1.0 INTRODUCTION

1.1 How This Document is Organized

This document provides background information about, and analysis of, harvest specifications and management measures for fisheries covered by the Pacific Coast Groundfish Fishery Management Plan (Groundfish FMP) and developed by the Pacific Fishery Management Council (hereafter, the Council). These measures must conform to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the principal legal basis for fishery management within the Exclusive Economic Zone (EEZ), which extends from the outer boundary of the territorial sea to a distance of 200 miles from shore. In addition to addressing Magnuson-Stevens Act mandates, this document is organized so it contains the analyses required under the National Environmental Policy Act (NEPA), the Regulatory Flexibility Act (RFA), and Executive Order (EO) 12866, which mandates an analysis similar to the RFA. For the sake of brevity, this document is referred to as an Environmental Impact Statement (EIS), although it address the mandates just mentioned and may also be considered an Initial Regulatory Flexibility Analysis (IRFA) pursuant to the RFA and a Regulatory Impact Review (RIR) pursuant to EO 12866.

The rest of this chapter discusses why the Council must establish management measures for fisheries anticipated to catch groundfish in 2003 and the process that has been used to develop these measures. This description of ***purpose and need*** defines the need for, and goals and objectives of, the proposed action, which helps to determine the scope of the subsequent analysis. Chapter 2 outlines different ***alternatives*** the Council considered to address the purpose and need. One of these alternatives was chosen by the Council as its preferred alternative, representing the harvest specifications and management measures that could be applied in 2003. Chapter 3 describes the ***affected environment***. This information provides the basis for the analysis contained in Chapter 4, which assesses the potential ***environmental and socioeconomic impacts*** of the alternatives outlined in Chapter 2. Chapter 5 explains how these management measures are consistent with the Groundfish FMP and 10 National Standards set forth in the Magnuson-Stevens Act (§301(a)) and governing plans, plan amendments, and pursuant regulations. Chapter 6 in this document describes how this EIS addresses relevant laws and EOs, other than the Magnuson-Stevens Act. As appropriate, it also includes additional information and determinations required by these mandates.

This EIS analyzes possible environmental and socioeconomic impacts of harvesting at the proposed range of 2003 optimum yield (OY) specifications as compared to the 2002 harvest guideline specifications. It also analyzes the management measures accompanying each set of harvest level alternatives, season, and structure alternatives.

1.2 The Pacific Fishery Management Council's Proposed Action

The Council's *proposed action*, evaluated in this document, is the implementation of calendar year 2003 management measures for federally managed Pacific groundfish fisheries occurring off the coasts of Washington, Oregon, and California (WOC).

1.3 Purpose and Need

The Groundfish FMP establishes a framework authorizing the range and type of measures that may be used, enumerates 18 objectives that management measures must satisfy (organized under three broad goals), and describes more specific criteria for determining the level of harvest that will provide the greatest overall benefit to the Nation (termed "optimum yield" or OY). The management regime described in the Groundfish FMP is itself consistent with 10 National Standards described in governing legislation, the Magnuson-Stevens Act.

<u>The purpose of this action</u> is to ensure that Pacific Coast groundfish subject to federal management are harvested at OY during 2003 and in a manner consistent with the aforementioned Groundfish FMP and National Standards Guidelines (50 CFR 600 Subpart D). Chapter 5 of this EIS describes how the proposed action (preferred alternative) is consistent with the Groundfish FMP and Magnuson-Stevens Act.

The proposed action is needed to constrain commercial and recreational harvests in 2003 to levels that will ensure groundfish stocks are maintained at, or restored to, sizes and structures that will produce the highest net benefit to the nation, while balancing environmental and social values.

1.4 Background

1.4.1 Background to Purpose and Need

Marine fish are "common pool" resources with access and use stemming from the public trust doctrine. It is difficult to exclude people from using a common pool resource, because of the physical characteristics of these resources (Ostrom 1990). (Fish are a relatively mobile, "fugitive" resource, making it impossible for any one individual to precisely know their location or control their distribution.) A fish stock is also "subtractable," meaning that exploitation by any one person diminishes the total amount available to others. Under the common law public trust doctrine, resources in ocean areas under U.S. jurisdiction are believed to be held in trust by government to satisfy a broadly-defined public interest (Committee to Review Individual Fishing Quotas 1999). This doctrine also makes a legally defensible exclusive property right to fishery resources difficult or impossible (at least before fish are harvested). The Magnuson-Stevens Act, originally enacted in 1976 as part of the extension of jurisdiction to the 200-mile EEZ (and most recently amended in 1996), establishes the goals, standards, responsibilities, and processes needed to address the characteristics of the fishery resource. A paramount purpose is to "conserve and manage the fishery resources found off the coasts of the United States" (§2(b)(1)). This Act delegates management responsibility to the U.S. Secretary of Commerce (Secretary) who, with the aid of eight regional fishery management councils and through the National Marine Fisheries Service (NMFS), implements measures to ensure the conservation and management goals of the Magnuson-Stevens Act and fulfills the trust responsibility. Councils develop FMPs describing how particular species and fisheries will be managed. The Pacific Fishery Management Council was assigned stewardship responsibilities for the fish resources in the EEZ off the Pacific Coast (see Figure 1.4-1) and first approved the Groundfish FMP in 1982.[1/]

The proposed action, which is based on the framework established in the Groundfish FMP, exemplifies the need for federal fishery management described above. Chapter 6 in the Groundfish FMP describes the management measures the Council may recommend NMFS use and the process of establishing and adjusting such measures. Various biological reference points and information on fishery performance are used to determine, on an annual basis, the OY for particular species or species groups. (See section 3.2.1 for a description of these reference points.) The Groundfish FMP also describes "points of concern" and socioeconomic frameworks which help managers determine whether and what types of management measures are needed. Section 6.2 of the Groundfish FMP describes the deliberative process the Council must follow, and the parallel process NMFS uses to translate Council recommendations into regulations. NEPA-mandated environmental impact assessment is a central component of this process. (Due to recent litigation, *Natural Resources Defense Council* v. *Evans* discussed below, the current process differs somewhat from what is described in the Groundfish FMP. The NEPA analysis has gained greater prominence, and there is more opportunity for public notice and comment during rulemaking.)

In accordance with the groundfish FMP, since 1990 the Council has annually set Pacific Coast groundfish harvest specifications (acceptable and sustainable harvest amounts) and management measures designed to achieve those harvest specifications. Over 80 species of groundfish are managed under the Groundfish FMP, although only about 20 of these species are assessed for stock size and status on a regular basis. Each of the assessed stocks usually receives a stock assessment update once every three years. Thus, when the Council recommends a new set of harvest specifications in a given year, normally only specifications for those species with new assessments are changed from the previous year's value. Changes to the groundfish management regime as a whole reflect the associations between newly assessed stocks and previously assessed or unassessed stocks.

1/ The Groundfish FMP has been amended 13 times to date.

Harvest specifications and management measures for 2003 are shaped by new assessments for bocaccio, canary rockfish, and yelloweye rockfish, as well as sablefish and whiting. The overall 2003 groundfish management regime is also affected by re-addressed rebuilding targets and time frames for overfished species such as lingcod and Pacific ocean perch, darkblotched rockfish and widow rockfish. Harvest specifications for species other than the nine species listed above are not under new consideration for 2003 and are thus not newly analyzed in this document. Management measures for species without new harvest levels may be changed for 2003, depending on their interactions and co-occurrence with overfished and assessed species.

In order to rebuild overfished groundfish species, Council policy is to use management measures that discourage or prevent targeting of these species. The Council has also recommended management policies to reduce the incidental catch of overfished species taken in fisheries targeting healthier stocks. For 2002, the Council began using an analysis of the incidental catch rates of particular overfished species taken in trawl fisheries targeting healthy stocks. Then, in setting management measures for the year, the Council recommended trip limit combinations that allowed higher landings of healthy stocks in months and seasons when those healthy stocks co-occur less frequently with overfished stocks. Inseason changes to trip limits during 2002 were largely based on the need to keep incidental catch of overfished species low, with limits on healthy stocks modified by the overfished species catch ratios set in the bycatch analysis for the 2002 specifications and management measures. In early 2003, NMFS expects to review observer data from the first year of the West Coast groundfish observer program (August 2001 through August 2002). Because that data and the trawl bycatch model will be reviewed shortly, the scope of the action analyzed in this document does not include a re-analysis of the bycatch analysis and overfished species co-occurrence rates used in setting 2002 specifications and management measures. However, the scope of this action does include revisions to the bycatch assumptions in the 2002 analysis to account for effort shifts associated with the time-area closures the Council is considering for 2003. Any revisions would be subject to a separate NEPA analysis conducted at the time the action is contemplated.

In summary, in addition to a general need to manage fisheries for sustainable harvests, the proposed action satisfies several objectives. Management is based on “the best available science,” the second National Standard enumerated in the Magnuson-Stevens Act. Regular stock assessments for target species in groundfish fisheries, whenever possible, are an example of the application of this requirement. Continuing efforts to improve the quality of data and analysis support assessment and catch accounting. Because of the decline in several groundfish stocks revealed by these assessments, preventing overfishing and rebuilding overfished stocks is a paramount concern. However, the ability of fishers to access healthy stocks is also considered, because a competing goal in the Groundfish FMP is to maximize the value of the groundfish resource. Striking this balance between conservation of and direct social benefit from groundfish is another way to understand the purpose of this action.

