how these other stakeholders might be included in initial allocations of ITQ shares. Furthermore, the MSA requires fishery managers to consider the allocation of a portion of the annual harvest in a fishery for entry level fishers, small vessel owners, and crew members who do not hold or qualify for individual fishing quotas.

While recognizing that the MSA may currently restrict such actions,[13] fishery managers might also consider the future prospect of selling or auctioning some or all of the ITQ shares to allow the public to capture all or a share of the windfall gains created by the ITQ system (Macinko and Bromley 2002). A variety of tax mechanisms could also be used to capture a portion of the net economic returns that fish harvesting might generate and place them in the public coffer. The mechanism for collecting these profits should be implemented at the beginning of the ITQ program, as the windfall gains accrue to the initial holders of quota (Sutinen et al. 1992)

If cooperatives are expanded to other West Coast groundfish fisheries, the cooperatives themselves would likely be responsible for allocating quota shares among their individual members. However, an equitable method of allocating among cooperatives is still required. If quota shares are granted to communities, allocations might be based on the historic landings made in those communities and/or the pooled catch histories of the communities' residents. A variety of other formulas might be developed to meet particular social and economic objectives. Under the western Alaska Community Development Quota (CDQ) program allocations to CDQ groups are not fixed in order to allow flexibility in directing benefits and achieving community development goals. In such an arrangement, it is of paramount importance that the process for allocating community quotas be stable and transparent (National Research Council 1999).

Whether quota shares are allocated to individuals, cooperatives or communities, it may be prudent to put in place mechanisms that will allow the nature of the fishing privileges to be altered. A stable set of privileges and responsibilities with a long time horizon is important to promote the efficiency and stability of the fishery, but it is also important to maintain administrative flexibility for unforeseen eventualities that may oblige changes in the distribution of quota shares. One such mechanism discussed by the National Research Council (1999) is referred to as the Australian drop-through system. In this system, initial entitlements are defined and fixed for a long but finite period: 30 years in certain Australia fisheries. Periodically, perhaps every ten years, a comprehensive review of these entitlements takes place and changes can be made to the set of rights and obligations. Share holders can switch to this new set of entitlements (whatever is currently on offer) any time before the term of their old entitlements expire, at which time they would automatically exchange entitlements for the current set on offer. Switching to the new entitlement package locks in the right to guard those entitlements for the remaining life of that entitlement. Other systems of balancing stability with flexibility are possible. The most important element is to strike the proper balance to protect the health and prosperity of the fishery and the authority of regulators to make appropriate management decisions in the best interest of the public.

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[13]Section 304(d) of the MSA places strict limitations on fees that can be levied on the fishing industry. These limitations effectively preclude auctions or other means of collecting some of the rents that may be created with ITQs (Anderson 1992).

2.5.9 Effects on Management and Enforcement Costs

Experience with the ITQ programs in fisheries around the world indicates that such programs typically result in substantial increases in the costs of monitoring, enforcement and administration. If ITQs and/or other rights-based systems are implemented in the West Coast groundfish fisheries, NOAA Fisheries will be required to manage increasingly small blocks of fish. It will be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches of a large number of individual vessels. Under Alternative 5, 100% observer coverage is used to monitor the harvest of each participant and ensure that it does not surpass his current individual quota level. It is estimated that the cost of an additional NOAA Fisheries-certified observer is about $900 per deployment day for each vessel. The installation of video cameras on board vessels to document activities at sea has the potential to substantially reduce monitoring costs.

In addition to these daily deployment costs, the increase in the number of observers and its associated increase in the amount of data collected is expected to raise overall annual costs of the groundfish observer program. This budgetary increase can be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. With transferability, it will also be necessary to keep track of the current amount of quota owned or leased by each participant. Though computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the observer program have not been estimated.

Lastly, a rights-based management system requires additional agency resources to develop the process through which fishing rights are assigned and to adjudicate appeals about the assignment of fishing rights to individuals or groups.[14]

The MSA provides for cost recovery measures that can impose a fee on quota holders of up to 3 percent of the ex-vessel value of IFQ landings. Total fee collections cannot exceed the annual cost of management and enforcement. Such measures were implemented for the Alaska sablefish and halibut IFQ program in 2001. Seventy-five percent of fee payments are deposited in the Limited Access System Administrative Fund and made available to NOAA Fisheries to offset costs of management and enforcement of the halibut and sablefish IFQ program.

[14]Both private and public costs may be incurred adjudicating evidentiary and fairness issues to make the initial determination of "who's in" and "who's out." (Anderson 1992)

2.5.10 Effects on Harvesting and Processing Capacity

Rights based systems, whether they allocate shares of the catch to individuals or groups, are incentive adjusting methods, in that they attempt to prevent the build up of excess harvesting and processing capacity or reduce excess capacity that already exists by creating economic incentives for owners of vessels to decrease their use of labor and capital, rather than by directly regulating the level of fishing effort. Where property rights exist, there is no incentive for fishers to invest in ever more elaborate vessels or equipment or, to be more precise, to select anything but the least-cost combination and deployment of fishing inputs (Crutchfield 1979; Scott 2000).

The implementation of ITQ programs would be expected to lead to some consolidation of quota to fewer vessels. The degree of consolidation will vary depending on the level of excess capacity, economies of scale and scope in harvesting, and rules that restrict transfer and accumulation of quota shares. Similar consolidation could occur with expanded use of cooperatives or community quota programs.

Some excess capacity (in the sense of an ability of vessels and processors to harvest and process the total allowable catch in less time than a maximum season length would allow) can be expected to persist in the West Coast groundfish fisheries regardless of what type of additional rights-based measures are put in place. This is generally the case for a number of reasons: it is often not economically efficient to operate at maximum possible production levels; there are typically certain times of the year when it is more efficient and profitable to harvest fish; and alternative uses for excess fishing capital and labor outside of the fisheries in which fishers normally participate may be limited. In addition, many of the participants view the groundfish fisheries as a means of supplementing income from other major fisheries such as salmon and crab. Allowing fishers to choose when to harvest their ITQs will further establish the groundfish fisheries as part-time fisheries, as fishers will have a greater choice of when to harvest their shares to avoid conflicts with other seasons. Finally, an IFQ program may include restrictions on the use, transfer, and accumulation of quota shares that are specifically designed to limit the degree of consolidation in the groundfish fisheries. The aim of such restrictions may be to avoid excessive consolidation and maintain the small-scale, owner-operator characteristics of vessels in some fishing fleets.

2.6 Alternative 6:

This alternative includes a wide array of measures to reduce bycatch, including a 100 percent groundfish retention requirement, marine protected areas and transferable restricted species quotas (RSQs) for overfished species, and transferable individual fishing quotas (ITQs) for other groundfish species. The mixture of measures greatly complicates an analysis of the economic impacts of the alternative as the economic effects of some measures may be offsetting. For example, the decrease in costs that commercial harvesters are expected to experience under an ITQ program may render them better able to sustain possible reductions in harvests and revenues caused by the establishment of MPAs. However, in most cases there is insufficient information to determine the net economic effect of different measures on various components of the human environment.

2.6.1 Effects on Fishers' Incentives to Reduce Bycatch

This alternative represents both a traditional "command-and-control" approach to reducing bycatch, and a "market-based" approach that removes the economic incentives that lead to bycatch. MPAs would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing bycatch outside of MPAs. Forbidding discarding produces a strong incentive to develop and apply more selective gear. In addition, Alternative 6 is similar to Alternative 5 in that individual commercial groundfish vessels would also be assigned transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (ITQs) for other groundfish species. As described in the effects analysis for Alternative 5, RSQs and ITQs provide an economic incentive to avoid catching overfished species and unwanted fish if an effective monitoring and enforcement program is in place.

2.6.2 Effects on Commercial Harvesters

Either a significant increase or decrease in the average costs of fishing vessel owners could occur under this alternative. The 100% groundfish retention requirement as well as the establishment of MPAs are likely to increase average costs, whereas the establishment of ITQs for groundfish species is likely to reduce costs. It is uncertain if the cost decreases would compensate for the cost increases.

The establishment of ITQs for groundfish species is expected to reduce the costs of harvesting (See Alternative 5 discussion on commercial harvesters). Individual vessels will have the opportunity to select the least-cost combination of fishing inputs. At the industry level, costs will fall because production is expected to shift over time toward the most cost-effective harvesting operations. Fixed costs will be reduced by consolidating harvesting operations and retiring or selling off vessels. The cost savings will depend both on the constraints put on the transfer and consolidation of harvesting rights and on the level of excess capacity prior to implementation of remedial measures. The implementation of a rights-based management program will also tend to improve product quality as these systems give individuals the incentive to get the maximum value out of each unit of catch.

On the other hand, the 100% groundfish retention requirement could have a positive or negative effect on the commercial harvesting sector depending on 1) how much the fish formerly discarded would decrease the vessel hold space available for more valuable product and 2) the revenue earned from product derived from the additional fish retained. Revenue per trip may decrease if a large of amount of hold space is taken up by lower-valued fish. Vessels may offset to some extent the lost revenues by taking additional fishing trips. However, the number of trips vessels can make may be limited by the catch allowance for overfished groundfish species. When the catch allowance is reached, a vessel owner must stop fishing unless he/she can purchase additional RSQ shares. It is also possible that markets could be expanded for some groundfish species that currently fetch lesser prices. However, the prospect of market development is uncertain.

The problem of damaging target species that are caught by mixing wanted and unwanted groundfish in the hold may be a problem for some vessels. For example, dogfish sharks have high levels of urea (or more generally, non-protein nitrogen - NPN - compounds) in their flesh and when the shark dies bacteria rapidly convert this to ammonia, contributing to spoilage. This problem may be avoided if sharks are segregated in a separate hold. However, most vessels are unlikely to be able to dedicate an entire hold to the dogfish sharks that are taken. The problem of contamination of target catch could also be avoided by on-board processing of the sharks in order to remove as much of the NPN compounds as possible. However, the costs involved in processing and preserving dogfish shark meat currently outweigh the revenue that might be garnered from doing so. It is possible that for some species there is currently no established market. If vessels cannot sell the additional fish retained they may face delivery costs for shipment to a disposal site.

Smaller vessels may be disproportionately affected by the groundfish retention requirement, as they are more likely constrained by hold space during a fishing trip and their slower speed restricts their ability to increase revenue by taking additional trips.

The spatial displacement of fishing effort resulting from the establishment of MPAs is also expected to a have a significant negative economic impact on many fishing operations. Displaced fishers would have the option of relocating their fishing activities to groundfish grounds that remain open. However, vessel owners will likely be required to fish in less productive areas and competition for remaining fishing locations would increase. Consequently, catch rates will likely fall, translating into less harvesting revenue for any given effort level. In addition, the area closures may force some fishers to travel further than previously, thereby making effort more costly.

The MPAs established under this alternative may also cause product quality to decline. It is reasonable to assume that, subject to regulatory constraints, harvesters target catch in areas that maximize its value either by increasing the quality of the fish or by decreasing the harvesting cost or both. Consequently, a measure that prohibits vessels from using historical fishing grounds may result in a decline in product quality (e.g., fish may be smaller or a less uniform size). In addition, the quality of some groundfish species may deteriorate as the time from harvest to processing lengthens. To the extent that the establishment of MPAs results in vessels traveling farther distances from processors, and thereby lengthening the time between harvest and processing, the quality of product will be adversely affected.

Enterprises with high operating costs would be the first to feel the cost-revenue squeeze. Over the longer run, operations with high fixed costs would be disadvantaged by the reduced contribution margin of each fishing trip made. These negative economic effects are likely to cause some vessel owners to exit the groundfish fisheries. For those enterprises that weather the financial negative effects created by the initial reduction in net earnings, the long-term outlook would be brightened by a gradual increase in catch rates in response to the initial effort reduction. The final outcome for these enterprises may be a situation similar to the pre-regulatory situation, at least in terms of financial rewards.

Some displaced fishers may elect to switch to non-groundfish fisheries. A substantial number, if not most, of groundfish vessel owners derive a substantial portion of their income from other fisheries. Consequently, many fishers are likely to recover some portion of the revenue previously generated from groundfish fishing. However, many of these alternative fisheries are already fully exploited. Furthermore, it is probable that some displaced vessel owners will have difficulty relocating their operations given the limited access programs that have been implemented in West Coast fisheries and other U.S. fisheries. In addition, some boat owners may not be capable of shifting into other fisheries without significant additional capital outlays, while others may face increased costs and uncertain markets if they are forced to shift their operations away from the communities in which they live.