1.4.2 Background to Groundfish Management and the Annual Specifications Process

The Groundfish FMP lists three overall goals to guide the management process:

1. Conservation - prevent overfishing by managing for appropriate harvest levels and prevent any net loss of habitat of living marine resources.
2. Economics - maximize the value of the groundfish resource as a whole.
3. Utilization - achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

A variety of management measures have been employed to achieve these goals, including gear restrictions, a license limitation program, time/area closures, the specification of OYs or other harvest limitations for some species, seasons, and trip/cumulative landing limits, which are limitations on the amount of certain species that may be caught, retained, and landed by any vessel. The Groundfish FMP allows harvest guidelines and quotas to be re-specified on a periodic basis. Harvest guidelines are specified numerical harvest objectives which are treated as targets but not absolute limitations. Therefore, a fishery does not have to be closed if its harvest guideline is reached, although the Council may choose to do so. All recent numerical harvest specifications, including OY values, have been harvest guidelines. A quota is defined as a specified numerical harvest objective, the attainment (or expected attainment) of which causes closure of the fishery for that species or species group. The main use of harvest guidelines and quotas recently has been to designate allocations and sub-components of a specified OY.

Although the Groundfish FMP was first implemented 20 years ago, changes in the fishery and the Magnuson-Stevens Act have resulted in substantial modification through plan amendments. Three recent amendments (numbered 11 through 13), which in part respond to new requirements imposed by the 1996 Sustainable Fisheries Act (SFA) reauthorizing and amending the Magnuson-Stevens Act, have affected the framework for specifying harvest levels and management measures. Approved in 1999, Amendment 11 establishes a default OY policy that reduces the numerical OY of any stock believed to be below its precautionary threshold, which is defined as smaller than 40% of its pristine (unfished) abundance (denoted B_0) unless better information is available.[2/] A groundfish stock is defined to be overfished if its abundance is less than 25% of its unfished abundance. The procedures and criteria for determining OYs for Pacific groundfish are detailed in section 3.2.1. Amendment 12, although subsequently remanded, in part, by court order, establishes procedures to rebuild overfished stocks. To date, nine groundfish stocks have been declared overfished; rebuilding measures, therefore, have an important influence on annual management.[3/] The guidelines in the Groundfish FMP added by these amendments address Magnuson-Stevens Act National Standard 1: *Conservation and management measures shall prevent overfishing while achieving on a continuing basis, the optimum yield from each fishery for the United States fishing industry*. Amendment 13 was developed in response to SFA requirements to address bycatch and bycatch accounting. (It also added to the list of routine management measures that are part of the Groundfish FMP framework. This allows more effective management of overfished species and bycatch.) This amendment addresses Magnuson-Stevens Act National Standard 9: *Conservation and management measures shall, to the extent practicable (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize mortality of such bycatch*. Bycatch (fish discarded at sea for regulatory or economic reasons) has emerged as a difficult problem in groundfish management. In order to manage for overfished stocks, it is necessary to estimate total catch, rather than only the catch landed at the dock. At the same time, reductions in cumulative landing limits can increase the amount of fish discarded, since these limits are based on landed catch rather than total catch. (Until the recent development of an observer program, it has been difficult to effectively monitor discards, confounding the ability to accurately estimate total catch.)

Although the Groundfish FMP states that all specifications will remain in effect until changed, they are announced annually on or about January 1. These management specifications are developed by the Council, based on a review of available stock status information, over the course of several meetings. Until this year, this occurred at the September meeting, when the Council would adopt a range of alternatives representing preliminary harvest specifications (the Acceptable Biological Catch [ABC] and OY for species or species groups) and management measures intended to limit catches to those targets. At its November meeting, the Council would then choose a preferred alternative, representing final harvest specifications and management measures. However, the court ruling in *Natural Resources Defense Council* v. *Evans*, 2001 168 F. Supp. 2d 1149 (N.D. Cal. 2001) found that NMFS was not allowing sufficient time for public notice and comment on the regulations before they were implemented at the beginning of the new year. Now, in order to allow enough time for the required comment period and still implement management measures early in the year, the Council must make its final decision at its September meeting, with the development of alternatives pushed back to the June meeting.[4/]

2/ Sometimes spawning stock biomass is used instead of total stock biomass, and sometimes spawning potential is used. Where there is insufficient information to develop a numerical OY, the Groundfish FMP still allows establishment of a non-numerical OY.

3/ Table 3.2-2 lists the overfished species and associated rebuilding parameters. The species are: cowcod, bocaccio, canary rockfish, yelloweye rockfish, lingcod, darkblotched rockfish, Pacific ocean perch, widow rockfish, and Pacific whiting.

4/ Even with the earlier decision-making framework, regulations cannot be promulgated by January 1. Therefore, NMFS must promulgate emergency regulations, which are exempt from regular rulemaking procedures, for January and February, with the full rulemaking procedure applying to regulations

(continued...)

1.5 Scoping Summary

Scoping is an "early and open process" for determining the range of issues and alternatives for implementing the proposed action (40 CFR 1501.7). NEPA regulations stress that agencies should make diligent efforts to provide public notice of NEPA-related proceedings and hold public hearings whenever appropriate during EIS development (40 CFR 1506.6). Fortunately, the process by which the Council adopts annual harvest specifications and management measures, described above in general terms, allows early and open scoping and public involvement as well. In fact, public and stakeholder involvement lies at the core of the Council process. More specifically, the Council, subcommittees, and advisory bodies hold public meetings with opportunity for public comment. Further, advisory bodies directly represent stakeholders. For groundfish management these bodies include the Groundfish Management Team (GMT), with representation from state, federal, and tribal fishery scientists; the Groundfish Advisory Subpanel (GAP), whose members are drawn from the commercial and recreational fishery, processing, and conservation sectors; and the Ad Hoc Allocation Committee, which provides advice on allocating harvest opportunity among the various fishery sectors.

In the past, the development of annual specifications was accompanied by an environmental assessment (EA). An EA was also planned for the 2003 specifications, but early scoping revealed the action might have significant impacts and generate substantial controversy. Therefore, the Council and NMFS decided to prepare an EIS without first preparing an EA.

1.5.1 Scoping Opportunities

Although the Council process provides opportunity for public information gathering and deliberation, NMFS undertook agency-required scoping after they published a Notice of Intent (NOI) to prepare an EIS in the *Federal Register* on August 14, 2002. The NOI identified the August 28-29, 2002, Ad Hoc Allocation Committee meeting as an opportunity for NMFS to hold a public scoping meeting to determine the issues the public would like the EIS to address and analyze. The September Council meeting, during which the Council identified its preferred alternative, provided another venue for scoping after the NOI was published. Issues raised at the meetings described below, which were part of preliminary scoping, helped the Council define some of the issues the EIS should focus on. Discussions at these meetings are summarized below. (Meeting minutes, which provide more detail, are available from the Council office.)

<u>GMT meeting, May 13-17</u>: During this meeting, GMT members reviewed new stock assessments, which provided the basis for 2003 harvest specifications and management measures. The assessments suggested the OY values for canary rockfish, yelloweye rockfish, and bocaccio would have to be set at very low levels. Managers would likely have to limit catches (by setting low cumulative landing limits) in a range of fisheries, because of the potential for bycatch of overfished species. The GMT began discussing the use of depth-based restrictions as a way to manage bycatch of certain overfished species.

<u>Ad Hoc Allocation Committee teleconference, May 21, 2002</u>: The Ad Hoc Allocation Committee reviewed new stock assessments and the difficulties raised by the new information. It was clear that OY values for overfished species such as yelloweye rockfish and canary rockfish (which mainly effect the northern part of the management area) and bocaccio (affecting the southern part) would have to be set at very low levels. These low values will require better accounting of all sources of fishing mortality, including research fisheries (such as surveys used for assessments). The Ad Hoc Allocation Committee discussed whether the mixed-

4/ (...continued)
implemented March 1. (This EIS covers the March 1 regulations; an environmental assessment is prepared for the regulations covering January and February.) It should also be noted the Council planned to implement a three-meeting decision process in 2002 in order to allow more time for deliberations. Under this scenario harvest specification alternatives would be developed at the June meeting, final harvest specifications (a preferred alternative) and management measure alternatives would be determined in September, and final management measures (a preferred alternative) adopted at the November meeting. Because of the court decision and the need for the Council's preferred alternatives to be identified at the September meeting, this process was not used.

stock exception, described in National Standards Guidelines (50 CFR 600.310(d)(5)), could be invoked to allow higher OYs for selected overfished species.[5/] Participants also discussed various management measures, but primarily depth restrictions, that could limit harvest of overfished species. The Ad Hoc Allocation Committee also discussed the feasibility of implementing a vessel monitoring system (VMS), which would be an important tool in enforcing any depth-based management regime.

Ad Hoc Allocation Committee meeting, June 3-4: This meeting covered many of the same issues as the May 21 teleconference, but in more detail. The Ad Hoc Allocation Committee discussed the stock assessments again, and particularly the data and assumptions that were used in modeling the bocaccio stock. NMFS gave a presentation on VMS technology and the different options that could be implemented in support of depth-based management. The cost of such systems, and who will bear those costs, are key issues. Enforcement personnel also emphasized that restrictions based on depth contours need to be translated into relatively straight boundary lines, which can be a difficult task. The Ad Hoc Allocation Committee developed preliminary ideas for management measures for each fishery that would satisfy the most conservative assumptions about acceptable harvest levels. (The Council subsequently recommended that VMS be implemented; this action is currently undergoing a separate NEPA evaluation.)

Council meeting, June 18-21: As noted above, the Council developed a preliminary range of harvest specifications and management measures during this meeting, based on input from the Ad Hoc Allocation Committee, advisory bodies, and public comment. A range of management measures that would satisfy these harvest specifications was also developed. (After the meeting, this information was made available on the Council website.) Oral comments given at this meeting on preliminary harvest levels and proposed management measures are included in the scoping summary below.

GMT meeting, July 29-31: The GMT further refined the alternatives developed by the Council at its June meeting, especially to ensure management measures would be likely to result in harvest levels within the range of specifications.

State-sponsored public hearings: State fish and wildlife departments held a series of public hearings at various locations in all three states between July 23 and August 9. Although the Council did not sponsor these hearings, they received written summaries of the proceedings. Summaries of the comments received at these hearings are provided in section 1.5.2. This public input was an important consideration when the Council developed its preferred alternative at the September meeting. Council members, representatives from NMFS, and stock assessment scientists also attended the meetings to listen to public input and explain the need for 2003 management measures, the range of measures being considered, and the scientific basis for decision making.