Given that opportunities for displaced fishers to recover their lost harvest and income may be limited, and that the groundfish fisheries are already characterized by limited profitability, it is likely that some displaced fishers would be forced to sell out or retire. It is uncertain how active the West Coast or nationwide market is for the types of vessels, gear and other investment capital used in the groundfish fisheries. However, it is possible that the West Coast market for these assets could quickly be flooded, thereby depressing the immediate resale value of fishing equipment and vessels. Furthermore, the restrictive regulatory environment under Alternative 6 may diminish the long-term investment value of the vessels owned by displaced fishers who opt to continue fishing. This could create an economic hardship for those fishers who are relying on money earned from selling their fishing assets to supplement their retirement funds.

Transfer of effort from groundfish to non-groundfish fisheries could also indirectly create economic hardship in the form of reduced profitability for fishers already engaged in non-groundfish fisheries. The majority of fisheries along the West Coast and other areas of the U.S. are fully utilized. If fishers in the groundfish fisheries were to shift their effort to other fisheries, catch per unit of effort and individual harvest for non-groundfish fishers would likely decline due to the intensified fishing pressure on fish stocks.

MPAs have the potential to enhance exploited populations and benefit fisheries by 1) dispensing larvae that replenish fishing grounds removed from MPA source populations; 2) exporting biomass to adjacent fishing grounds in the form of emigrating juveniles and adults; and 3) protecting portions of exploited stocks from genetic changes, altered se ratios and other disruptions caused by selective fishing mortality (Murray et al. 1999). These benefits could potentially mitigate, in part, deleterious effects of overfishing and restore, stabilize, or enhance fishery yields for some coastal stocks (Dugan and Davis 1993). However, the ability of closed areas to increase yields has not been demonstrated for groundfish fisheries along the West Coast. It should also be noted that even if a closed area has the potential to have a positive effect on fish populations and fishery productivity, it may take several years after the closure for this effect to be realized. For example, considering the longevity and erratic recruitment of many rockfish, it might be decades before MPA benefits to rockfish stocks and outside fisheries are demonstrated (Yoklavich 1998 cited in Murray et al. 1999). Given this time lag, it is improbable that the potential economic benefits of a MPA would accrue to the current generation of groundfish fishers. Even if the lag is considerably shorter, it is likely to be perceived as too long for most fishers whose social and economic well-being is contingent on shorter schedules (Murray et al. 1999).

Reductions in fishery landings and the resulting social and economic adjustments required by fishers may be partially mitigated by phasing in MPAs to distribute the loss of fishing grounds and related catches throughout several years. During this period, the benefits obtained from MPAs may begin to offset losses due to displacement of fishing activities (Sladek et al. 1997 cited in Murray et al. 1999).

2.6.3 Effects on Buyers and Processors

The 100% retention requirement could result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. Some processors have the capability of processing low grade fish as fish meal. However, there may be concerns that increased retention will overwhelm existing infrastructure and supplies of potable water (Radtke and Davis 1998).

Because of their lack of mobility, we would expect the impacts of MPAs on buyers and processors to be greater than the impacts on fishers as a group. However, the effects of MPAs on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations (Parrish et al. 2001). Processors that have continued to rely on local supply to maintain operations at a particular plant will be most affected by any change in local supply. Processors that have adapted to current fishery conditions by centralization of processing and distribution activities may be somewhat less affected. By shipping raw product to centralized locations, these processors are able to maintain a more consistent product supply and better utilize their factory capital and work force. They are likely to be less affected by localized disruption in supply, but will still be affected by MPAs that change the total amounts of fish available for harvest.

If this alternative results in a significant net decrease in the amount of target species delivered to buyers and processors, we would expect higher average costs in this sector. Average costs will increase because of the reduction in the overall level of production resulting from lower catches. Many costs are fixed (e.g., loan repayments, general office and accounting expenses and insurance costs) and will not change with the level of production. These costs would be allocated to a smaller amount of product, thereby raising the average cost per unit of product. The cost increase will be larger for those processors and buyers that are most dependent on groundfish. Smaller operations would probably be more affected by changes in landings than larger buyers because smaller buyers are relatively less diversified in the range of species handled. As average costs per unit of production rise, it is possible that they would exceed the value of production and lead to a temporary shutdown or permanent closing of some firms.

The variable costs of processors and buyers may also increase under this alternative. The reduction in supply of fish is likely to put upward pressure on ex-vessel prices. If spatial shifting of production raises average costs for fishing vessels, buyers and processors may face increased pressure to pay higher prices for fish. The extent to which processors versus harvesters would absorb increased harvesting costs and the extent to which fishers will be able to demand higher prices as total supply declines will depend on their relative bargaining power as well as price elasticities of the products made from the fish.

An additional problem that processors may face if landings decline is the maintenance of a skilled workforce (Parrish et al. 2001). Diminished work opportunities could diminish processor abilities to attract and maintain a skilled workforce. This could lead to either increased costs related to less efficient workers or additional expenditures to recruit or retain skilled workers.

2.6.4 Effects on Consumers of Groundfish Products and Other Segments of the American Public

Over the long term, MPAs that effectively increase the size and variety of seafood species could actually make consumers better off. On the other hand, large MPAs could substantially decrease seafood supply enough to make consumers worse off (Carter 2003). Both the intensity of this negative effect and the probability of its occurrence are uncertain. The most likely result of the decrease in the groundfish catch would be a negative effect on the U.S. seafood trade balance, as more groundfish products are imported to offset the reduced domestic supply. For example, similar products from South America, Mexico and Canada could potentially substitute for West Coast production. The imported groundfish products may be generally lower in quality than domestic products. In addition, a reduction in local supplies of fresh fish would have a negative effect on those retail or restaurant patrons who place a premium on knowing the product they are purchasing is locally caught (Parrish et al. 2001).

The price elasticity of demand for groundfish products is fairly high in the U.S. market, but assuming that demand is not perfectly elastic, the decreased production could result in higher product sales prices and a loss of consumer surplus (i.e., net benefits) to the American public. The magnitude of that loss will depend on price elasticities that are not quantifiable at this time and on the degree to which production is shifted toward or away from the export markets.

Marine ecosystems and species associated with them provide a broad range of benefits to the American public (National Research Council 2001). Some of the goods and services these ecosystems produce are not exchanged in normal market transactions but have value nonetheless. For example, in addition to supporting commercial fisheries, these ecosystems support an array of recreational fishing and subsistence activities as well as non-consumptive activities such as wildlife viewing and research and education (Carter 2003; Parrish et al. 2001). Furthermore, some people may not directly interact with the marine environment, but derive satisfaction from knowing that the structure and function of that environment is protected.

A primary purpose of this alternative is to provide increased protection for habitat and the overall ecosystem. In particular, the establishment of MPAs is intended to ensure protection for a large number of species and their interrelationships and provide for the maintenance of natural processes. In turn, these positive effects on marine ecosystems and associated species are expected to lead to a significant increase in the levels of the range of benefits these ecosystems and species provide. However, MPA-related changes in these benefits have not been estimated. It is also important to note that some individuals may hold religious or philosophical convictions that humankind has an ethical obligation to preserve species and ecosystems, notwithstanding any utilitarian benefits.

While additional surveys and polls are needed to better understand the values and motives underlying public support of measures that protect marine species and ecosystems, Parrish et al. (2001) note that a 1999 survey conducted by the Mellman Group for SeaWeb found a high level of approval for the establishment of MPAs. Seventy-five percent of the individuals surveyed favored having certain areas of the ocean as protected areas; 60% believed that there should be more marine sanctuaries; and 3% believed there were already too many marine sanctuaries. Survey respondents cited the following as "convincing" reasons for creating MPAs: 1) distinctive areas should be protected similar to what is done for national parks (65%); 2) less than 1% of U.S. waters are in MPAs (63%); 3) MPAs would be an important step in improving the health of oceans (58%); 4) harmful activity should be restricted to preserve ocean beauty for future generations (57%). Support for MPAs diminished by only 1% when respondents were first read a statement outlining potential negative socioeconomic effects of creating MPAs and increased by 6% when respondents were first read a statement outlining potential positive effects of creating MPAs.

2.6.5 Effects on Communities

The decrease in groundfish catches would have a direct and significant negative impact on individual fishing enterprises. Fishery participants would suffer from a loss of earning potential, investment value and lifestyle. Deckhands would arguably be the most severely impacted by the reduction in groundfish catches. They will probably be the first to lose their jobs, and they may have the greatest difficulty in finding alternative employment. It is likely that the net revenue of a groundfish fishing vessel is highly sensitive to the crew share percentage. If the regulations implemented under Alternative 6 result in a reduction in net revenues, vessel owners may partly try to make do by decreasing the pay of deckhands or laying them off. Appropriate employment opportunities outside of fishing may be limited for affected individuals, and for many the income losses may be long-term.

The reduction in groundfish production would also have a negative economic impact on local businesses that directly or indirectly support and are supported by the fishery. Included are individuals or firms that process, distribute and sell fishery products and enterprises that provide goods and services to the fish-harvesting sector, such as chandlers, gear manufacturers, boatyards, tackle shops, bait shops and insurance brokers. While the percentage of business derived from the groundfish fisheries may be relatively small for some of these firms, any permanent loss of income during this extended period of stagnation in the U.S. economy could affect their economic viability.

On the other hand, when examined from a community frame of reference, the economic contribution of the harvesting and processing of groundfish fishery resources to the total economy of even small coastal communities is diluted by the relative scale of other economic activities, such as tourism and the wood products industry. Nevertheless, the finding that relatively few persons would be negatively affected economically and the overall economy of a community would not be significantly affected does not lessen the economic hardship that reduced earnings or loss of a job would create for some fishers and their families.

Those who become unemployed would face the social and psychological costs of job loss. Individuals who lose their jobs typically experience heightened feelings of anxiety, depression, emotional distress and hopelessness about the future, increases in somatic symptoms and physical illness, lowered self-esteem and self-confidence, and increased hostility and dissatisfaction with interpersonal relationships. In addition, both spouses and children of such individuals are at risk of similar negative effects. Families may find it difficult to pay bills and afford transportation, health care, and even food and clothing. The results of this financial strain may be high levels of psychological distress among some family members as well as an increase in physical health problems. It is important to note that many families in West Coast communities that depend on fishing and the seafood industry are already economically, socially, and psychologically stressed because of the increasingly restrictive regulatory environment.

In addition to economic losses associated with declines in landings and revenues, there would be the loss of lifestyle to contend with, assuming that displaced fishers cannot find an equally satisfactory alternative way of life. It is likely that enjoyment of the lifestyle or work itself is an important motivation for fishing among fishery participants. Moreover, some individuals may be motivated to fish for a living by a long-term family tradition. The loss of fishing-related jobs will cause some individuals to abandon the fishing life style. Furthermore, the groundfish fisheries are a historically important component of an industry that is deeply intertwined with the social and cultural resources of some coastal communities. For example, the Newport Beach dory fishing fleet, founded in 1891, is a historical landmark designated by the Newport Beach Historical Society. By reducing the economic viability of the commercial fishing lifeway in these communities, this alternative would diminish the influence of local maritime culture, at least in the short term. On the other hand, the establishment of MPAs is expected to have a positive effect on the long term productivity of fish stocks, which determines the abundance of fish in the future. Consequently, these measures could help ensure harvests for future generations and the sustained participation of communities in the fisheries.

2.6.6 Effects on Recreational, Charter and Tribal Fisheries

If the establishment of MPAs results in a geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open may lead to localized depletion of stocks and a decline in catch per unit effort and individual harvests. Lower individual catches would mean a reduction in the quality of the fishing experience to a number of recreational fishers and charter fishing patrons. The value of the fishing experience would be further reduced if MPAs increase the distance that recreational fishers must travel to reach productive fishing grounds.

While not completely immobile with respect to a port of operation, charter boat operations are location dependent both in terms of their reliance on location-specific marketing channels to bring them customers, and the effects of distance to fishing grounds on profit (Parrish et al. 2001). Increased distance to fishing grounds may affect both the cost and revenue side of their profit function (increased distance and travel time increases the fuel and labor opportunity costs and at the same time is likely to decrease willingness of customers to take a trip). Charter vessels that work as independents rely on charter offices to book their clients, and have somewhat more locational flexibility than those vessels that serve as their own booking agents. Charter booking offices, on the other hand, are more closely tied to the fishing opportunities available in the port that they serve.

Recreational fishers would face the same situation as described for charter vessels except that recreational fishers may be more mobile in their choice of fishing ports (Parrish et al. 2001). The likelihood that fishers will change fishing ports depends on the degree to which fishing is the primary purpose of a trip and the distance to alternative ports.

As with commercial fishers, participants in charter and recreational fisheries could potentially benefit over the long term from increases in local catch rates and fish size due to spillage of adults out of the MPAs (Parrish et al. 2001). Fishery enhancement from adult spillover would be in addition to the theoretical possibility of increases in biomass outside the MPAs through larval and juvenile export.

Fishing restrictions in MPAs may conflict with federally recognized treaty rights of tribes to fish in their "usual and accustomed" fishing areas (Parrish et al. 2001). Under these circumstances, it may be possible that NOAA Fisheries and tribal authorities could negotiate a "co-management" arrangement whereby tribes are granted preferential access to MPAs for selected purposes and certain responsibilities related to MPA management are delegated to the tribes.

2.6.7 Effects on Fishing Vessel Safety

Either a significant improvement or reduction in fishing vessel safety could occur under this alternative. The net effect of the various measures on fishing vessel safety is uncertain. The establishment of ITQs for groundfish species is expected to promote vessel safety by reducing the pressure to fish under dangerous conditions (See Alternative 5 discussion on fishing vessel safety). On the other hand, the establishment of MPAs may result in a reduction in safety for the fishing vessels that remain active. While the decline in landings and revenues may reduce the number of active vessels, and thereby decrease the number of persons at risk, it is likely that the decrease in catches will encourage vessel owners to reduce crew size in an effort to compensate for reduced earnings. Reductions in crew size, in turn, may increase the risk of vessel accidents. Moreover, as revenues decline, vessel owners and captains are likely to find it more difficult to retain qualified crew who are fully trained in vessel operations, including safety. In addition, one short-term survival mechanism that may be exercised by some vessels is the deferment of needed maintenance for the vessel and equipment key to safe vessel operation. Such deferrals will likely be associated with increased levels of risk.

The closure of fishing grounds would also result in vessels fishing farther from port and possibly in more hazardous areas. The adverse effects on safety of human life at sea would be more extreme for smaller vessels.

MPAs that force commercial and recreational fleets to fish in the same waters may increase the risk of collisions, especially in bad weather. Recreational boaters tend to be less experienced and have less safety equipment than commercial skippers. The combination of increased vessel density and relatively inexperienced skippers increases the risks to recreational boaters.

2.6.8 Effects on Management and Enforcement Costs

The tracking, monitoring and enforcement activities associated with an ITQ program are expensive (See Alternative 5 discussion on management and enforcement costs). One hundred percent observer coverage would be used to monitor the harvest of each participant and ensure that it does not surpass his current individual quota level. This level of observer coverage would also facilitate enforcement of a full retention regulation. Any observed discarding of groundfish would be an offense. A possible concern to NOAA Fisheries is the implications of having observers directly involved in monitoring compliance with discard restrictions. Doing so may require observers to assume an enforcement role that is not consistent with objectives of the groundfish observer program.

Enforcement costs will vary with the following factors

- the number, size, and shape of the MPAs
- types of activities restricted and allowed
- degree of change the MPAs require as compared to current usage of the area
- proximity of the MPAs to other activities such that public surveillance can occur or there will be an enforcement presence in the area for other reasons
- the types of activities enforcement is diverted from in order to enforce MPAs (unless new funds are made available for enforcement) (Parrish et al. 2001).

VMS may be of limited usefulness if certain types of fishing are allowed within MPAs. While a track signature would indicate whether a vessel was engaged in fishing activities (as opposed to transiting a closed area), it may not be possible to differentiate vessels pursuing different fishing strategies. To address this problem the Council adopted a rule in 2002 requiring one type of gear on board during any one trip and a declaration system whereby the skipper notifies NOAA Fisheries of their fishing strategy prior to embarking on a fishing trip. It is anticipated that NOAA Fisheries will implement a final rule in October 2003.

Restricting recreational fisheries in MPAs would increase regulatory complexity and the monitoring and enforcement costs associated with these fisheries. Although many recreational vessels carry the necessary electronic equipment to chart their location, monitoring compliance in the recreational fisheries may be costly. Unless VMS requirements were extended to include recreational vessels, the existing methods of patrolling sea areas either by airplane or ship would have to be used to monitor and enforce closed areas. At-sea monitoring would be more expensive and less effective than using VMS.

The burden of covering the costs associated with VMS is a significant issue and federal funds have not been identified for these expenditures. The Council has recommended that VMS units be installed on the limited entry trawl and limited entry fixed gear fleets (over 400 vessels) and that NOAA Fisheries fully fund all VMS requirements if funding becomes available. The hardware and software within NMFS Enforcement necessary for receiving, processing, interpreting and storing vessel data has already been set up, representing a sunk cost.

Comprehensive baseline and post-implementation studies of MPAs are necessary to determine their biological effects (Parrish et al. 2001). The costs of monitoring MPA effectiveness are difficult to evaluate at this general level of discussion and will primarily be dependent upon the number and size of reserves and the number of significant types of habitat encompassed in the MPAs. As an example of expected costs, $80,000 was spent for a one-time only survey of the bottom habitat in deep water (25 m to 100 m) inside and outside the Big Creek Ecological Reserve off central California; this represented about 25 square kilometers of total study area (Parrish et al. 2001). An additional $300,000 was spent to collect baseline information on fish abundance, diversity, and size composition in and out of the reserve in deep water over two years following establishment of the reserve. Parrish et al. (2001) note that with larger MPAs, there is potential for using cooperative industry/agency research platforms for extractive monitoring.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data collection system (Russell Porter, PSMFC, pers. comm., Oct. 30, 2003).

2.6.9 Effects on Harvesting and Processing Capacity

Because this alternative may result in a large decrease in the quantity of catch and products from the groundfish fisheries, it is expected to generally lead to higher excess capacity in both the harvesting and processing sectors, but some exceptions are expected. For example, those processing plants that are only marginally dependent on groundfish may not experience a significantly higher excess capacity. These negative effects on capacity may be offset to some extent by the establishment of ITQs for groundfish species, which may result in consolidation of the fleet though sales of IFQ shares (See Alternative 5 discussion on capacity reduction).

3.0 Data Gaps and Information Needs

As discussed previously, there may be insufficient information to comprehensively assess the economic consequences of existing or expanded measures to control bycatch in the groundfish fisheries. This section will outline the data requirements needed to frame a more complete economic impact assessment.

The following quantitative data would support the analysis of the economic effects of the alternatives. In some cases, time series data would be useful to compare the economic status of the groundfish fisheries before and after implementation of existing management measures that have affected the level of bycatch. This data would also provide a benchmark that would allow before-and-after comparisons if alternative measures are implemented.

- Estimates of excess harvesting and processing capacity (including latent capacity of inactive vessels) derived from information on the quantities of capital equipment purchased and maintained by plants and vessels, their activity levels in various fisheries, and variable input use (for items such as labor, fuel fishing gear and other essential inputs). These estimates should be by sector and length category.
- Average sale price of groundfish license by vessel designation, length category, gear type and area endorsement, 1995-2001.
- Estimates of the economic effects of groundfish bycatch in groundfish and other fisheries using "bioeconomic" multi-species models that incorporate data on biological interactions, effort levels, catch and bycatch rates, and catch values.
- Model-based estimates of the economic effects of introducing ITQs in the fisheries, including changes in the size, structure, location and profitability of the fleet.
- Information on the current economic performance of the fleet and individual vessels and processors, including disaggregated income, cost and employment information from harvesting and processing firms.
- Vessel and processing facility ownership data to monitor changes in concentration of ownership in the harvesting and processing sectors, the structure of ownership (including proprietorships, publicly traded corporations and privately held corporations) and the relationships both within firms (i.e., the amount and nature of vertical and horizontal integration) and among firms.
- Updated FEAM multipliers to reflect changes in the harvesting and processing sectors and other fishery-related businesses.
- Data to measure the willingness to pay (demand) for recreational fishing experiences of varying quality.

- Data on the relative economic importance of fisheries (salmon, crab, groundfish, and pelagic species) to individual fishing vessels and processing companies in various ports, and information on the amounts of product processors acquire from local and outside sources.
- Model-based estimates of the economic effects of establishing MPAs using information on the location and magnitude of current harvest and effort, travel costs to different fishing grounds and the extent to which fishermen can relocate to other areas.
- Estimates of the existence value and other non-consumptive values attributed to resources within proposed MPAs.
- Information on the dependence of families in various communities on income from fishing, alternative sources of income, and resources available in communities to assist families in adapting to change.
- Information on the costs and effectiveness of alternative onboard technology to monitor catch and discards, including video recording devices.
- Information on the costs and effectiveness of alternative industry reporting and recordkeeping requirements to monitor catch and discards, including vessel logbooks.

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GROUNDFISH ADVISORY SUBPANEL STATEMENT ON GROUNDFISH BYCATCH PROGRAM ENVIRONMENTAL IMPACT STATEMENT

The Groundfish Advisory Subpanel (GAP) received reports from Mr. Jim Glock and Mr. Marcus Hartley regarding development of the bycatch Environmental Impact Statement (EIS). The GAP applauds both Mr. Glock and Mr. Hartley for the amount of effort they have put into preparing the document.

The GAP believes the EIS is complete enough to go forward for further public review in order to meet the legal time frame. The GAP encourages the Council, when considering the alternatives developed in the document, to ensure the capability exists to mix and match portions of the alternatives. Our fishery is changing rapidly, and additional management measures, which could lead to reduced bycatch, are being developed. The Council needs to have the flexibility to respond to changes in the fishery as they occur.

PFMC
11/06/03

HABITAT COMMITTEE COMMENTS ON GROUNDFISH BYCATCH PROGRAM ENVIRONMENTAL IMPACT STATEMENT

The Habitat Committee (HC) heard a report on the status of the Groundfish Bycatch Environmental Impact Statement (EIS) and reviewed the preliminary alternatives presented in the EIS.

Alternative 5 has the potential to reduce habitat impacts (and bycatch of benthic species) by changing fishers' behavior, reducing effort, encouraging selective fishing techniques, and decreasing the pace of the fishery.

Alternative 6 is similar to Alternative 5, but provides time and area closures. The HC is concerned that, based on the Executive Summary, the Council and public will consider the "large area closures" included in Alternative 6 (page 4-77) to mean only long-term area closures to all fishing. Given the existing wording, the HC is concerned this alternative will be misunderstood. A detailed description of area closures is presented on page 4-20 of this document. Area closures fall along a spectrum from permanent, fully-closed areas to seasonally closed areas or restrictions for certain gear types. These are valuable tools that will not be fully considered if the option is interpreted as meaning permanent, fully-closed areas.

Of these alternatives, Alternative 6 appears to offer the most potential benefit to habitat because it provides the Council a more diverse "toolbox" with which to manage fisheries.

PFMC
11/06/03

Exhibit D.12.b
Supplemental TIQC Report 2
November 2003

summarized by Jim Seger

TABLE 1. Timeline for consideration of an IQ program for the groundfish trawl industry.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003												
Council			Mtg	Mtg		Mtg			Mtg		Mtg Control Date	
TIQC										Mtg		Mtg?
NEPA - Scoping											Notice of Intent to prepare an EIS	
Analysts											Draft Scoping Doc	
2004												
Council			Mtg	Mtg		Mtg			Mtg		Mtg- Adopt Final Set of Alternatives for DEIS	
TIQC	Mtg				Mtg		Mtg			Mtg		Mtg
NEPA - Scoping			Hrg at Cncl Mtg	Hrg at Cncl Mtg		Hrg at Cncl Mtg, End Scoping						
Analysts							Draft Post Scoping Doc				Draft Formal PDEIS	
	-----Monitoring and Tracking Capability Assessment - Ongoing With Reports to TIQC -----											
	-----Initial Allocation Analysis and Discussion Documents for TIQC-----											
2005												
Council			Mtg - Preferred Alternative Adopted	Mtg		Mtg - Final Council Decision			Mtg - Review Draft Regs	Submission to Secy of Commerce	Mtg	
TIQC			Mtg									
NEPA - EIS				DEIS - 4/26			FEIS 7/31					
Analysts	----Draft Formal PDEIS by 2/1-----					----Draft FEIS----						
Agencies										Begin Monitoring System Implementation (Fed and State)		
2006												
Council			Mtg	Mtg		Mtg			Mtg		Mtg	
Agencies	-----Continue Monitoring System Iimplementation (Fed and State)-----											
			ROD signed	Approve/Dis approve	-----Application, Issuance, Appeals -----							
2007												
Council			Mtg	Mtg		Mtg			Mtg		Mtg	
	TIQ Program Begins 01/01/07											

PDEIS = Preliminary draft EIS. DEIS = Draft EIS. FEIS = Final EIS. ROD = record of decision.