Ad Hoc Allocation Committee meeting, August 28-29: In addition to Ad Hoc Allocation Committee business, this meeting was used as an opportunity for public comment on the scope of the EIS, including the range of alternatives and issues that will be analyzed.

Council Meeting, September 10-13: With assistance from the GMT and GAP, and comments from the public, the Council identified its preferred alternative at this meeting. Oral comments provided at this meeting on final harvest levels and final action on 2003 management measures are summarized below.

5/ The mixed-stock exception can be applied if in multi-species fisheries healthy stocks cannot be caught without simultaneously overfishing another component of the stock complex. However, three conditions must be met: analysis shows that such a policy will produce long-term net benefits to the nation, mitigating measures have been considered, and similar long-term net benefits cannot be achieved by modifying fleet behavior, and harvests will not result in an Endangered Species Act listing for the relevant species or evolutionarily significant unit thereof.

1.5.2 Summary of Public Comments Received by the Council

Table 1.5-1 summarizes **letters, emails and oral comments** received from 130 different sources by the Council during development of the 2003 management measures. In order to be consistent about which written testimony to summarize, only those written comments incorporated into the June and September Council Briefing Books (including supplemental materials) are included among the letters and emails. Because some comments were sent anonymously, it is possible that some are from duplicate sources.

In compiling Table 1.5-2, comments were categorized in themes (such as bycatch, disaster relief, and buybacks) and were recorded in a spreadsheet. It is important to point out some weaknesses in this type of analysis. Comments were recorded only once, even if they were applicable to different categories. In addition, the small number of comments on some issues is misleading. This problem is inherent in any attempt to quantify what is essentially a collection of qualitative, nonlinear texts. For example, comments on economic loss to a business were recorded under "Groundfish cuts will harm business," but not under "Regulations have negative impact on families." So while "Regulations have negative impact on families" was only mentioned specifically three times, negative impacts on families are also implied in other categories of the "Effects on families and individuals" section, as well as in sections on business and economic hardship, socioeconomic impacts on communities, and others. It is important to view these comments as an interconnected and overlapping web, rather than emphasizing, for example, that one comment such as "Measures are too severe" garnered only two mentions. In fact, the vast majority of letters *implied* the measures were too severe.

One other factor to be aware of when interpreting this table is it combines comments from recreational anglers, commercial fishers, conservationists, and the general public. While our spreadsheet tracks the names and (when possible) the profession/vocation and locations of the individual authors, for privacy purposes this information is not included in the summary presented here. In addition, the majority of authors did not provide personal information in their comments.

In addition, we summarize comments from two other types of public scoping venues: the **Ad Hoc Allocation Committee Meeting** held on August 28-29, and the **state hearings** held in Washington, Oregon, and California. These comments are not included in Table 1.5-2. An additional summary of comments made at the Oregon hearings was provided to the Council by Oregon Sea Grant staff at the September meeting and reflected many of the same beliefs, opinions, and values that appeared in the letters and email summarized here.

1.5.2.1 Summary of Comments at Ad Hoc Allocation Committee Meeting

Four individuals made comments during this meeting:

Joe Easley of the Oregon Trawl Commission commented on the need to consider the economic impacts of trawl opportunities in the EIS. If trawlers cannot cover their trip costs (such as fuel, food, and crew), they won't fish. In addition, there is a potential misidentification of darkblotched rockfish and blackgill rockfish. The relative composition of darkblotched rockfish and blackgill rockfish catches in foreign fisheries needs to be assessed. Mr. Easley noted the Oregon coast is much more dependent on fisheries than most realize. Timber and tourism are not, or are no longer, economic mainstays. Most of the demographic growth on the coast is from retirees who don't contribute much to coastal economies.

Mark Powell of the Ocean Conservancy stated with so many soft bycatch numbers, it is critical to provide estimates of uncertainty and a confidence interval about these estimates in order to understand their accuracy and reliability. The credibility of fishery monitoring needs to be high. With such small OYs, there needs to be 100% observer coverage with bycatch caps. This would be the most risk-averse strategy.

Brian Petersen of the Shrimp Fishermen's Marketing Association said the new management regime would put pressure on small trawlers. Exempted fishing permits (EFPs) will be critical to develop gear types that will allow shelf fishing opportunities. He was concerned that groundfish trawlers might switch over to the shrimp fishery without an EFP opportunity. These EFPs should incorporate the use of hard grate excluders to allow trawlers to continue to target Dover sole and other flatfish on the shelf without impacting rockfish.

Peter Huhtula of the Pacific Marine Conservation Council emphasized the need to analyze the potential impacts of effort shifts to nearshore areas. He also emphasized the need for EFPs in order to allow opportunities to fish on the shelf. Streamlining and focusing the EFP process is critical. In addition, Mr. Huhtula said a comprehensive area-specific economic analysis needs to be done. Families and communities will need this analysis to get financial assistance.

1.5.2.2 Summary of Comments at State Hearings

Each state held hearings on the groundfish management measures. The states provided summaries (in varying formats), which are further summarized below. For more information on the hearings, see Exhibit C.3.b in the September 2002 Council Briefing Book.

Comments received at the hearings reflected many of the same concerns as those expressed in the written and oral comments provided to the Council.

<u>California Comments</u>

Location	Date	Approximate Number of Attendees
Eureka, California	July 23	Total of 8
Oakland, California	July 24	Total of 45
Los Alamitos, California	July 25	Total of 28 (17 from NMFS and California Department of Fish and Game)
TOTAL FOR CALIFORNIA		**81**

Slightly more recreational than commercial fishers testified at the California meetings. Many of the comments related to nearshore management issues and the expected shift of effort into nearshore areas. Both recreational and commercial commenters at the California meetings expressed concerns about the lack of data and the need for better stock assessment data. Recreational anglers expressed the need for more economic data on the effects of the recreational fishery.

Many of the recreational comments were specific recommendations for size limits–for example, suggested minimum sizes of 15"-16" for cabezon, and 22"-24" for lingcod. Other comments related to bag limits–for example, allowing a small bag limit for vermilion rockfish in the nearshore recreational fishery, keeping the 10 rockfish bag limit, or reducing the rockfish bag limit to five fish. Some recreational fishers said they wanted a year-round season, while at least one wanted to completely close all nearshore areas to fishing. Several recreational commenters wanted to ban nearshore areas to commercial fishing or put limits on the type of gear used in nearshore areas. Several expressed support for “Option 3,” an early option put forward by the Groundfish Advisory Subpanel. This option called for no depth closures, a bag limit of 10 on all species except lingcod, canary and yelloweye rockfish; one canary rockfish allowed; and two lingcod 24” or larger allowed between March 16 and October 15.

Like the recreational commenters, the commercial commenters made specific recommendations on size limits, allowances, and fathom lines. Some emphasized the difference between bocaccio catches in different geographic areas or depths. They also emphasized the need for a trawl buyback and more observers. Some commercial fishers said they were uncomfortable endorsing any option until they had more information about how many fish could be landed.

Oregon Comments

Location	Date	Approximate Number of Attendees
Newport, Oregon	August 5	Not noted
Astoria, Oregon	August 7	
Brookings, Oregon	August 14	
North Bend, Oregon	August 14	
TOTAL FOR OREGON		

The Oregon comments were similar in many ways to the California comments. The Oregon hearings included special meetings to gather information from community leaders, so many of the comments relate to community impacts.

Many fishers and community members stressed the need for finding the best options required by federal law that meet the biological needs and yet have minimal economic impact on coastal communities. Representatives of some communities with unique circumstances (for example, Brookings, which was affected by a nearby forest fire) asked if the regulations could take them into account.

Commercial fishers, insurance safety agents, and processors expressed concerns about having to travel further to reach open fishing waters. They were concerned the increased distance would increase operating costs and time at sea and would effectively exclude small vessels. Salmon trollers said they do not catch the rockfish species that are driving the proposed options, and they wanted observers on board to document these claims.

Sport fishers were concerned about the shift of commercial effort into nearshore areas. They were also concerned about gear conflicts. Most sport fishers wanted to see the most conservative option for the nearshore commercial fishery. One sport fisher requested a slot limit for cabezon rather than a minimum size limit. Sport fishers also suggested giving a small allowable yelloweye rockfish limit for the sport halibut fishery to reduce waste; adopting gear restrictions for drift fishing instead of shutting down sport fishing outside 20 fm to 50 fm; having an observer program on selected sportfishing vessels; and developing educational programs aimed at ways to reduce bycatch mortality. Gear suppliers noted they would lose money on supplies that became unusable due to regulatory changes, leading to tens of thousands of dollars in losses. They suggested considering tax credits for obsolete gear that had been ordered before regulatory changes were made. Several alternative management measures were promoted, such as IFQs, implementation of the mixed stock exception, area closures for trawlers, use of smaller or larger footropes and other gear. One fisher suggested investigating the possibility of lower interception of darkblotched rockfish at night, when they are off the sea floor.

Attendees were concerned about the effects of cutbacks on the Dungeness crab fishery, which will become the most valuable fishery in Oregon if the options are implemented. More vessels will move into the crab fishery, but there is likely to be diminished processing capacity as a result of the cutbacks in groundfish.

Certain comments were universally agreed upon at all meetings. People were concerned about bycatch and expressed the belief that cumulative limits were problematic and wasteful. They had several suggestions for minimizing bycatch (such as full retention, decriminalizing small amounts of overages, and donations to charity.) They also supported vessel buyouts, retraining programs, and more economic and biological data-gathering. Commenters were also concerned that losses to community infrastructure (for example, ice plants, processors, and fuel supply) would be difficult to re-establish in the future. They felt enforcement of fathom lines would be difficult, and expressed concerns about marine reserves, Canadian harvest management, and safety. Several people noted that weekly limits for the fixed gear fishery would be more efficient and safe than daily limits.