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON DEVELOPMENT OF GROUNDFISH TRAWL INDIVIDUAL QUOTA AND CONTROL DATE

The Groundfish Advisory Subpanel (GAP) received a report from Jim Seger regarding the recent meeting of the Council's Ad Hoc Groundfish Trawl Individual Quota Committee (Committee). Overall, the GAP endorses the Committee report which will be presented to the Council.

The GAP does not wish to second-guess the Committee's work, and therefore, will comment only on those items which the Committee is bringing before the Council for action. In regard to proposed changes in the program goal, the GAP supports the recommendation of the Committee. In regard to the structure and timing of the control date, the GAP again endorses the recommendation of the Committee and urges the Council to adopt the Committee's recommendation.

Finally, the GAP encourages the Council and NMFS to continue providing the funding support necessary for the Committee to complete its work in a timely manner.

PFMC
11/06/03

APPLICATION FOR ISSUANCE OF AN EXEMPTED (EXPERIMENTAL) FISHING PERMIT FOR ARROWTOOTH FLOUNDER

A. Date of application: August 19, 2003

B. Applicant's names, mailing addresses, and telephone numbers:

Washington Department of Fish and Wildlife
600 Capitol Way North, Olympia, WA 98501-1091
Contacts: Philip Anderson (360) 902-2720
Brian Culver (360) 249-1205
Michele Robinson (360) 249-1211

C. A statement of the purpose and goals of the experiment for which an EFP is needed, including a general description of the arrangements for the disposition of all species harvested under the EFP.

Pacific Coast groundfish are managed by the Pacific Fishery Management Council under a federal fishery management plan (FMP). The management goals of the FMP are to:

1. Prevent overfishing by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.
2. Maximize the value of the groundfish resource as a whole.
3. Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

The purpose of the experiment is to assist the Pacific Fishery Management Council in achieving the goals of the FMP by collecting bycatch data on overfished stocks to allow for informed management decisions in setting appropriate trip limits to maximize safe harvest levels of healthy stocks.

Specifically, the goals of the experiment are to:

- Measure bycatch rates for canary and other rockfish associated with the arrowtooth flounder fishery through an at-sea observer program,
- Test specific selective flatfish gear off northern Washington, and
- Collect data that could be used to augment the National Marine Fisheries Service groundfish observer program.

With regard to the disposition of the species harvested under the EFP:

- Species caught within current trip limits as published in the Federal Register, may be retained by the vessel.
- Species caught in excess of current trip limits, but permitted within the EFP (i.e., arrowtooth flounder, petrale sole), will be retained by the vessel.
- Rockfish caught in excess of current trip limits, but required to be retained under the EFP, will be sold at fair market value and the revenue will be forfeited to the

state.

D. Valid justification explaining why issuance of an EFP is warranted:

Since 1998, the Pacific Council has initiated rebuilding plans for several species, including canary rockfish and widow rockfish. Critical to these rebuilding plans and to the overall improvement of groundfish management is the need for more and better scientific data. Fishery dependent data that is needed includes amount of total catch and catch location, as well as biological data (e.g., age and sex). There are 82 species covered under the Pacific coast groundfish FMP, and at present, there is little or no biological data on a large number of these species. There is a need for comprehensive, timely and credible data for priority species to aid in the conservation and rebuilding efforts for these stocks. The data collected under this EFP will include total catch (amount and species composition) data, catch location, bycatch data on associated species, and biological data.

Arrowtooth flounder are an extremely important species in Washington groundfish fisheries. The stock is healthy and Washington fishers and processors have worked aggressively to develop strong markets for this species. A large component of the Washington trawl fleet, and at least two major processors, are heavily dependent upon arrowtooth flounder. Fishers targeting arrowtooth are currently constrained by their limit of canary rockfish. The current flatfish trip limit is based upon the assumed bycatch rate of canary rockfish. Fishers who have historically targeted arrowtooth have indicated that under this monthly trip limit, targeting arrowtooth will not be economically feasible. Further, these fishers believe that they can prosecute an arrowtooth fishery with a much lower canary bycatch rate, thereby allowing a higher arrowtooth catch.

This EFP is expected to provide much needed information that can be used to assess bycatch rates in the directed arrowtooth fishery which in turn may be used to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

Without this EFP vessels would not be allowed to fish for arrowtooth flounder and petrale sole the Trawl Rockfish Conservation Area. According to some Washington fishermen, the majority of the arrowtooth flounder catch occurs inside this closed area.

E. A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals.

The applicant of this EFP believes that the information collected during this experiment will have broader significance than the applicant's individual goals by:

- Producing data on the amount and location of canary rockfish bycatch in the arrowtooth flounder fishery, which can be used to set appropriate management

  measures in the future (e.g., trip limits, area closures)
- Providing valuable and accurate data on the catch composition by species of the trawl flatfish fishery off the Washington coast,

- Providing a pilot program for assessing the feasibility of the retention of rockfish overages, and
- Providing a pilot program for experimenting with gear modifications to selectively fish for flatfish.
- Age and sex data may also be collected to aid in future groundfish stock assessments.

These data could allow the Council to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

F. Vessels covered under the EFP:

Fishers covered under the EFP will include those who have historically participated in the targeted arrowtooth fishery off Washington. These fishers must:

- Have a 3-year cumulative total of at least 400,000 lbs of arrowtooth flounder landed into Washington in the following calendar years: 1998, 1999, and 2000,
- Have landed of arrowtooth flounder into Washington in all three consecutive years (1998, 1999, and 2000),
- Have completed and mailed the Washington Department of Fish and Wildlife EFP application form by October 3, 2003, and
- Be a Washington resident and have a valid Washington delivery permit

There are five vessels that meet this criteria; a list of the fishermen (and their designated vessels) that meet these criteria is attached.

G. A description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment:

The targeted species is arrowtooth flounder which would not be subject to a monthly trip limit, but which would be constrained by the measured bycatch allowance of canary rockfish for the flatfish fishery. Fishers are currently allowed 300 lbs per month of canary rockfish with an assumed 16% discard rate (when applied, this equals 348 lbs total). Under the EFP, the bycatch allowance for canary rockfish would be divided as follows:

- Individual vessels would be limited to 275 lbs/month of canary rockfish for tows that are identified as directed arrowtooth tows by the skipper of the vessel (in advance) and all tows within the federal groundfish conservation area (GCA) for trawl. Once the 275 lbs of canary rockfish are caught, and if the vessel has already reached the current <u>small</u> footrope trip limits (see Table 1.) for arrowtooth and petrale sole published in the Federal Register, then the vessel cannot have any directed arrowtooth tows for the rest of the month and cannot retain any more arrowtooth or petrale.

- Once 275 lbs/month of canary rockfish are caught, and if the vessel has **not** reached the current small footrope trip limits (see Table 1.) for arrowtooth and petrale sole published in the Federal Register, then the vessel can continue to conduct directed arrowtooth tows until the current monthly trip limits for arrowtooth and petrale have been reached. Once those trip limits have been reached, the vessel cannot have any directed arrowtooth tows for the rest of the month and cannot retain any more arrowtooth or petrale.

Table 1. Small Footrope Limits

	Mar - Apr	May - June
Dover sole	10,000 lbs/2 mo.	21,000 lbs/2 mo.
Other flatfish	30,000 lbs/2 mo.	50,000 lbs/2 mo.
Petrale sole	Sublimit of other flatfish: 10,000 lbs/2 mo.	Sublimit of other flatfish: 25,000 lbs/2 mo.
Rex sole	Included in other flatfish	Included in other flatfish
Arrowtooth flounder	6,000 lbs/2 mo.	6,000 lbs/2 mo.

- The balance of the canary rockfish would be used to accommodate the bycatch of canary while targeting other groundfish species.

- An individual bycatch cap of 1100 lbs. of canary rockfish will also apply to each vessel. Once this cap has been reached by an individual vessel in directed tows, the vessel will not be allowed to continue to fish under the EFP.

- All tows conducted within the federal rockfish conservation area (RCA) for trawl will be considered "directed" tows.

- For all fishing under the EFP overall bycatch amounts would be as follows:
  Canary rockfish - 2.5 mt
  Darkblotched rockfish - 3.0 mt
  Lingcod - 2.0 mt
  Widow rockfish - 3.0 mt
  POP - 18.0 mt
  Yelloweye rockfish - 0.5 mt

  Once one or more of these bycatch caps has been reached, the EFP will be terminated.

- Petrale sole caught in a directed arrowtooth tow would not be subject to a monthly trip limit.

- Other species could be landed under current trip limit levels and fishers could land up to the current limit of other flatfish in addition to their arrowtooth flounder landings. There is not expected to be any interactions with protected species (e.g., seabirds), ESA-listed species, nor marine mammals.

- Based upon the EFP programs conducted in 2001 and 2002, expected amounts of targeted species taken above trip limits in the arrowtooth EFP are:

Arrowtooth Flounder	- 455 mt
Petrale sole	- 36 mt

In addition, rockfish species taken in directed EFP tows and forfeited to the state as required (above trip limit or non-market size) are anticipated as follows:

Slope rockfish	- 2.3 mt
Shelf rockfish	- 2.7 mt
Yellowtail rockfish	- 3.6 mt
S.spine thornyhead	- 1.8 mt

Fish above trip limits taken in non-EFP tows would be consistent with fishing activities of the fleet at large and will be estimated separately.

General

- Incidental catches of rockfish in excess of the trip limit must be retained.

H. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used:

The EFP will be valid in Pacific Ocean waters adjacent to Washington, outside three miles. Vessels must fish north of Destruction Island for all of their fishing strategies during the months of the EFP. There may be specific areas within the RCA that would be closed to EFP fishing; these areas will be specified in the Washington Department of Fish and Wildlife contracts with the individual vessel owners participating in the EFP.

Approximate time for the experimental fishery is May 1-August 31, 2004.
Total estimated duration of the EFP: This is year 4 of 4 (final year).

Vessels covered by the EFP can use large footrope for directed arrowtooth tows on the slope only. Slope tows must be conducted entirely in depths greater than 120 fathoms. If a vessel uses small footrope while fishing in the RCA, the vessel may still retain and sell up to the higher trip limits for sablefish, Dover sole, arrowtooth, petrale, and other flatfish (large footrope only limits) until the individual monthly or total bycatch cap is reached, or the EFP is terminated, whichever is sooner.

Vessels are allowed to have more than one type of gear onboard (large footrope, small footrope, and midwater gear).

All vessels fishing under the authority of the EFP must:

- Carry a Washington Department of Fish and Wildlife-provided observer or a federal observer onboard all fishing trips. State-sponsored observers must successfully complete an observer training course that prepares them for collecting data with sampling protocols as defined in the NMFS West Coast Groundfish Observer Program manual. In addition, NMFS observer coverage requirements at 50 CFR 660.360 are independent of EFP observer requirements, so vessels that carry state-sponsored observers may also be required to carry a NMFS observer.

- Employ legal trawl gear as defined in current federal regulations. Vessels fishing under the EFP must adhere to gear specifications, including the use of one of the prescribed excluder mechanisms for all directed EFP tows and all tows within the RCA. Specific excluder definitions will be described in the Washington Department of Fish and Wildlife contracts with the individual vessel owners participating in the EFP.

- Land all fish caught under the authority of the EFP into the State of Washington to a processor designated to participate in this program by the Washington Department of Fish and Wildlife. In order for a processor to be able to participate in this program, it must hold a contract with the Washington Department of Fish and Wildlife and abide by the conditions listed in the contract. Failure to abide by the conditions in the contract will result in revocation of the contract by the Director of the Washington Department of Fish and Wildlife.

- Hold a contract with the Washington Department of Fish and Wildlife and abide by the conditions listed in the contract. Failure to abide by the conditions in the contract and/or to follow the provisions in the EFP will result in revocation of the contract by the Director of the Department of Fish and Wildlife. The Director of the Department of Fish and Wildlife may modify the terms of the contract based on the status of the stocks which are caught incidentally in the experimental fishery.