Washington Comments

Comments at the Washington state hearings focused on the proposed management options, the status of yelloweye rockfish, general management of groundfish, proposals for EFPs, the Council process, inseason management, the results of the Ad Hoc Allocation Committee meeting, and proposed changes to the Halibut Catch Sharing Plan.

Recreational fishers were concerned about the status of yelloweye rockfish and its potential impact on the halibut fishery and other recreational groundfish opportunities. Washington Department of Fish and Wildlife (WDFW) staff provided information on the status of yelloweye rockfish, the results of the new stock assessment, and efforts to collect additional data from the yelloweye rockfish taken in the International Pacific Halibut Commission setline survey and through a submersible survey off the Washington coast. Recreational fishing interests provided WDFW staff with information regarding areas where halibut fishing could be allowed with minimal yelloweye rockfish catch in the event that such areas would be needed as a management tool. They also proposed extending the current Yelloweye Conservation Area for recreational groundfish and halibut fisheries.

Discussion with commercial fishers focused primarily on the OYs and harvest guidelines for 2003 and the depth-based management measures being proposed to achieve them. Commercial fishers commented on the latitude and longitude waypoints, which would be used to implement the depth closures, and how those closures would affect various fishing opportunities for both trawl and fixed gear fisheries. There was considerable discussion of possible EFPs that could be conducted in 2003.

Location	Date	Approximate number of recreational attendees	Approximate number of commercial attendees
Port of Ilwaco, Washington	August 6	25	5
Forks, Washington (City Council meeting)	August 15	20	None noted
Olympia, Washington	August 16	4	3
Olympia, Washington	August 21	None noted	20
Montesano, Washington	August 23	None noted	4
Olympia, Washington	September 5	5	5
TOTAL FOR WASHINGTON		**54**	**37**

1.5.2.3 Summary of Written and Oral Comments

The comments were categorized into a few major themes, described below. The themes referred to in the text correspond to the numbered themes in Table 1.5-2. These themes are roughly ordered by how many times they appeared in the public comment.

The reliability of data and methods used to assess fish stocks. Apart from specific comments about commercial and recreational management measures (which are too diverse to include in one category), the largest block of comments fell under the theme, “Science and data are faulty - or not enough.” (Theme 28). Both recreational and commercial fishers argued the data on which management decisions are made is of poor quality or incomplete (Theme 28.1). Some were also skeptical or distrustful of the scientific models used to estimate stock abundance and structure, based on these data. Many expressed the belief there were plenty of bocaccio in the ocean and expressed frustration and disbelief about cutbacks aimed at protecting bocaccio (Theme 11.1). Others expressed the view that bocaccio abundance differed in different geographic areas and should be managed regionally (Theme 13). Members of all groups expressed interest in developing cooperative research or data gathering projects, so resource users could supply what they felt would be more accurate information (Theme 28.4).

The following sections in this FEIS address these issues:

1.4.1 Background to purpose and need
1.4.2 Background to groundfish management and the annual specifications process
3.2 Biological environment – managed species (groundfish resources, overfished stocks, other stocks)
3.5.1 The stock assessment process
3.5.2 Capture of fish in research fisheries
3.5.4 Uncertainty and risk in the management process
4.6 Cumulative effects
4.7 Environmental management issues
4.7.7 Mitigation (cooperative research)

Socioeconomic impacts: After expressing distrust of the science, commenters were most likely to mention the effects of management measures on their communities, families, and businesses, including an expected reduction in business and personal income stemming from more restrictive management measures (Theme 6). Many of the comments supplied in the Oregon Sea Grant summary of the Oregon hearings echoed these concerns. Commenters also expressed concern that investments in vessels or supplier inventory could lose value if management restrictions prevent these assets from being used or purchased (Theme 6.1).

Commenters emphasized the importance of evaluating socioeconomic effects on coastal communities, including harm to children and families stemming from loss of income and unemployment (Theme 6.2 and 6.4). Communities could also be affected due to a shrinking tax base, making it more difficult to maintain critical infrastructure such as port facilities. Some commenters noted that reduced supply of fish due to management restrictions would also affect consumers, if products were less available or more expensive (Theme 6.3). They also noted the proposed management restrictions follow on several years of progressively lower harvest specifications and progressively more stringent regulations, so the cumulative socioeconomic impacts should be recognized (Theme 6.5). Several commenters emphasized the need for disaster relief programs, buybacks or retraining programs (Theme 1).

The following sections in this FEIS address these issues:

1.3.2 Impacts on consumers
2.2.1.4 Impacts on consumers
3.3.6.7 Impacts on the built environment in fishing communities
3.3 Socioeconomic impacts
3.4.1.10 Impacts on consumers
3.2.6 Impacts on communities
3.5.1.9 Cumulative impacts of downturns in other industries
4.6.2.11 Buybacks
4.3.7.4 Cumulative impacts on communities
4.7.5 Urban quality
4.7.7 Mitigation (buybacks)

Management measures: The Council received many comments about the suite of initial management measures proposed at the Council's June meeting. Some of these comments were quite specific, recommending a variety of gear, season, and size restrictions. Proposed depth restrictions also generated many specific recommendations.

Many anglers expressed anti-commercial fishing sentiments, and a desire for management to prioritize recreational fisheries over commercial fisheries (Theme 26.3). For example, recreational fishers were concerned about the effects of commercial gear, such as trawling, which they believe results in high bycatch rates or causes other impacts (Theme 2.1). Recreational fishers were also concerned about proposals to shorten the fishing season in California; until 2002 there was no structured season limiting recreational groundfish fishing (Theme 26.2).

Some comments touched on broader measures that cannot be implemented through annual management measures, such as reducing fleet capacity through a vessel buyback program or implementing individual fishing quotas (IFQs) as a way to rationalize fisheries (Themes 1 and 14).

Commercial fishers similarly place a high priority on a year-round fishery and advocate management measures that will ensure this.

While management measures are discussed through the FEIS, the following sections are specifically relevant:

2.2	Management measure alternatives
2.3	Alternatives eliminated from detailed study
3.3.2	Effected environment – directed commercial groundfish fishery
3.3.4	Effected environment – recreational fishery
4.3.4.1	Effects of recreational management measures
4.4	Distribution of landed catch and bycatch among sectors
4.5.2.1	Nearshore effects south of Cape Mendocino, and allocation between commercial and recreational sectors, recreational and commercial fishery management measures
4.5.2.2	Nearshore effects north of Cape Mendocino
4.6.2.4	Future groundfish management measures (includes IFQs)

<u>Bycatch</u>: A variety of bycatch-related issues were aired (Theme 2). Some commenters identified fishery sectors other than their own which they believed produced high bycatch (such as the trawl fishery, noted above), or, conversely, emphasized that their fishery was relatively “clean.” Others suggested various methods to reduce or better account for bycatch, such as full retention of catch (Theme 2.3), use of fish excluders, and other tools.

The issue of avoiding bycatch of overfished species is fundamental to this FEIS. Nearly every section refers to bycatch. Some especially relevant sections include:

1.4.2	Background
2.0	Alternatives including proposed action
2.3	Alternatives eliminated from detailed study
3.4	Distribution of landed catch and bycatch of overfished species among sectors
4.4	Distribution of landed catch and bycatch of overfished species among sectors
4.7.7	Mitigation (observers, new gear designs)
5.1	Consistency with the Groundfish FMP

<u>Species abundance and harvest limits</u>: Based on personal observation, some commenters were skeptical of the low estimated abundances of certain species, particularly bocaccio (Themes 11.1 and 13). Several commenters said bocaccio were extremely numerous, and it was difficult to avoid them when fishing in Southern California. (See FEIS sections listed under “reliability of data,” above).

<u>Allocation</u>: The most distinct divide in terms of allocation, and more broadly, who should bear the burden of more restrictive management, is between commercial and recreational fishers. Some recreational fishers argued for a larger share of the available harvest, based on the greater economic or social value of that sector (Theme 26.3). Within the recreational sector, difference emerged between charter operations, which are business concerns, and individual recreational fishers. Some charter boat advocates pointed out that, as businesses, they generate income and provide jobs (Theme 3). Non-charter anglers also pointed out their economic impacts (Theme 26.4). Many comments referred to specific fisheries, such as those for spot prawn or live fish, arguing both for and against harvest reductions or outright closures for certain fisheries (Theme 11).

The following sections in this FEIS address these issues:

3.3.1.5	Recreational fishing experience markets
3.3.4	Allocation, catch and value, seasonality, types of recreational fishers, and the charter industry

3.3.6 Community effects of recreational fishing
3.3 Distribution of catch among sectors
3.4.5 Catch in recreational fisheries
4.3.4 Impacts of regulations on recreational fisheries (including charter)
4.3.4.1 Effects of recreational management measures
4.4.4 Bycatch in incidental open access fisheries (including spot prawn)
4.4.5 Distribution of landed catch and bycatch in recreational fisheries
4.5.2.1 Nearshore effects south of Cape Mendocino, and allocation between commercial and recreational sectors

Safety: Commenters noted that proposed depth-based restrictions would force some vessels to fish in deeper water (Theme 27). Going farther offshore would expose them to severe weather, and using heavier gear could compromise vessel stability. Depth restrictions would restrict other fishers (particularly anglers) inside certain depth lines, increasing crowding and the danger of being grounded or caught in shore-breaking swells. Comments from the U.S. Coast Guard and others pointed out that vessel maintenance and investment in safety equipment might be reduced, and fishers might take undue risks because of the decline in fishing income.

Safety is referred to in Sections 3.3.7 and 4.3.8 of this FEIS.

Habitat impacts: A few comments referred to habitat-related fishing impacts (Theme 21). Habitat issues are discussed in Sections 3.1, 3.1.2 (essential fish habitat), 4.1 (effects of management measures on fish habitat), 4.6.2 (external factors, including ecosystem structure), in descriptions of specific fish stocks, and in other areas of this FEIS.

Other impacts on fisheries: Commenters called for fisheries managers to look into non-fishing impacts on stocks, such as marine mammals and other predators (Themes 11.5, 23), foreign fishing (Theme 12), illegal netting (Theme 15), ocean conditions (Theme 19), cruise ships, illegal dumping, and overconsumption of fish (Theme 21).

Predation is discussed in 3.1.3 (biodiversity of managed stocks), in 3.2.1.1 (lingcod and Pacific whiting), 3.2.1.2 (Dover sole and sablefish), and 3.2.1.3 (English sole, Petrale sole, and shortbelly rockfish). Marine mammals are discussed in 3.2.3.2 and 4.2.3.1.

Exempted Fishing Permits (EFPs) and enforcement: Several commenters either expressed general support for EFPs or specifically requested an EFP for their fishery (Theme 9). Others were supportive of observers, and volunteered to take observers on their vessels (Theme 8.3). One person said he would be happy to put a vessel monitoring system (VMS) on board (Theme 8.1).

EFPs are discussed in Sections 3.4.1 (limited entry trawl), 4.2.1.2 (dover sole), 4.2.1.3 (arrowtooth flounder and "other groundfish stocks"). VMS is discussed in Sections 3.5.3 (fishery management and enforcement), 4.3.8.2 (effects of depth-based management on vessel safety), 4.5.1 (enforcement impacts), 4.6.2.4 (future groundfish management measures), 4.7.4 (energy requirements), and 4.7.7 (mitigation).

Anger: Finally, the letters expressed a great deal of anger, frustration, and disbelief surrounding the management measures (Theme 5). Several people expressed the belief that managers were simply trying to close down the fishing industry. They felt targeted and victimized by the system. (These comments were echoed in the Oregon hearings). Many commenters did not seem to understand the management process or the way data was collected and used in management decisions (Theme 28.5). Others expressed a desire to become more involved in management, mainly by providing information or assistance to scientists and managers (Theme 28.4).

While anger was not specifically discussed in the DEIS, cooperative research is discussed in section 4.7.7.

2.0 ALTERNATIVES INCLUDING PROPOSED ACTION

Annual groundfish harvest specifications and management measures are determined in a Council process that begins with the Council's Scientific and Statistical Committee (SSC) recommending the best available science for management use. The acceptable biological catch (ABC) is determined for each stock and stock complex by applying estimated or proxy maximum sustainable yield (MSY) harvest rates to estimates of exploitable biomass. The total catch optimum yield (OY) is the management target for each stock and complex. OY alternatives in this Environmental Impact Statement (EIS) are determined by precautionary reductions of the ABC designed to rebuild stocks to a level that supports MSY (see section 3.2). Alternatives vary by the balance between risk to stock rebuilding objectives and short-term socioeconomic consequences for West Coast fishers and fishing communities.

At their June 17-21, 2002 meeting, the Council adopted several management alternatives for analysis. Harvest levels and associated management measure alternatives were identified for 2003 commercial, recreational, and tribal groundfish fisheries, as well as nongroundfish fisheries that might have an impact on rebuilding overfished groundfish species. The Council's Ad Hoc Allocation Committee met on August 28-29, 2002, to review new Groundfish Management Team (GMT) recommendations for 2003 harvest levels. These recommendations were based on a revised bocaccio rebuilding analysis and a new yelloweye rockfish stock assessment and rebuilding analysis requested by the Council in June. Harvest levels and associated management measures recommended by the Ad Hoc Allocation Committee were added as another alternative to those specified by the Council in June. The Council adopted final harvest levels and management measures for 2003 groundfish and nongroundfish fisheries at their September 9-13, 2002 meeting. This alternative represents the *Council-preferred Alternative* in this EIS.

The centerpiece of the *Council-preferred Alternative* and for all considered alternatives other than the *No Action Alternative* and *Allocation Committee Alternative* (without depth restrictions) is depth-based restrictions that seasonally move fisheries that catch overfished stocks out of the depth zones they inhabit. This management strategy was considered critical for managing fisheries to stay within the OYs of the most constraining overfished groundfish stocks given the current uncertainty in monitoring total catch for most fishery sectors. Depth-based fishery restriction zones are therefore prescribed to reduce the risk of overfishing these stocks. These depth-based fishery restriction zones or Conservation Areas are described using latitude and longitude waypoints to define the shallow and deep bounds of the closed area. Upon the advice of the Council's Enforcement Consultants, these lines are specified to be as straight as possible for ease of enforcement. (NOTE: the actual line specifications were not available for analytical use in this EIS and fathom contours were used instead as a proxy. However, actual line specifications defined by waypoints will be available in the final rulemaking). While bycatch reduction is the primary goal of depth-based management, it also provides some economic benefits for some sectors of the fishery, especially those sectors operating in areas deeper than the outer bounds of Conservation Areas. In those circumstances, there is an ability to allow larger trip and cumulative landing limits that are not constrained by the need to limit harvest of otherwise co-occurring overfished species.

The area and time fisheries are restricted varies among alternatives relative to the amount of harvest allowed under each alternative. More liberal harvest alternatives allow more fishery opportunities in these depth zones during a greater portion of the year in order to better access healthy co-occurring groundfish and non-groundfish stocks. Otherwise, as per the analyses of effects described herein, fisheries without a significant bycatch of overfished groundfish species or those with mitigative gear modifications may be allowed to occur. The California Rockfish Conservation Area (CRCA), which is part of the *Council-preferred Alternative* and described in Section 2.2.5, is a good example of this approach. All gears with a demonstrated significant bycatch of bocaccio, cowcod, and other constraining overfished groundfish species, are excluded from the 20-150 fm depth zone south of Cape Mendocino, California where these species reside. Exemptions based on gear type or fishing strategy are allowed under the preferred alternative given anticipated bycatch to balance the socioeconomic needs of fishing communities with stock rebuilding needs. Such depth-based restrictions are considered coastwide to afford protection to other overfished stocks and, in essence, can be construed as de facto Marine Protected Areas.

2.1. Harvest Level Alternatives

The ABCs calculated for West Coast groundfish stocks and stock complexes in 2003 and associated OY alternatives are depicted in Table 2.1-1. Associated management measures for commercial groundfish, recreational groundfish, tribal, and nongroundfish fisheries are shown in Tables 2.1-2 through 2.1-5, respectively.

2.1.1 The *No Action Alternative*

The *No Action Alternative* is defined in this EIS as the OYs (Table 2.1-1) and associated management measures adopted for the 2002 West Coast groundfish fishery. The management measures under the *No Action Alternative* are those specified for the beginning of 2002 without any of the inseason changes adopted through the year. The landing and trip limits for limited entry trawl, limited entry fixed gear, and open access under *No Action Alternative* are depicted in Tables 2.1-6, 2.1-7, and 2.1-8, respectively.

Specifying *No Action Alternative* harvest levels for use in 2003 management would be much more restrictive than management in previous years, but would constrain West Coast fisheries significantly less than the other alternatives considered for 2003. The *No Action Alternative* does not conform to the latest scientific evidence guiding the rebuilding of some overfished groundfish stocks and risks further declines in stock biomass.

2.1.2 The *Low OY Alternative*

The *Low OY Alternative* harvest levels for most of the overfished species with alternative harvest levels (i.e., canary rockfish, lingcod, Pacific ocean perch, and widow rockfish) are based on rebuilding trajectories with an estimated 80% probability of rebuilding by T_{MAX}, the maximum allowable rebuilding period under the NMFS National Standards Guidelines. The darkblotched rockfish *Low OY Alternative* of 100 mt is on a trajectory with an estimated 92% probability of rebuilding within T_{MAX}. A darkblotched rockfish suboption analyzed in this EIS that is not part of the other structured alternatives is a *2001 OY Alternative* of 130 mt, which represents the harvest level set in 2001. The *Low OY Alternative* for Pacific whiting is the 2002 specification and is based on the default $F_{40\%}$ harvest rate applied to abundance at the start of 2002 with the 40-10 adjustment. The sablefish harvest level under the *Low OY Alternative* is based on a conservative $F_{60\%}$ harvest rate applied to the current estimated biomass. This harvest rate projects no decline in abundance after ten years when recent recruits no longer contribute to the spawning biomass. The *Low OY Alternative* for yelloweye rockfish is based on an initial rebuilding analysis that has since been updated. The new rebuilding analysis completed this summer and recommended for 2003 management by a Stock Assessment Review (STAR) Panel and the SSC is more optimistic; which may justify a higher harvest rate for yelloweye rockfish than the *Low OY Alternative*. Finally, the *Low OY Alternative* for bocaccio is zero harvest. This very pessimistic outcome results from the inability of the stock to rebuild by T_{MAX} with at least a 50% probability, as recommended in the NMFS National Standards Guidelines, even under no harvest.

Under the *Low OY Alternative*, most fishing activities on the U.S. West Coast within the 0 fm to 150 fm depth zone that have a chance of taking overfished shelf rockfish species as bycatch would be prohibited or restructured to avoid these species. There would be a zero tolerance for bocaccio bycatch south of Cape Mendocino, California (south of 40°10' N latitude) and a near-zero tolerance for yelloweye rockfish bycatch north of 36° N latitude in 2003 fisheries. The limited entry groundfish trawl fishery north of Point Reyes, California (north of 38° N latitude) would be maximally constrained in the 100 fm to 250 fm depth zone by the need to rebuild darkblotched rockfish. Table 2.1-9 depicts a summary of the limited entry non-whiting trawl trip limits and projected bycatch of overfished groundfish species under this alternative.

The *Low OY Alternative* is the <u>environmentally preferable alternative</u>. It results in the lowest levels of fishing mortality and is based on generally higher modeled probabilities of overfished species reaching target biomass within the time frame specified in the management framework.