I. The signature of the applicant:

____

Washington Department of Fish and Wildlife

Application for Issuance of an Exempted Fishing Permit to Test a Selective Flatfish Trawl (including Scottish Seine) in an area otherwise closed to fishing, 2004

A. **Date of application:** Draft: August 20, 2003
Final: October 28, 2003

B. **Applicant Contact**

California Department of Fish and Game
350 Harbor Blvd.
Belmont, CA 94002

Contact: Susan Ashcraft (650) 631-6786

C. **Statement of purpose and goals of the experiment, for which an EFP is needed, including a general description of the arrangements for the disposition of all species harvested under the EFP:**

The purpose of the experiment is to determine whether a shelf flatfish fishery can be prosecuted in an otherwise closed area of California waters using modified trawl gear designed to minimize the bycatch of overfished rockfish species. The first year of this study was initiated in California in 2003, and is due to be completed in November 2003. A second year of study is necessary to draw conclusive results to demonstrate its applicability to other geographic regions, including deeper waters in California where bocaccio and other overfished stocks are located.

Pacific Coast groundfish are managed by the Pacific Fishery Management Council (PFMC) under a federal fishery management plan (FMP) for the west coast. The management goals of the FMP are to:

- Prevent overfishing by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.
- Maximize the value of the groundfish resource as a whole.
- Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

The experiment conducted through an EFP will assist the PFMC in achieving the goals set forth in the FMP while collecting bycatch data on overfished stocks and evaluating the effectiveness of specific trawl gear modifications in avoiding bycatch of overfished stocks. In particular, this EFP expands the applicability of equivalent gear tested off the coasts of Oregon and Washington in EFPs during the past two years.

The specific goals of the experiment are:

- To evaluate the effectiveness of modified trawl gear (see Section I below for modified trawl gear specifications) to catch shelf flatfish while minimizing take of overfished rockfish species in all depths.
- To measure bycatch rates of bocaccio and other rockfish species that may be associated with the small footrope trawl shelf flatfish fishery using the modified trawl gear with no depth restrictions through an at-sea observer program.
- To provide fishermen with an incentive to modify their gear by giving them the opportunity to take shelf flatfish in areas that are otherwise closed.

Disposition of the species harvested under the EFP will be as follows:

- Species caught within the normal current trip limits may be retained and sold by the vessel.
- All rockfish caught while targeting shelf flatfish during the EFP must be retained and offloaded. Overages of rockfish must be surrendered and proceeds from these species in excess of trip limits will be forfeited to the State of California.

D. **Valid justification explaining why issuance of an EFP is warranted:**

Since 1998, the PFMC has initiated rebuilding plans for several species, including bocaccio rockfish. Conservation areas have since been established and closed to groundfish fishing in order to prevent harvest of the overfished stocks in multi-species fisheries. Critical to these rebuilding plans and to the overall improvement of groundfish management, is the need for more and better scientific data. There are 82 species covered under the FMP, and at present, there is little or no data on a large number of these species. There is a need for comprehensive, timely, and credible data for priority species to aid in the conservation and rebuilding efforts for these stocks.

The shelf flatfish are an extremely important group of groundfish in the California groundfish fisheries. These stocks are believed to be healthy, and California fishers and processors have worked aggressively to develop strong markets for these species. A component of the California trawl fleet and processors are heavily dependent upon these flatfish.

A depth closure was enacted from July 1 to December 31, 2002 to prohibit landing of all shelf groundfish, including vessels using small footrope trawl gear to target flatfish. An EFP was approved for use in the shelf flatfish trawl fishery during this closed period. Results from the 2002 EFP indicated that the incidental take of bocaccio and other sensitive rockfish species was minimal in depths from 3 miles to 70 fm using conventional flatfish trawl gear.

In 2003, a new EFP was issued to conduct a follow-up fishery experiment in deeper water to 100 fm, where the likelihood of incidental take of bocaccio increases. An important condition added under this EFP was a requirement to use a modified trawl design to determine if bocaccio and other shelf rockfish catch is kept to a minimum using the modified trawl gear. The 2003 EFP is not complete at the time of this application. However, a second year of study is necessary to draw conclusive results to demonstrate its applicability to other geographic regions off the California coast. The 2004 EFP provides for testing the modified trawl gear without any depth restriction.

E. **A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals.**

The applicant of this EFP believes that the information collected during this experiment will have significance, broader than the applicant's individual goals, applicable to fisheries throughout California and the West Coast.

- The experiment will produce data on the amount and location of any bocaccio and other depleted rockfish bycatch in the shelf flatfish fishery using this trawl.

- Results indicating that rockfish bycatch rates are minimized while using this modified trawl could lead to a management tool that allows the Council to maximize sustainable access to healthy shelf flatfish stocks while depleted rockfish stocks are rebuilt.

- This EFP complements an EFP experiment that was conducted off the coast of Oregon in 2003, in slope habitat to avoid catch of overfished darkblotched rockfish, and a previous EFP experiment conducted in 2002 in shelf habitat, to avoid catch of overfished canary rockfish. Additionally, a similar trawl design is being evaluated at the time of this application through an EFP off the coast of Washington, to evaluate the ability of the gear to avoid the take of rockfish associated with the arrowtooth flounder fishery. An experiment off the coast of California in shelf habitat to evaluate ability to avoid overfished bocaccio rockfish was designed to increase validity and applicability of the use of the modified trawl design in other geographic regions.

- A second year of the EFP experiment in California is necessary to evaluate the appropriateness of converting the EFP provisions into regulations for use in California. Regulations, based on the successful EFP results in Oregon and Washington, are being crafted for implementation along the Oregon and part or all of the Washington coast during the 2005-06 Council management cycle. The evaluation of the modified trawl gear in California will determine whether this regulatory provision can be extended to flatfish trawl fishermen off the coast of California.

F. Vessels covered under the EFP:

Vessels covered under the EFP will include those which have historically participated in the targeted shelf flatfish fishery off California according to criteria used in the 2002 and 2003 flatfish EFP:

- Vessels must have landed into California ports at least 10,000 pounds of shelf flatfish (California halibut, Pacific sanddab, English sole, sand and rock sole, starry flounder, and unspecified flatfishes) taken with trawl gear in each of two years during 1998 to 2000.
- Vessels must have a valid California delivery permit.

Vessels identified as qualifiers in the 2003 EFP process will qualify for this pool of applicants.

A letter of inquiry will be sent to the owners of each of the qualifying vessels requesting a statement of interest to be returned by a specified closing date.

A maximum of **six** vessels will be selected to participate throughout the EFP fishing period, with a goal of issuing permits to two vessels per California port group between Pt. Conception and Pt. Mendocino. Potential port complexes are Morro Bay/Avila, Monterey/Moss Landing, and Half Moon Bay/San Francisco/Bodega Bay.

Applications received will be selected at random following the closing date if more vessels apply than can be accommodated by observers.

Any EFP may be canceled and made available to another vessel if the permitted vessel: 1) does not follow the terms and conditions of the permit; 2) fails to follow federal or State fishing regulations; 3) does not prosecute shelf flatfish using small footrope trawl gear as provided in the EFP; or 4) does not reasonable accommodate the observer or cooperate with the applicant.

A permitted vessel may withdraw once from the EFP program and resume participation the following month.

G. **A description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment:**

The target species are collectively referred to as *shelf flatfish* and include California halibut, Pacific sanddab, English sole, rock and sand sole, and unspecified flatfish. The maximum expected catch per vessel for all species will be the normal trip limits in place in Period 4. That allowable trip limit for other flatfish is anticipated to be 70,000 pounds per two months of which no more than 20,000 pounds may be petrale sole. EFP participants will be exempted from any closures or reductions in allowable trip limits during the EFP study period. Trip limits for EFP participants will be increased to match any increases in federal trip limits resulting from in-season adjustments. Note that California halibut is not included in the trip limit and is estimated later in this section. Total harvest of target species for the EFP fishery is anticipated to be the same as in the 2003 EFP and will therefore be:

Species/Species Group	Vessels * no. periods in EFP[1]	Maximum allowable catch (lbs)
Other flatfish	6*2=12	840,000 of which no more than 120,000 is Petrale sole

[1] A maximum of 6 vessels will be operating for the entire EFP period, encompassing 2 periods of cumulative trip limits.

The program requires full retention of rockfish. All rockfish species will be landed to enhance biological sampling and to document the actual rockfish mortality and discard rates, with catch thresholds in place for overfished rockfish species to ensure that take remains below allocated bycatch caps. The EFP thresholds for incidental take of bocaccio, cowcod, canary, and yelloweye rockfish will be applied as follows:

- <u>Monthly per species threshold</u>: An individual vessel will be constrained to a maximum of 100 pounds each of bocaccio, canary, and yelloweye rockfish per fishing month. Additionally, an individual vessel will be constrained to a maximum of 50 pounds of cowcod rockfish per fishing month. If that amount is exceeded for <u>any</u> of the four species, then all fishing by that vessel will be terminated for the balance of the month, but may resume for the following month.

- <u>Monthly cumulative threshold</u>: The cumulative amount of bocaccio, canary, or yelloweye rockfish harvested by all vessels fishing under the EFP must not exceed 500 pounds in a fishing month. Additionally, the cumulative amount of cowcod rockfish must not exceed 100 pounds. If that amount is exceeded for <u>any of the four species</u> by all vessels combined, then all EFP fishing will be terminated for the remainder of the month, but may resume for the following month.

- EFP threshold: The cumulative amount of bocaccio, canary, or yelloweye rockfish harvested by all vessels fishing under the EFP must not exceed 1,000 pounds at any time. Additionally, the cumulative amount of cowcod rockfish must not exceed 250 pounds at any time. If the cumulative EFP threshold amount is exceeded for any of the four species, then all EFP fishing will be terminated for the remainder of the year.

- EFP threshold for lingcod: The maximum amount of total catch that may be taken by all participating vessels fishing under this EFP is 20 mt. If the limit for this species is reached, the EFP will be terminated for the remainder of the year.

Data from the 2003 EFP using modified shelf flatfish trawl gear is not available at the time of this application; the 2003 EFP study will not be completed until November 30, 2003. We have therefore based estimates of expected fishing mortality on estimates included in the 2003 EFP study application, which used bycatch rates from our 2002 EFP experiment, except that estimated take of overfished rockfish species is based on the EFP species thresholds contained in this proposal. Actual bycatch rates of these overfished rockfish species during the 2002 EFP were well below these thresholds, with bycatch rates of 0.01% for bocaccio, 0.02% for cowcod rockfish, and 0% for canary and yelloweye rockfish. Although 2002 NMFS observer data indicates that in waters deeper than 100 fm proposed for access in this study, the probability of bocaccio catch increases significantly when using unmodified conventional flatfish trawl gear, it is anticipated that the use of the selective flatfish trawl during this EFP period will significantly reduce the probable take of overfished rockfish, including bocaccio. However, some bycatch is likely to occur. Therefore, the total estimated fish mortality in metric tons for overfished rockfish species (including overfished rockfish and lingcod) for this EFP is as follows:

Species/Species Group	EFP Threshold (mt)	Total Estimated Catch (mt)
Bocaccio Rockfish	0.5	0.5
Canary Rockfish	0.5	0.5
Cowcod Rockfish	0.2	0.2
Yelloweye Rockfish	0.5	0.5
Lingcod	20.0	20.0

Based on bycatch information from our EFP program in 2002, the following catches would be expected in addition to target flatfish and overfished rockfish species, if the bycatch rates were the same as in 2002:

Species/Species Group	Bycatch Rate[1] (2002)	Expected Bycatch[2] (lbs)
Other Flatfish	2.67	22,455
California Halibut	8.02	67,332
Nearshore Rockfish	0.14	1,183
Shelf Rockfish	2.86	24,042
Lingcod	0.56	4,699
Sablefish	0.44	3,678
Sharks	1.23	10,367
Skates	5.87	49,295
Crab, Dungeness and misc.	7.02	59,000
King Salmon	0.09	774
Green Sturgeon	0.06	465
Misc. Fish[3]	4.74	39,820
Nominal Bycatch Species[4]	0.16	1,334

1 Bycatch is defined as the total landed and discarded pounds of a species relative to the total landed target species group (i.e., the trip limit). An estimate of discarded 'other flatfish' is included in this table as discards of target species may occur due to size, market, etc.