2.1.3 The *High OY Alternative*

The *High OY Alternative* for most of the overfished species with alternative harvest levels (i.e., canary rockfish, darkblotched rockfish, lingcod, Pacific ocean perch, widow rockfish, and yelloweye rockfish) are based on rebuilding trajectories with an estimated 50% probability of rebuilding by T_{MAX}. This is the longest rebuilding duration and the highest harvest allowed for overfished groundfish species under the National Standards Guidelines. The sablefish harvest level under the *High OY Alternative* assumes an environmental regime shift state of nature (i.e., environmental conditions determine recruitment) and is calculated using an $F_{40\%}$ harvest rate with the 40-10 adjustment. The *High OY Alternative* for Pacific whiting uses the same criterion for the *Low OY Alternative* ($F_{40\%}$ harvest rate with the 40-10 adjustment), but assumes projected abundance at the start of 2003. The *High OY Alternative* for bocaccio is as close to a zero fishing mortality as possible without exceeding 20 mt in any case (see section 4.2.1.1).

Under the *High OY Alternative*, most bottom fishing activities on the U.S. West Coast within the 0-150 fm depth zone south of Cape Mendocino would be prohibited or restructured to avoid bocaccio. There would be a near-zero tolerance for bocaccio bycatch south of Cape Mendocino; however, a higher level of harvest would be allowed to avoid significant socioeconomic impacts relative to the *Low OY Alternative*. Fisheries operating in the 0 fm to 150 fm depth zone north of Cape Mendocino under the *High OY Alternative* would be less constrained than under the *Low OY Alternative*; yet constraints are significantly greater than under the *No Action Alternative*, given the more pessimistic outlook for rebuilding canary rockfish. The limited entry groundfish trawl fishery operating north of Point Reyes in the 100 fm to 250 fm depth zone would be least constrained relative to the *Low OY Alternative* by the need to rebuild darkblotched rockfish. Table 2.1-10 depicts a summary of the limited entry non-whiting trawl trip limits and projected bycatch of overfished groundfish species under this alternative.

2.1.4 The *Allocation Committee Alternative*

The Council's Ad Hoc Allocation Committee specified the *Allocation Committee Alternative* at its August 2002 meeting. The harvest level alternatives under the *Allocation Committee Alternative* are intermediate to the *Low OY Alternative* and *High OY Alternative*. The harvest alternatives for canary rockfish, lingcod, and widow rockfish under the *Allocation Committee Alternative* would be on a 60% probability rebuilding trajectory. The Ad Hoc Allocation Committee determined a 50:50 catch sharing as the initial set-aside for canary rockfish. The probabilities of rebuilding within T_{MAX} for Pacific ocean perch and darkblotched rockfish under the *Allocation Committee Alternative* are 70% and 80%, respectively. The yelloweye rockfish OY under the *Allocation Committee Alternative* (13.5 mt) is the same as for the *No Action Alternative*, or half the ABC calculated for the stock last year. The sablefish OY under the *Allocation Committee Alternative* (5,000 mt) is slightly greater than for the *Low OY Alternative*, but still less than the estimated OY using the proxy $F_{45\%}$ harvest rate with the 40-10 adjustment under the assumption that density-dependence is the primary factor determining recruitment. The *Allocation Committee Alternative* for Pacific whiting (148,200 mt) is based on a conservative $F_{45\%}$ harvest rate ($F_{40\%}$ is the Council default harvest rate for the stock) with the 40-10 adjustment applied to the biomass projected to the start of 2003. The bocaccio OY under the *Allocation Committee Alternative* is the same as for the *High OY Alternative* or #20 mt, but as close to zero as practicable.

The OYs represent a mix of the harvest levels and management measures within the range specified under the *Low OY Alternative* and *High OY Alternative*. There would be a near-zero tolerance for bocaccio bycatch south of Cape Mendocino with fishery effects similar to those under the *High OY Alternative*. Fisheries north of Cape Mendocino would be constrained slightly more than under the *High OY Alternative*; yet constraints are significantly greater than under the *No Action Alternative*, given the more pessimistic outlook for rebuilding canary rockfish.

The relative effect of depth-based management is analyzed under the *Allocation Committee Alternative* with suboptions that include and exclude depth-based restrictions. The shallow depth lines (20 fm in California south of Cape Mendocino, 27 fm in California north of Cape Mendocino and Oregon, 25 fm in Washington) are considered routine management measures since they were used in 2002 management, and do not require new or reprioritized enforcement capabilities, nor do they require specification of waypoints using latitude/longitude coordinates. Therefore, only the specification of the deeper lines, which affect commercial groundfish and nongroundfish fisheries, are analyzed under the *Allocation Committee Alternative*. Although depth-based management is contemplated under all alternatives analyzed in this EIS (except the *No Action Alternative*), the effect is only analyzed under this alternative. Table 2.1-11 depicts a summary of the limited entry non-whiting trawl trip limits and projected bycatch of overfished groundfish species under this alternative.

2.1.5 The *Council-Preferred Alternative* or Preferred Alternative

The Council adopted the *Council-preferred* Alternative at its September 9-13, 2002 meeting, in Portland, Oregon. A few revisions to the Council's recommendations were made at their November meeting, which do not affect the analysis in this EIS. The *Council-preferred* Alternative is the preferred alterative in this EIS and is the Council's recommendation to the U.S. Secretary of Commerce for harvest levels and management specifications for the 2003 West Coast groundfish fishery.

The alternative harvest levels under the *Council-preferred Alternative* are the same as for the *Allocation Committee Alternative*, except for sablefish. The sablefish OY under the *Council-preferred* Alternative is 6,500 mt. While less than the estimated OY using the proxy $F_{45\%}$ harvest rate with the 40-10 adjustment under a density-dependence assumption, the sablefish harvest level specification provides greater socioeconomic benefits than specified under the *Allocation Committee Alternative*.

The management measures under the *Council-preferred Alternative* are similar to those under the *Allocation Committee Alternative* with slightly higher trip and landing limits for sablefish (Tables 2.1-12, 2.1-13, and 2.1-14). Table 2.1-15 depicts a summary of the limited entry non-whiting trawl trip limits and projected bycatch of overfished groundfish species under this alternative.

2.2 Management Measures Consistent With Harvest Level Alternatives

Alternative management measures for West Coast fisheries that target or incidentally catch federally-managed groundfish species are linked to the alternative harvest levels discussed in section 2.1. This section provides further clarification of the alternative management measures for each fishery sector. However, alternative management measures are not segregated from the alternative harvest levels described in section 2.1, but are integrally linked. The conceptual and analytical context for these linkages are provided in chapters 3 and 4, respectively, in this EIS.

2.2.1 Commercial Groundfish Fisheries

Table 2.1-2 presents management measure alternatives for commercial groundfish fisheries considered in the Council decision-making process this year. In order to minimize or prevent harvest of overfished species with very low OYs, all of the alternatives, except for the *No Action Alternative* and one variation on the *Allocation Committee Alternative* (see section 2.1.4), propose the implementation of depth-based restrictions in addition to the two-month cumulative landing limits employed in previous years. The *No Action Alternative* is the continuation of 2002 management measures into 2003.

2.2.2 Recreational Groundfish Fisheries

Table 2.1-3 presents management measure alternatives for recreational groundfish fisheries considered in the Council decision making process this year. In order to minimize or prevent harvest of overfished species with very low OYs, all of the alternatives, except for the *No Action Alternative*, propose the implementation of depth-based restrictions that vary by management area. The *No Action Alternative* is the continuation of 2002 management measures into 2003.

2.2.3 Tribal Groundfish Fisheries

Table 2.1-4 presents two alternatives, including the *No Action Alternative*, for tribal groundfish fisheries prosecuted by tribes in Washington state. The proposed 2003 management measures for tribal groundfish fisheries are essentially the same as the *No Action Alternative* measures adopted for 2002 fisheries, except there is a specified trip limit proposed for yelloweye rockfish.

2.2.4 Nongroundfish Fisheries

Table 2.1-5 presents management measure alternatives to minimize incidental catch of overfished species in nongroundfish fisheries considered in the Council decision-making process this year. In order to minimize or prevent harvest of overfished species with very low OYs, all of the alternatives, except for the *No Action Alternative*, propose the implementation of depth-based restrictions that vary by management area. The *No Action Alternative* is the continuation of 2002 management measures into 2003, where proposed measures to reduce bycatch are potentially much less binding to West Coast fisheries in general.

2.2.5 The California Rockfish Conservation Area

The California Rockfish Conservation Area (CRCA) is a management concept developed by the California Department of Fish and Game (CDFG) and adopted by the Council (and therefore part of the *Council-preferred Alternative*). It prescribes gear restrictions within the depth range of overfished groundfish species, notably bocaccio, in waters off California south of Cape Mendocino. The conceptual elements described in the CRCA (as follows) are incorporated in the descriptive tables cited in this section 2.2 for each of the fishery sectors. The following description of the CRCA provides further clarification of this management concept.

<u>California Rockfish Conservation Area</u>

<u>Defined as</u>: (1) Ocean waters 20 fm to 250 fm between Cape Mendocino and Point Reyes and 20 fm to 150 fm between Point Reyes and the U.S./Mexico Border, and (2) the Cowcod Conservation Areas (CCA). Waypoints may eventually be substituted for fm (for depths greater than 20 fm).

<u>Purpose</u>: To regulate all gear types that have a potentially substantial effect on rebuilding of overfished rockfish species south of Cape Mendocino.

<u>General Provisions</u>: (1) No fishing for, or retention of, rockfish, lingcod, California scorpionfish, and ocean whitefish is allowed within the CRCA except as provided; (2) where state or federal laws or regulations prohibit the use of, prescribe the use of, or describe the construction of, various types of fishing gear identified in the exceptions, those provisions also apply; (3) if requested, any commercial fishing vessel intending to fish in, or transit the CRCA must accommodate a state or federal observer; (4) each commercial fishing vessel that fishes in or transits the CRCA with regulated gear or federal groundfish species aboard may be required to be equipped with a NMFS-approved and functional satellite-based tracking device(VMS); and (5) the use of all other gear types within the CRCA (not identified in the exceptions) shall be consistent with state and federal laws and regulations.