2 There are six vessels that will be operating for the entire 4 months of the EFP, encompassing 2 periods of cumulative trip limits. Expected bycatch is bycatch rate*70,000(2-month trip limit)*6*2.

3 Miscellaneous fish includes white croaker, squid, hake, ratfish, sculpin, and shad, and other misc. fish.

4 Nominal bycatch includes species with *individual bycatch rates* of <0.05% in 2002, and includes the following species: slope rockfish, white seabass, striped bass, cabezon, surfperch, greenlings, midshipman, and surfperch.

H. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place:

- The test fishery will be conducted from September through December 2004.
- The EFP will be valid in those Pacific Ocean waters adjacent to California coastwide deeper than 3 miles. While the allowable depth exceeds the inner boundary for the trawl RCA (up to 100 fm during the proposed study period), the removal of a depth restriction is necessary to test the modified trawl gear in areas with a history of bocaccio catches, and to allow for fishing at depths where target flatfish species may be distributed.

I. All participating vessels under the authority of the EFP:

- Must exclusively employ legal small footrope trawl as defined in current federal regulation, except that modification is required to create a severely cut-back top section, which allows roundfishes to "rise" out of the trawl while flatfish, which remain near the bottom, are captured.

- Must apply and submit a net plan for approval. Net plans must meet specifications utilized by the 2003 Oregon Flatfish EFP, and by the 2003 California Flatfish EFP, which specified that:
  - *"The trawl must have a headrope to footrope ratio of at least 1.30 (i.e., 30% longer footrope).*
  - *The trawl must have a maximum rise of 5 ft at the center of the headrope.*
  - *There must be no floats along the middle 33% of the headrope",* except for Scottish seine, for which there must be no floats along the middle 25% of the headrope.
  - *The headrope must be wide in the center, not a narrow V-shape that creates shoulders that would trap ascending fish.*
- Must carry a National Marine Fisheries Service-trained observer onboard all trips using the selective flatfish net in the NTZ. A total of three observers are necessary to execute the EFP. Vessels participating in the program must share observer time.
- Must land all fish caught under the authority of the EFP into the State of California.
- Must sign a contract with the State of California detailing the vessel's responsibility for the EFP fishery. Failure to abide by the conditions in the contract or to follow provisions in the EFP will result in revocation of the contract and of the EFP for the year.

J. Signature of the applicant:

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California Department of Fish and Game

Exhibit D.13.b
Supplemental ODFW Report 3
November 2003

Summary of Oregon's Discard Reduction EFP for 2004

- Exhibit D.13.b ODFW Report 1 "Reduced discard strategy for the deepwater complex fishery"

- This EFP was presented to the Council at the September meeting.

- The purpose of this EFP is to test a discard reduction strategy in the DTS fishery using processor-vessel agreements to create economic incentives to reduce the discard of marketable DTS species and promote higher economic efficiency for the fishery.

- The only addition to the September proposal is the addition of overall bycatch caps, requested by the GMT, for Pacific Ocean perch (11.8 mt), and darkblotched rockfish (15.8 mt).

- This small-scale test will occur during the March-April and May -June periods, and involve only three vessels in Oregon. The EFP is designed only to test the feasibility of the economic structure at this point.

Notes:

- This fishery occurs outside of 200 ftm, no access to RCA is necessary. Darkblotched bycatch should be minimal.
- The EFP lasts only 2 periods, with monthly review, so it involves little risk of catching too much of any overfished species.
- Vessels will be operated under the same trip limits, but retain marketable discard.
- EFP vessels will carry federal observers.
- Includes full retention for all *Sebastes* species.
- Bycatch cap estimation:

  To estimate potential bycatch of overfished species associated with this EFP, we used the current trip limits plus expected discard. Bycatch of overfished species in the DTS fishery outside of 200 fm is limited to Pacific ocean perch and darkblotched rockfish.

  For Pacific ocean perch, trip limits plus an assumed 16% discard totals results in 1,740 pounds per month per vessel. For darkblotched rockfish, a limit of 1,000 lbs per month plus discard, or 2,320 pounds per vessel per month. To account for any unexpectedly high catches, we added 25% to the normal fishery catch to create an overall EFP cap. This amount multiplied for 3 vessels over four months resulted in 26,100 pounds of Pacific Ocean perch and 34,800 pounds of darkblotched rockfish.

APPLICATION FOR ISSUANCE OF AN EXEMPTED (EXPERIMENTAL) FISHING PERMIT FOR SPINY DOGFISH

A. Date of application: August 19, 2003

B. Applicant's names, mailing addresses, and telephone numbers:

Washington Department of Fish and Wildlife
600 Capitol Way North, Olympia, WA 98501-1091
Contacts: Philip Anderson (360) 902-2720
Brian Culver (360) 249-1205
Michele Robinson (360) 249-1211

C. A statement of the purpose and goals of the experiment for which an EFP is needed, including a general description of the arrangements for the disposition of all species harvested under the EFP.

Pacific Coast groundfish are managed by the Pacific Fishery Management Council under a federal fishery management plan (FMP). The management goals of the FMP are to:

1. Prevent overfishing by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.
2. Maximize the value of the groundfish resource as a whole.
3. Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

The purpose of the experiment is to assist the Pacific Fishery Management Council in achieving the goals of the FMP by collecting bycatch data on overfished stocks to allow for informed management decisions in setting appropriate trip limits to maximize safe harvest levels of healthy stocks.

Specifically, the goals of the experiment are to:

- Measure bycatch rates for canary, yelloweye and other rockfish associated with the longline dogfish fishery through an at-sea observer program, and
- Collect data that could be used to augment the National Marine Fisheries Service groundfish observer program.

With regard to the disposition of the species harvested under the EFP:

- Species caught within current trip limits, as published in the Federal Register, may be retained by the vessel.
- Groundfish caught in excess of current trip limits, but required to be retained under the EFP, will be sold at fair market value and the revenue will be forfeited to the state

D. Valid justification explaining why issuance of an EFP is warranted:

Since 1998, the PFMC has initiated rebuilding plans for several species including canary and yelloweye rockfish. Critical to these rebuilding plans and to the overall improvement of the ground fish management, is the need for more and better scientific data. Fishery dependent data that is needed includes amount of total catch and catch location, as well as biological data (e.g., age and sex). There are 82 species covered under the Pacific Coast groundfish FMP, and at present, there is little or no biological data on a large number of these species. There is a need for comprehensive, timely and credible data for priority species to aid in the conservation and rebuilding efforts for these stocks. The data collected under this EFP will include total catch (amount and species composition) data, catch location, bycatch data on associated species, and biological data.

Spiny dogfish is an extremely important species in Washington groundfish fisheries. The stock is healthy, and Washington fishermen and processors have worked aggressively to develop and maintain strong markets for this species. A number of Washington groundfish longline fishers and at least one major processor are heavily dependent upon spiny dogfish. Fishermen targeting dogfish are currently constrained by their limit of yelloweye and canary rockfish. In 2002, dogfish were prohibited for fixed gear due to the associated bycatch of yelloweye rockfish. Fishermen who have historically targeted dogfish have indicated that under without a bycatch allowance of yelloweye and canary rockfish, the dogfish fishery cannot be pursued. Further, these fishermen believe that they can pursue a dogfish fishery with a much lower yelloweye and canary bycatch rate than data indicates, thereby allowing a dogfish fishery to continue. This EFP is expected to provide much needed information that can be used to assess bycatch rates in the directed dogfish fishery which in turn may be used to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

Without this EFP vessels would not be allowed to fish for dogfish and other groundfish within the Non-Trawl Groundfish Conservation Area (< 100 fms north of 40°10'N latitude). According to some Washington longline dogfish fishermen, the majority of the dogfish catch occurs inside this closed area.

E. A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals.

The applicant of this EFP believes that the information collected during this experiment will have broader significance than the applicant's individual goals by:

- Producing data on the amount and location of rockfish bycatch in the longline dogfish fishery; which can be used to set appropriate management measures in the future (e.g., trip limits, area closures)
- Providing valuable and accurate data on the catch composition by species in the longline dogfish fishery off the Washington coast, and
- Providing a pilot program for assessing the feasibility of the retention of groundfish overages.

- Age and sex data may also be collected to aid in future groundfish stock assessments

These data could allow the Council to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

F. Vessels covered under the EFP:

Fishers covered under the EFP will include those who have historically participated in the targeted arrowtooth fishery off Washington. These fishers must:

- Have a 3-year cumulative total of at least 300,000 lbs of spiny dogfish landed into Washington in the following calendar years: 2000, 2001, and 2002 with longline gear,
- Have landed spiny dogfish with longline gear into Washington in all three consecutive years (2000, 2001, and 2002),
- Have completed and mailed the Washington Department of Fish and Wildlife EFP application form by October 3, 2003, and
- Be a Washington resident and have a valid Washington delivery permit

There is one vessel that meets this criteria; the name of the fisherman (and his designated vessel) that meets these criteria is attached.

G. A description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment:

The targeted species is spiny dogfish which would not be subject to a monthly trip limit, but which would be constrained by the measured bycatch allowance of canary and yelloweye rockfish. Under the EFP, the bycatch allowances for canary and yelloweye rockfish would be divided as follows:

- Individual vessels would be limited to 220 lbs of canary rockfish and 275 lbs/month of yelloweye rockfish for sets within the federal rockfish conservation area (RCA) for longline (< 100 fms north of 40°10'). Once the 275 lbs of yelloweye rockfish are caught, the vessel cannot fish in the RCA for the rest of the month. Once the 220 lbs of canary rockfish are caught, the vessel can no longer participate in the EFP.

- For all fishing under the EFP overall bycatch amounts would be as follows:
  Canary rockfish - 0.1 mt
  Yelloweye rockfish - 0.5 mt
  Widow rockfish - 0.4 mt
  Darkblotched rockfish - 0.5 mt
  Pacific ocean perch - 0.5 mt
  Lingcod - 2.0 mt
  Once one or more of these bycatch caps has been reached, the EFP will be

terminated.

- Other species could be landed under current trip limit levels, however, it is not anticipated that the participating vessels will fish for groundfish other than dogfish for the duration of the EFP. There is not expected to be any interactions with protected species (e.g., seabirds), ESA-listed species, nor marine mammals.

- Expected amounts of targeted species taken in the dogfish EFP are:
  Spiny dogfish - 300 mt

Fish above trip limits taken in non-EFP sets would be consistent with fishing activities of the fleet at large and will be estimated separately.

General
- Incidental catches of all groundfish in excess of the trip limit must be retained.

H. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used:

The EFP will be valid in Pacific Ocean waters adjacent to Washington, outside three miles. Vessels must fish north of 46°16'00" north latitude for all of their fishing strategies during the months of the EFP. There may be specific areas within the RCA that would be closed to EFP fishing; these areas will be specified in the Washington Department of Fish and Wildlife contract with the individual vessel owner participating in the EFP.

Approximate time for the experimental fishery is February 1-May 31, 2004.
Total estimated duration of the EFP: This is year 2 of 2 (final year).

All vessels fishing under the authority of the EFP must:

- Carry a Washington Department of Fish and Wildlife-provided observer or a federal observer onboard all fishing trips. State-sponsored observers must successfully complete an observer training course that prepares them for collecting data with sampling protocols as defined in the NMFS West Coast Groundfish Observer Program manual. In addition, NMFS observer coverage requirements at 50 CFR 660.360 are independent of EFP observer requirements, so vessels that carry state-sponsored observers may also be required to carry a NMFS observer.

- Employ legal longline gear as defined in current federal regulations.

- Land all fish caught under the authority of the EFP into the State of Washington to a processor designated to participate in this program by the Washington Department of Fish and Wildlife. In order for a processor to be able to participate in this program, it must hold a contract with the Washington Department of Fish and Wildlife and abide by the conditions listed in the contract. Failure to abide by the conditions in the contract will result in revocation of the contract by the Director of the Washington Department of Fish and Wildlife.

- Hold a contract with the Washington Department of Fish and Wildlife and abide by the conditions listed in the contract. Failure to abide by the conditions in the contract and/or to follow the provisions in the EFP will result in revocation of the contract by the Director of the Department of Fish and Wildlife. The Director of the Department of Fish and Wildlife may modify the terms of the contract based on the status of the stocks which are caught incidentally in the experimental fishery.

I. The signature of the applicant:

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Washington Department of Fish and Wildlife

APPLICATION FOR ISSUANCE OF AN EXEMPTED (EXPERIMENTAL) FISHING PERMIT FOR NEARSHORE FLATFISH

A. Date of application: August 19, 2003

B. Applicant's names, mailing addresses, and telephone numbers:

Washington Department of Fish and Wildlife
600 Capitol Way North, Olympia, WA 98501-1091
Contacts: Philip Anderson (360) 902-2720
Brian Culver (360) 249-1205
Michele Robinson (360) 249-1211

C. A statement of the purpose and goals of the experiment for which an EFP is needed, including a general description of the arrangements for the disposition of all species harvested under the EFP.

Pacific Coast groundfish are managed by the Pacific Fishery Management Council under a federal fishery management plan (FMP). The management goals of the FMP are to:

1. Prevent overfishing by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.
2. Maximize the value of the groundfish resource as a whole.
3. Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

The purpose of the experiment is to assist the Pacific Fishery Management Council in achieving the goals of the FMP by collecting bycatch data on overfished stocks to allow for informed management decisions in setting appropriate trip limits to maximize safe harvest levels of healthy stocks.

Specifically, the goals of the experiment are to:

- Measure bycatch rates for canary and other rockfish associated with the nearshore flatfish fishery through an at-sea observer program,
- Test selective flatfish gear off northern Washington in nearshore areas (< 150 fms), and
- Collect data that could be used to augment the National Marine Fisheries Service groundfish observer program.

With regard to the disposition of the species harvested under the EFP:
- Species caught within current trip limits as published in the Federal Register, may be retained by the vessel.
- Species caught in excess of current trip limits, but permitted within the EFP (i.e., English, rex, and Dover sole), will be retained by the vessel.
- Rockfish caught in excess of current trip limits, but required to be retained under

the EFP, will be sold at fair market value and the revenue will be forfeited to the state.

- Valid justification explaining why issuance of an EFP is warranted:

  Since 1998, the Pacific Council has initiated rebuilding plans for several species, including canary rockfish and widow rockfish. Critical to these rebuilding plans and to the overall improvement of groundfish management is the need for more and better scientific data. Fishery dependent data that is needed includes amount of total catch and catch location, as well as biological data (e.g., age and sex). There are 82 species covered under the Pacific coast groundfish FMP, and at present, there is little or no biological data on a large number of these species. There is a need for comprehensive, timely and credible data for priority species to aid in the conservation and rebuilding efforts for these stocks. The data collected under this EFP will include total catch (amount and species composition) data, catch location, bycatch data on associated species, and biological data.

  Nearshore flatfish are an extremely important species in Washington groundfish fisheries. The stocks are healthy and Washington fishers and processors have worked aggressively to develop strong markets for these species. A large component of the Washington trawl fleet, and at least two major processors, are heavily dependent upon nearshore flatfish. Fishers targeting nearshore flatfish are currently constrained by their limit of canary rockfish. The current flatfish trip limit is based upon the assumed bycatch rate of canary rockfish. Fishers who have historically targeted flatfish have indicated that under this monthly trip limit, targeting flatfish will not be economically feasible. Further, these fishers believe that they can prosecute a nearshore flatfish fishery with a much lower canary bycatch rate, thereby allowing a higher flatfish catch.

  This EFP is expected to provide much needed information that can be used to assess bycatch rates in the directed nearshore flatfish fishery which in turn may be used to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

- A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals.

  The applicant of this EFP believes that the information collected during this experiment will have broader significance than the applicant's individual goals by:
  - Producing data on the amount and location of canary rockfish bycatch in the nearshore flatfish fishery, which can be used to set appropriate management measures in the future (e.g., trip limits, area closures)
  - Providing valuable and accurate data on the catch composition by species of the trawl flatfish fishery off the Washington coast,
  - Providing a pilot program for assessing the feasibility of the retention of rockfish overages, and
  - Providing a pilot program for experimenting with gear modifications to selectively fish for flatfish.

- Age and sex data may also be collected to aid in future groundfish stock assessments.

These data could allow the Council to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

F. Vessels covered under the EFP:

Fishers covered under the EFP will include those who have historically participated in the targeted nearshore flatfish fishery off Washington. These fishers must:

- Have completed and mailed the Washington Department of Fish and Wildlife EFP application form by October 3, 2003, and
- Be a Washington resident and have a valid Washington delivery permit

There are three fishermen who meet this criteria; a list of the fishermen (and their designated vessels) is attached.

G. A description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment:

The targeted species is nearshore flatfish which would be subject to the large footrope-only trip limits, as specified in Table 1.

Table 1. Large Footrope-Only Limits

	Mar - Apr	May - June
Dover sole	45,000 lbs/2 mo.	21,000 lbs/2 mo.
Other flatfish	100,000 lbs/2 mo.	100,000 lbs/2 mo.
Petrale sole	100,000 lbs/2 mo.	100,000 lbs/2 mo.
Rex sole	Included in other flatfish	Included in other flatfish
Arrowtooth flounder	150,000 lbs/2 mo.	150,000 lbs/2 mo.

Under the EFP, the bycatch allowance for canary rockfish would be divided as follows:

- Individual vessels would be limited to 180 lbs/month of canary rockfish for tows that are identified as directed nearshore flatfish tows by the skipper of the vessel (in advance) and all tows within the federal rockfish conservation area (RCA) for trawl. Once the 180 lbs of canary rockfish are caught, and if the vessel has already reached the current <u>small</u> footrope trip limits (see Table 2.) for nearshore flatfish species published in the Federal Register, then the vessel cannot have any directed nearshore flatfish tows for the rest of the month and cannot retain any more nearshore flatfish.

- Once 180 lbs/month of canary rockfish are caught, and if the vessel has **not** reached the current small footrope trip limits (see Table 2.) for nearshore flatfish published in the Federal Register, then the vessel can continue to conduct directed nearshore flatfish tows until the current monthly trip limits for nearshore flatfish have been reached. Once those trip limits have been reached, the vessel cannot have any directed nearshore flatfish tows for the rest of the month and cannot retain any more nearshore flatfish.

Table 2. Small Footrope Limits

	Mar - Apr	May - June
Dover sole	10,000 lbs/2 mo.	21,000 lbs/2 mo.
Other flatfish	30,000 lbs/2 mo.	50,000 lbs/2 mo.
Petrale sole	Sublimit of other flatfish: 10,000 lbs/2 mo.	Sublimit of other flatfish: 25,000 lbs/2 mo.
Rex sole	Included in other flatfish	Included in other flatfish
Arrowtooth flounder	6,000 lbs/2 mo.	6,000 lbs/2 mo.

- The balance of the canary rockfish would be used to accommodate the bycatch of canary while targeting other groundfish species.

- An individual bycatch cap of 700 lbs. of canary rockfish will also apply to each vessel. Once this cap has been reached by an individual vessel in directed tows, the vessel will not be allowed to continue to fish under the EFP.

- All tows conducted within the federal rockfish conservation area (RCA) for trawl will be considered "directed" tows.

- For all fishing under the EFP overall bycatch amounts would be as follows:
  Canary rockfish - 1.0 mt
  Widow rockfish - 1.0 mt
  Yelloweye rockfish - 0.1 mt

  Once one or more of these bycatch caps has been reached, the EFP will be terminated.

- Other species could be landed under current trip limit levels. There is not expected to be any interactions with protected species (e.g., seabirds), ESA-listed species, nor marine mammals.

- In addition, rockfish species taken in directed EFP tows and forfeited to the state as required (above trip limit or non-market size) are anticipated as follows:
  Slope rockfish - 0

Shelf rockfish	- 1.0 mt
Yellowtail rockfish	- 3.0 mt
S.spine thornyhead	- 0 mt

Fish above trip limits taken in non-EFP tows would be consistent with fishing activities of the fleet at large and will be estimated separately.

General

- Incidental catches of rockfish in excess of the trip limit must be retained.

H. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used:

The EFP will be valid in Pacific Ocean waters adjacent to Washington, outside three miles. Vessels must fish north of Destruction Island and in waters shallower than 150 fms for all of their fishing strategies during the months of the EFP.

Approximate time for the experimental fishery is March 1-June 30, 2004.
Total estimated duration of the EFP: This is year 1 of 2.

Vessels covered by the EFP must use small footrope for directed nearshore flatfish tows and while fishing in the RCA. However, under the EFP, the vessel may still retain and sell up to the higher trip limits for sablefish, Dover sole, arrowtooth, petrale, and other flatfish (large footrope only limits) until the individual monthly or total bycatch cap is reached, or the EFP is terminated, whichever is sooner.

All vessels fishing under the authority of the EFP must:

- Carry a Washington Department of Fish and Wildlife-provided observer or a federal observer onboard all fishing trips. State-sponsored observers must successfully complete an observer training course that prepares them for collecting data with sampling protocols as defined in the NMFS West Coast Groundfish Observer Program manual. In addition, NMFS observer coverage requirements at 50 CFR 660.360 are independent of EFP observer requirements, so vessels that carry state-sponsored observers may also be required to carry a NMFS observer.

- Employ legal trawl gear as defined in current federal regulations. Vessels fishing under the EFP must adhere to the following gear restrictions to be consistent with the Oregon and California Selective Flatfish EFPs:
    1) Trawl must have a headrope to footrope ration of at least 1.30 (i.e., 30% longer footrope)
    2) No floats along middle 33% of the headrope

- Land all fish caught under the authority of the EFP into the State of Washington to a processor designated to participate in this program by the Washington Department of Fish and Wildlife. In order for a processor to be able to participate in this program, it must hold a contract with the Washington Department of Fish and Wildlife and abide by the conditions listed in the contract. Failure to abide by the conditions in the contract will result in revocation of the contract by the Director of the Washington Department of Fish and Wildlife.

- Hold a contract with the Washington Department of Fish and Wildlife and abide by the conditions listed in the contract. Failure to abide by the conditions in the contract and/or to follow the provisions in the EFP will result in revocation of the contract by the Director of the Department of Fish and Wildlife. The Director of the Department of Fish and Wildlife may modify the terms of the contract based on the status of the stocks which are caught incidentally in the experimental fishery.

I. The signature of the applicant:

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Washington Department of Fish and Wildlife

APPLICATION FOR ISSUANCE OF AN EXEMPTED (EXPERIMENTAL) FISHING PERMIT FOR POLLOCK

A. Date of application: August 19, 2003

B. Applicant's names, mailing addresses, and telephone numbers:

Washington Department of Fish and Wildlife
600 Capitol Way North, Olympia, WA 98501-1091
Contacts: Philip Anderson (360) 902-2720
Brian Culver (360) 249-1205
Michele Robinson (360) 249-1211

C. A statement of the purpose and goals of the experiment for which an EFP is needed, including a general description of the arrangements for the disposition of all species harvested under the EFP.

Pollock are not part of the Pacific Fishery Management Council's groundfish fishery management plan (FMP); however, the State of Washington plans to pursue including pollock in the FMP in the near future. In the interim, the purpose of the experiment is to assist the Pacific Fishery Management Council and the State of Washington in achieving the goals of the FMP which are to:

1. Prevent overfishing by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.
2. Maximize the value of the groundfish resource as a whole.
3. Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

by collecting bycatch data on overfished stocks and other species of fish to allow for informed management decisions in setting appropriate trip limits to maximize safe harvest levels of healthy stocks.

Specifically, the goals of the experiment are to:

- Measure bycatch rates for rockfish, whiting, and prohibited species associated with the midwater trawl pollock fishery through an at-sea observer program, and
- To allow participating fishers to land unsorted groundfish catches.

With regard to the disposition of the species harvested under the EFP:

- Species caught within current trip limits as published in the Federal Register, may be retained by the vessel.
- Groundfish caught in excess of current trip limits, but required to be retained under the EFP, will be sold at fair market value and the revenue will be forfeited to the state.

D. Valid justification explaining why issuance of an EFP is warranted:

In July 2002, there were three midwater trawl vessels who participated in the coastal whiting fishery that discovered harvestable quantities of pollock off the northern coast of Washington. This stock is primarily located off the West Coast of Vancouver Island, and occasionally moves south to be available off Washington approximately every five to seven years. The length of time that they are available south of the U.S./Canada border is unknown.