<u>Prohibited Gear Types (except as provided in regulation)</u>:

1. Trawl nets
2. Fishing line with more than 1 lure/hook and 6 oz or more of weight attached
3. Fish traps and fish pots
4. Set gill and trammel nets with mesh sizes less than 6 inches

<u>Exceptions I</u>

1. Commercial salmon troll vessels may use up to 6 mainlines with multiple hooks per line and any amount of weight.
2. Commercial surface hook-and-line troll vessels for highly migratory species (HMS) and California halibut may use any number of lines and any amount of weight.
3. Recreational anglers may use an additional hook (sliding or fixed) with up to 4 pounds of weight on each line when trolling for salmon excluding “downriggers” where any amount of weight may be used and up to 5 pounds of weight when trolling for other species.

4. Set longline and trap fishing for sablefish is allowed in waters deeper than 150 fm between Cape Mendocino and Point Reyes; slope rockfish may be retained.
5. Recreational anglers may use no more than 2 hooks while drifting for salmon; no more than 2 hooks, and up to 16 oz of weight, while drifting for HMS, halibut, and yellowtail; and no more than 5 hooks (number 2 or smaller), and more than 32 oz of weight while fishing for sanddabs or coastal pelagic species (CPS) (bait); no limit on squid jigs.
6. Commercial line gear with no more than 12 hooks (number 2 or smaller) and up to 5 pounds of weight may be used if closely attended (sanddabs).
7. Fixed gear and recreational fishing is allowed in waters between 20 fm to 50 fm south of Point Fermin to the Newport South Jetty during July and August only; scorpionfish retention allowed.

Exceptions II – Nongroundfish

1. Exempted trawl gear using a small footrope as defined in federal regulations may be used in waters shallower than 50 fm during January and February or 60 fm during March through December north of Point Conception and in waters shallower than 100 fm along the mainland coast south of Point Conception (not including the CCA).
2. Ridgeback shrimp trawl nets must include any state required fish excluder device.

Exceptions III - Groundfish Trawls

1. Small footrope trawl (including Scottish seine) may be used in waters shallower than 50 fm or 60 fm seasonally north of Point Conception and in waters shallower than 100 fm along the mainland coast south of Point Conception (not including the CCA).
2. Midwater trawl fishing for widow rockfish is allowed (not including the CCA) with the provision that only one gear type at a time be permitted on the vessel; no retention of any other groundfish allowed.
3. The deeper closure fathom line may be moved into a shallower depth during the winter months north of Point Reyes.

Allowed Gears in the CRCA: Roundhaul, spears and spearguns, hand, traps for invertebrate species (Dungeness crab, rock crab, spot prawn, lobster, coonstripe shrimp), harpoon, drift gillnets, set gill and trammel nets with 6-inch or larger mesh, bows and arrows, dip or brail nets.

2.3 Alternatives Eliminated From Detailed Study

During the scoping process for this 2003 annual specifications EIS, there were many recommendations from environmental groups and individuals to consider a 2003 management strategy that uses direct observations of bycatch and discard and bycatch caps to control total mortality. While draft rebuilding plans for overfished groundfish species contemplate the efficaciousness of such a strategy, the federal groundfish observer program is too early in its inception to use as an established management tool. The NMFS Northwest Fisheries Science Center anticipates using observer data in 2003 to refine bycatch models used in making inseason management decisions. NMFS scientists must analyze whether the number of observations across all time/area/depth strata by fishery sector represent true bycatch rates for these sectors and strata. This analysis will not be completed before January 31, 2003 and is therefore unavailable for inclusion in this EIS. A workshop to review the analysis and determine how NMFS Observer Data should best be applied to West Coast groundfish management is scheduled for January 27-29 at the NMFS Northwest Fisheries Science Center in Seattle. Therefore, without these data and analyses in hand, the concept of using observer data and bycatch caps in 2003 groundfish management is eliminated from detailed study in this EIS. Current management uses available tools to implement default bycatch caps. If allowable harvest levels are exceeded, fisheries will be shut down.

No alternative harvest levels for bocaccio (the most binding constraint for groundfish and some nongroundfish fisheries south of Cape Mendocino) greater than 20 mt are analyzed. More liberal bocaccio harvest level alternatives could risk stock extinction or an Endangered Species Act (ESA) listing (see section 4.2.1.1) and are, therefore, eliminated from further study. While intermediate levels of bocaccio harvest between the *Low OY Alternative* and the *Council-Preferred Alternative* are not specifically analyzed, impacts to bocaccio are estimated by fishery in the preferred alternative (see Table 4.4-1). This disaggregation of analytical results enables the reader to infer which fisheries would have to be restructured or eliminated to achieve lower levels of bocaccio harvest.

Another problem is that complete closures could force some segments of the fishery into times of the year when bycatch rates for a particular overfished species are highest. Bycatch rates vary by season and target strategies. For some segments of the fishery bycatch rates for overfished species are lowest in the winter and for other segments the impacts of harvest on overfished species are highest in the winter (e.g. nesting lingcod males). Thus there is not one optimal time when all mixed stock fisheries could be closed and achieve the lowest bycatch rates.

One recommendation from the Natural Resources Defense Council was to consider a season structure with closed periods and higher landing limits during open periods for the 2003 West Coast groundfish fishery. This type of management approach was considered and rejected in the Environmental Assessment of 2002 West Coast Harvest Specifications and Management Measures. One problem with closing the groundfish fishery is that nongroundfish fisheries would then continue and groundfish would be prohibited from retention, forcing discard. Therefore, some retention needs to be allowed in order to prevent such discard. Once some retention is allowed, the potential for targeting on groundfish is created and the fishery is in fact "open." Another problem is that complete closures could force some segments of the fishery into times of the year when bycatch rates for a particular overfished species are highest. Bycatch rates vary by season and target strategies since some target species and overfished species have discrete movement patterns that vary seasonally. For some segments of the fishery bycatch rates for overfished species are lowest in the winter and for other segments the impacts of harvest on overfished species are highest in the winter (e.g., nesting lingcod males). Thus there is not one optimal time when all mixed stock fisheries could be closed and achieve the lowest bycatch rates. For 2003, using area closures, gear restrictions, and target species' cumulative limits, the Council has structured for consideration seasonal fishery alternatives that seek to minimize bycatch while providing as much harvest opportunity as possible. This approach is also consistent with community and industry desires for a year-round fishery to keep product available to processors and the affected markets year-round. A complete closure of the commercial fishery would have significant socioeconomic consequences. Therefore, an analysis of complete seasonal closures for the 2003 fishery is eliminated from further study in this EIS and significant attention and effort was placed on the development of seasonal management alternatives based on area closures, gear restrictions, and cumulative limits for target harvest species.

2.4 Comparison of the Environmental Consequences

Table 2.4-1 summarizes the analysis of physical, biological, and socioeconomic effects of the alternatives presented in Chapter 4. The table also ranks the relative effects of the alternatives for each resource/issue category. (Ranking ranges from 1, meaning the least impact, to 6, meaning the most impact.) For some resource/issue categories the relative effects of the alternatives cannot be sufficiently distinguished to apply this ranking. The *Council-preferred Alternative* is expected to allow the stocks to rebuild to MSY biomass levels. Until stocks are rebuilt, there will likely be significant adverse impacts on the groundfish fishery and groundfish-dependent economies on the West Coast. Potential negative economic effects of proposed actions are likely to be especially acute in California south of Cape Mendocino (south of 40°10' N latitude) where bocaccio rebuilding constraints may require curtailing or closing many fisheries that incidentally catch this species.

2.5 Net Benefit Analysis of the Alternatives

Net benefit analysis takes costs and benefits into account from a national perspective. Net benefit analysis uses measures of real costs and benefits to all entities affected by an action in order to assess the net effect on the nation. The minimum standard for a cost-benefit analysis is a qualitative listing of positive and negative impacts. From there, an attempt is made to quantify or provide some indicators of the scale of the impacts and, if possible, to assign a monetary value to those changes.

The choice of harvest levels for 2003 involves a tradeoff between levels of risk to the resources and severe near-term negative economic impacts to the users. On one side is the need to reduce human impacts (harvest) in order to achieve a timely recovery of overfished stocks (to ensure long-term benefits related to production, ecosystem services, and existence values). On the other side, the imposition of severe short-term negative economic effects on commercial and recreational fisheries, along with the businesses and communities that depend on those fisheries, must be considered. The risks of overfishing and the consequent reduction of long-term benefits from the fishery are greatest under the *No Action Alternative* (2002 ABCs and OYs, and management measures) and the *High OY Alternative*. The risk would be lowest under the *Low OY Alternative*. Overfished stocks of particular concern in establishing 2003 harvest regulations are bocaccio, yelloweye rockfish, and darkblotched rockfish.

Table 2.5-1 summarizes the costs and benefits associated with the proposed actions. More detailed discussion of the impacts of the proposed action is provided in Chapter 4. The *Council-preferred Alternative* will reduce harvest as compared to the *No Action Alternative*.

3.0 AFFECTED ENVIRONMENT

This chapter describes the affected environment, which is the baseline environmental condition. The baseline represents the status of environmental attributes at a time before the proposed action is implemented, and in Chapter 4 serves as a point of comparison to evaluate possible significant impacts. (The baseline differs from the *No Action Alternative*, which predicts a future environmental state in the absence of any action alternative.) Because of the time lag involved in compiling landings data and other fisheries information, 2001 is used as the baseline.