The nature of the midwater pollock fishery is similar to the whiting fishery in that sorting catches at sea is difficult, at best. While fishers are targeting pollock (state managed species), there are encounters with non-target species, such as yellowtail rockfish and whiting (federally managed species). One of the primary problems associated with these incidental catches is that the federal species are, at times, either prohibited or subject to a trip limit. Because the nature of the fishery makes it difficult to comply with these federal regulations, the Washington Department of Fish and Wildlife adopted an emergency regulation in September 2002 to close the state pollock fishery. Therefore, while the pollock resource is available off the Washington coast, fishers are not able to target them and economically profit from the opportunity.

Additionally, the State of Washington is pursuing adding pollock to the list of management unit species under the West Coast groundfish fishery management plan. If this occurs over the long-term, then the EFP would have allowed us to collect much-needed bycatch data on this fishery prior to it becoming federally managed. Fishery dependent data that is needed includes amount of total catch and catch location, as well as biological data (e.g., age and sex). The data collected under this EFP will include total catch (amount and species composition) data, catch location, bycatch data on associated species, and biological data. These data can then be used to assess bycatch rates in the directed pollock fishery which in turn may be used to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

Without this EFP vessels would not be allowed to fish for pollock, as the sorting requirements would not be feasible.

E. A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals.

The applicant of this EFP believes that the information collected during this experiment will have broader significance than the applicant's individual goals by:

- Producing data on the amount and location of rockfish and whiting bycatch in the midwater trawl pollock fishery, which can be used to set appropriate management measures in the future (e.g., trip limits, area closures)
- Providing valuable and accurate data catch composition by species of the midwater trawl pollock fishery off the Washington coast, and
- Provide a pilot program for assessing the feasibility of the retention of groundfish overages.

- Age and sex data may also be collected to aid in future groundfish stock assessments.

These data could allow the Council to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

F. Vessels covered under the EFP:

Fishers covered under the EFP will include those who have historically participated in the targeted pollock fishery off Washington. These fishers must:

- Have landed pollock from directed midwater trips into Washington in 2002;
- Have completed and mailed the Washington Department of Fish and Wildlife EFP application form by October 3, 2003, and
- Have a valid Washington delivery permit

There are three vessels that meet this criteria. A list of the fishers (and their designated vessels) that meet these criteria is attached.

G. A description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment:

The targeted species is pollock which would not be subject to a monthly trip limit, but which would be constrained by the measured bycatch allowance of canary and widow rockfish. Under the EFP, the bycatch allowances for canary and widow rockfish would be divided as follows:

- Individual vessels would be limited to 500 lbs/month of widow rockfish for tows that are identified as directed pollock tows by the skipper of the vessel (in advance) and all tows within the federal rockfish conservation area (RCA) for trawl. Once the 500 lbs of widow rockfish are caught, the vessel cannot have any directed pollock tows for the rest of the month.

- An individual bycatch cap of 200 lbs. of canary rockfish will also apply to each vessel. Once this cap has been reached by an individual vessel in directed tows, the vessel will not be allowed to continue to fish under the EFP.

- All tows conducted within the federal RCA for trawl will be considered "directed" tows.

- For all fishing under the EFP overall bycatch amounts would be as follows:
  Canary rockfish - 0.1 mt
  Widow rockfish - 3.0 mt
  Yelloweye rockfish - 0.1 mt
  Pacific whiting - 1,000 mt

Once one or more of these bycatch caps has been reached, the EFP will be terminated.

- Expected amounts of targeted species taken in the pollock EFP are:
  Pollock - 9,000 mt

  In addition, rockfish species taken in directed EFP tows and forfeited to the state as required (above trip limit or non-market size) are anticipated as follows:
  Yellowtail rockfish - 5.0 mt

  Fish above trip limits taken in non-EFP tows would be consistent with fishing activities of the fleet at large and will be estimated separately.

  - Other species could be landed under current trip limit levels; however, it is not anticipated that the participating vessels will fish for groundfish other than pollock for the duration of the EFP. There is not expected to be any interactions with protected species (e.g., seabirds), ESA-listed species, nor marine mammals.

  General
  - Incidental catches of all groundfish (except spiny dogfish) in excess of the trip limit must be retained.

H. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used:

The EFP will be valid in Pacific Ocean waters adjacent to Washington, outside three miles. Vessels must fish north of 46°16'00" north latitude for all of their fishing strategies during the months of the EFP.

Approximate time for the experimental fishery is August 1-October 31, 2004. Total estimated duration of the EFP: This is year 2 of 2 (final year).

All vessels fishing under the authority of the EFP must:

- Carry a Washington Department of Fish and Wildlife-provided observer or a federal observer onboard all fishing trips. State-sponsored observers must successfully complete an observer training course that prepares them for collecting data with sampling protocols as defined in the NMFS West Coast Groundfish Observer Program manual. In addition, NMFS observer coverage requirements at 50 CFR 660.360 are independent of EFP observer requirements, so vessels that carry state-sponsored observers may also be required to carry a NMFS observer.

- Employ legal midwater trawl gear as defined in current federal regulations.

- Land all fish caught under the authority of the EFP into the State of Washington to a processor designated to participate in this program by the Washington

Department of Fish and Wildlife. In order for a processor to be able to participate in this program, it must hold a contract with the Washington Department of Fish and Wildlife and abide by the conditions listed in the contract. Failure to abide by the conditions in the contract will result in revocation of the contract by the Director of the Washington Department of Fish and Wildlife.

- Hold a contract with the Washington Department of Fish and Wildlife and abide by the conditions listed in the contract. Failure to abide by the conditions in the contract and/or to follow the provisions in the EFP will result in revocation of the contract by the Director of the Department of Fish and Wildlife. The Director of the Department of Fish and Wildlife may modify the terms of the contract based on the status of the stocks which are caught incidentally in the experimental fishery.

I. The signature of the applicant:

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Washington Department of Fish and Wildlife

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON FINAL APPROVAL OF EXEMPTED FISHING PERMITS FOR 2004

The Groundfish Advisory Subpanel (GAP) reviewed three exempted fishing permits (EFPs) that were made available to it and briefly discussed two others that have been received by the Groundfish Management Team, but not provided to the GAP.

Since the GAP has reviewed all of these EFPs in preliminary form and any suggested changes have been made, the GAP believes they should be approved. However, given the potential effects of buyback on participation in EFP fisheries next year, the GAP wishes to make clear that the potential "release" of bycatch species must be considered at all of next year's Council meetings.

PFMC
11/06/03

Scoping Session
Amendment 16-3 to the Groundfish Fishery Management Plan:
Rebuilding Plans for Bocaccio, Cowcod, Widow Rockfish, and Yelloweye Rockfish
Hilton Hotel - San Diego Del Mar
Boardroom 1100
15575 Jimmy Durante Blvd.
Del Mar, CA 92014
(858) 792-5200
November 2, 2003

SUNDAY, NOVEMBER 2, 2003 - 3 P.M.-5 PM

Attendance:

Commercial fishing	1
Recreational fishing	5
Government agency	1
Conservation org.	1
Other	2
Total	10

Comments

- In the past, a $F_{20\%}$ harvest rate was used, which was reviewed, and worked well; but the unexpected shift in environmental regime, combined with continued management at this rate, is what caused overfishing problems.

- The environmental impact statement (EIS) should discuss and recognize the controversy surrounding stock assessment results.

- Ideally the Council should develop a programmatic ecosystem EIS. In this EIS, the cumulative effects analysis bring in other factors in a similar way. Such an analysis would include evaluation of coastal impacts such as development and pollution. Definitely recognize outcomes of bycatch Programmatic EIS and essential fish habitat EIS and how they might affect rebuilding.

- Considering habitat is especially important in rebuilding overfished species.

- Look at social values from a range of maximizing amount of cheap fish extracted to not having any fishing and relying only on non-consumptive values of the resource.

- In the scoping information document the discussion of fishing communities is inaccurate in stating that there are alternatives to recreational groundfish. Because recreational fishers show a strong preference for a particular type of fish (e.g., groundfish versus salmon) they will not necessarily switch if fishing opportunity on one type is eliminated. Also, there may be restrictions on other stocks that limit fishing. This affects both private and commercial passenger fishing vessels.

- There are people that "live and die by the rockfish" and will not be replaced. People focus on a particular group of fish by preference.

- There needs to be a strong monitoring component in the rebuilding plans. If the Council commits to rebuilding plans, they should also commit to making them work.

- How will rebuilding plans take into account that catch rates will increase as the stock increases?

- As stocks increase, the harvest increases will occur outside of the Rockfish Conservation Area (RCA). Retention of overfished species caught in areas outside the RCA should be allowed in the future. This is the spillover effect in action. The fish inside the RCA will continue to be protected.

- As stocks increase there is tradeoff in terms of management measures. Either the size of RCAs can be reduced, or retention of overfished species should be allowed.

- There has to be a provision in the rebuilding plan that, as an overfished stock gets above a certain level, they can be caught and retained.

- Scientists and fishermen should work collaboratively to do research to develop better methods for bycatch reduction.

- The EIS should look at the historical aspect of how these stocks came to be overfished. Can we learn anything from these rebuilding plans to determine better ways to manage the fishery?

- An analysis should be done of the effect of making the RCA a permanent marine protected area. The analysis should evaluate how to approach management in this way.

- At the least, there should be a discussion in the EIS about different management policies. For example, evaluate full retention or how catches should be treated to reduce bycatch.

PFMC
11/06/03

Exhibit D.14.b
Supplemental GAP Report
November 2003

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON GROUNDFISH FISHERY MANAGEMENT PLAN AMENDMENT 16-3: REBUILDING PLANS FOR BOCACCIO, COWCOD, AND WIDOW AND YELLOWEYE ROCKFISH

The Groundfish Advisory Subpanel (GAP) reviewed the range of alternatives identified for fishery management plan Amendment 16-3 and provides the following comments.

In regard to the range of rebuilding alternatives which need to be analyzed, the GAP agrees that for bocaccio rockfish, yelloweye rockfish, and widow rockfish only those alternatives in the range of $P_{60\%}$ to $P_{90\%}$ need be analyzed, as lower and higher rebuilding probabilities are unlikely to be adopted. This is consistent with GAP rebuilding recommendations for other species. In the case of cowcod, the GAP recommends that an additional alternative - $P_{55\%}$, the Council Interim - also be analyzed, due to lack of data on other alternatives.

In regard to mixed stock analysis, the majority of the GAP believes such an analysis is appropriate for yelloweye rockfish, bocaccio rockfish, and widow rockfish. All three of these species are harvested in close association with other species, and restrictions on their harvest have seriously curtailed the ability to achieve optimum yield for other more abundant species.

A minority of the GAP believes that a mixed stock exception is inappropriate, and precaution demands we maintain necessary harvest restrictions on these species in order to rebuild them.

PFMC
11/06/03

Exhibit D.14.b
Supplemental HC Report
November 2003

HABITAT COMMITTEE COMMENTS ON GROUNDFISH FISHERY MANAGEMENT PLAN AMENDMENT 16-3: REBUILDING PLANS FOR BOCACCIO, COWCOD, AND WIDOW AND YELLOWEYE ROCKFISH

The Habitat Committee (HC) notes that Amendment 16-3 should include a discussion of protecting habitat important to the early life history stages of rockfishes because the early life history stages are when most rockfish mortality occurs. Habitat protection at this stage may be an effective tool for rebuilding.

In addition, the rebuilding plans should be flexible enough to include management measures related to habitat areas of particular concern and other information that becomes available through the Essential Fish Habitat Environmental Impact Statement process.

PFMC
11/06/03

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON OPEN ACCESS LIMITATION DISCUSSION AND PLANNING

The Groundfish Advisory Subpanel (GAP) discussed future Council action on limiting participation in the open access sector of the groundfish fishery.

There is consensus among the GAP that this should not be a high priority issue, but there is no consensus on where in the Council's workload range it should fall. There is a sense of urgency in the fishery south of Pt. Conception that participation limits need to be established as soon as possible. Representatives from other areas of the coast suggested that immediate action be left to the states or that Council action be deferred until after other high priority items - such as improving stock assessments and data - are completed.

In regard to a possible control date, there was again a range of opinions among GAP members. Some felt the November 1999 control date remain in effect; others suggested that participation has changed substantially in the last four years and that a new control date is warranted. There was agreement that if the Council decided to establish a new control date, it should be done immediately so that effort increases were not encouraged.

Finally, the GAP agreed that - if feasible based on resources available and workload priorities - the Council should reconvene the Ad Hoc Open Access Subcommittee and ask it to develop a means of identifying dedicated open access fishermen.

PFMC
11/06/03