The affected environment description is subdivided into four main sections, describing different components of the human environment. Section 3.1 describes, in general terms, the habitats of and ecological relationships between the marine species potentially affected by the proposed action. Section 3.2 describes potentially affected groundfish, nongroundfish, and non-fish species. Section 3.3 covers socioeconomic components of the human environment, including descriptions of the different fisheries and support industries exploiting groundfish and coastal communities dependent on or substantially engaged in fishing. Section 3.4 describes the management regime, including the various sources of risk and uncertainty that affect groundfish management.

3.1 Ecosystem Habitat and Biodiversity

3.1.1 West Coast Marine Ecosystems

Ecosystem and habitat, discussed below, are closely related concepts. Ecosystems embody both the relationships between species, represented by the flow of material and energy through a network of relationships, and the sum total of the species comprising the system within a given physical setting. This overlaps with habitat as the physical and biological attributes to the space occupied by a particular species. The ecosystem concept is reflected in groundfish management through the use of biogeographic zones and species complexes to distinguish the application of management measures. These ecological divisions have both a north south component, with Cape Mendocino representing an important break in the distribution of many groundfish species (particularly rockfish), hence the use of the 40° 10' N line of latitude (or alternatively, 40° 30' N latitude). Point Conception represents another important biogeographic boundary considered when crafting management measures. A second, and perhaps more influential, ecological demarcation depends on distance from shore, or depth. Groundfish are managed based on distinction between nearshore, continental shelf, and continental slope species. Distinct species assemblages characterize these zones; in addition, there are differences between the zones based on possible vertical distribution of species. Finally, particular species may exhibit seasonal migrations, producing some annual variation in the characteristics of these different ecological zones. The nearshore, shelf, and slope ecosystems can be characterized by combinations of the habitat composites described below, the species assemblages particular to these ecosystems, and the trophic relationships between these species. More specific information on trophic relationships may be found in the managed species descriptions in section 3.2.

Bathymetry and physical topography helps determine habitat, by influencing its physical structure, and also the co-occurrence of species. The U.S. West Coast is characterized by a relatively narrow continental shelf. The 200 m depth contour shows a shelf break closest to the shoreline off Cape Mendocino, Point Sur, and in the Southern California Bight; and widest from Central Oregon north to the Canadian border, as well as off Monterey Bay. Deep submarine canyons pocket the Exclusive Economic Zone (EEZ), with depths greater than 4,000 m south of Cape Mendocino (Figure 3.1-1).

As on land, climate is another important ecological determinant. However, in the ocean's fluid medium, currents are the predominant expression of this broad environmental influence. Not only do currents influence water temperature, vertical mixing and movement can bring nutrient-rich, deep-bottom water into the photic zone, strongly influencing biological productivity. In the North Pacific Ocean, the large, clockwise-moving North Pacific Gyre circulates cold, subarctic surface water eastward across the North Pacific, splitting at the North American continent into the northward-moving Alaska Current and the southward-moving California Current (Figure 3.1-2). Along the U.S. West Coast, the surface California Current flows southward through the U.S. West Coast EEZ. The California Current is known as an eastern boundary current, meaning

it draws ocean water along the eastern edge of an oceanic current gyre. The northward-moving California Undercurrent flows along the continental margin and beneath the California Current. Influenced by the California Current system and coastal winds, waters off the U.S. West Coast are subject to major nutrient upwelling, particularly off Cape Mendocino (Bakun 1996). Shoreline topographic features such as Cape Blanco and Point Conception, and bathymetric features such as banks, canyons, and other submerged features, often create large-scale current patterns such as eddies, jets, and squirts. For example, a current jet off Cape Blanco drives surface water offshore, which is replaced by upwelling sub-surface water (Barth *et al.* 2000). One of the better known current eddies off the West Coast occurs in the Southern California Bight between Point Conception and Baja, California (Longhurst 1998), wherein the current circles back on itself by moving in a northward and counterclockwise motion just within the Bight.
While the seasonal environmental effects of the California Current and related lesser current patterns are easily observable (Lynn and Simpson 1987), the influence of longer period cycles has only been appreciated recently. The effect of El Niño-Southern Oscillation (ENSO) events on climate and ocean productivity in the northeast Pacific is relatively well-known. In the past decade a still longer period cycle, termed the Pacific Decadal Oscillation or PDO, has been identified. Although similar in effect, instead of the 1 year to 2 year periodicity of ENSO, PDO events affect ocean conditions for 15 years to 25 years (Mantua in press). The PDO shifts between warm and cool phases. The warm phase is characterized by warmer temperatures in the northeast Pacific (including the West Coast) and cooler-than-average sea surface temperatures and lower-than-average sea level air pressure in the central North Pacific; opposite conditions prevail during cool phases. Because the effects are similar, "in-phase" ENSO events (e.g., an El Niño during a PDO warm phase) can be intensified. (However, aside from these phase effects, PDO conditions, although of much longer duration than ENSO events, are milder. It is also important to note that—while the fundamental causes of PDO are not fully understood—they are known to be different from those driving ENSO events. And while ENSO has its primary effect on the tropical Pacific, with secondary effects in colder regions, the opposite is true of PDO; its primary effects occur in the northeast Pacific.) The ecosystem effects of PDO conditions are pervasive. Climate conditions directly affect primary production (phytoplankton abundance), but ecosystem linkages ensure these changes influence the abundance of higher trophic level organisms, including fish populations targeted by fishers (Francis *et al.* 1998). Scientists have identified four regime shifts during the twentieth century, with the most recent occurring in 1976/1977, when a warm phase began. This has produced less productive ocean conditions off the West Coast and more favorable conditions around Alaska. For example, Hare *et al.*(1999) document the inverse relationship between salmon production in Alaska and the Pacific Northwest and relate this to PDO-influenced ocean conditions. Researchers have identified similar relationships between meso-scale climate regimes and the productivity of other fish populations, including groundfish (see Francis *et al.* 1998 for a review). Researchers have recently identified a second regime shift, occurring in 1989 (Hare and Mantua 2000), which apparently resulted in a further decline in the productivity of some fish populations in the northeast Pacific, including some groundfish species (McFarlane *et al.* 2000). (Pacific hake and sardine populations, in contrast, showed increases.) Hare and Mantua (2000) hypothesize that a still longer, 50 year to 70 year oscillation may combine with the 15 year to 25 year PDO to produce shifts that vary in their characteristics, as do the 1977 and 1989 phenomena. However, a shift to a more favorable PDO cold phase may have occurred in the late 1990s, as evidenced in recent measurements of sea surface temperature (Bernton 2000).

The influence of ocean conditions, and in particular meso-scale climate regimes that can rapidly shift phases, is an important issue for annual management. As Hare and Mantua (2000) point out, current assessment models do not account for these changes in environmental conditions, which may lead to under- or over-estimation of population productivity. In turn, the range of OY values in the harvest level alternatives are derived from these assessments. Unfortunately, the ability to predict regime shifts and determine the precise correlation between environmental conditions and population productivity, preclude the incorporation of such measurements into assessment models. In contrast, fishers' direct empirical evidence (albeit unquantified) of recent increases in productivity (visible, for example, in the abundance of juvenile bocaccio due to a strong year class) causes some to distrust scientific assessments that lead to further reductions in harvest specifications. (These issues are closely related to the nature of scientific uncertainty in the management process, discussed in section 3.4.4.)

In summary, harvest level alternatives can be evaluated for their effects on several ecosystem-related issues. By specifying the maximum amount of fish that may be removed through fishing, these alternatives affect abundance, which in turn can contribute to changes in trophic relationships (target species as either predators or prey) and community structure (relative abundance of species within an assemblage). As just discussed, climate variation at various time scales (e.g., ENSO, PDO) complicates accurate determination of OY harvests through medium- to long-term shifts in population productivity. These effects are indirect and cumulative, especially since ecosystem effects are more likely to affect population changes that are the result of harvests over several years.

3.1.2 Essential Fish Habitat

The 1996 Sustainable Fisheries Act re-authorizing and amending the Magnuson-Stevens Act obligates the Councils and NMFS to identify and characterize essential fish habitat (EFH), which for West Coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. To satisfy this description EFH must be described for all life history stages of managed species. EFH descriptions have been incorporated into the Groundfish FMP in both section 11.10 and in a detailed appendix (available online at: http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html). West Coast groundfish species managed by the Groundfish FMP (see section 3.2.1) occur throughout the EEZ and occupy diverse habitats at all stages in their life histories. EFH may be large, because a species' pelagic eggs and larvae are widely dispersed for example, or comparatively small as is the case with the adults of many nearshore rockfishes which show strong affinities to a particular location or type of substrate.

This section summarizes the more than 400 EFH areas identified in the Groundfish FMP for all the different life history stages of West Coast groundfish species. This EFH collectively includes all waters from the mean high water line and the upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California seaward to the boundary of the U.S. EEZ.

The Groundfish FMP groups the various EFH descriptions into seven major habitat types called "composite" EFHs. This approach focuses on ecological relationships among species and between the species and their habitat, reflecting an ecosystem approach in defining EFH. The seven composite EFH identifications are as follows:

1. Estuarine - Those waters, substrates and associated biological communities within bays and estuaries of the EEZ, from mean higher high water level (MHHW, which is the high tide line) or extent of upriver saltwater intrusion to the respective outer boundaries for each bay or estuary as defined in 33 CFR 80.1 (Coast Guard lines of demarcation).

2. Rocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fm) overlying rocky areas, including reefs, pinnacles, boulders and cobble, along the continental shelf, excluding canyons, from the high tide line MHHW to the shelf break (~200 meters or 109 fm).

3. Nonrocky Shelf - Those waters, substrates, and associated biological communities living on or within ten meters (5.5 fm) overlying the substrates of the continental shelf, excluding the rocky shelf and canyon composites, from the high tide line MHHW to the shelf break (~200 meters or 109 fm).

4. Canyon - Those waters, substrates, and associated biological communities living within submarine canyons, including the walls, beds, seafloor, and any outcrops or landslide morphology, such as slump scarps and debris fields.

5. Continental Slope/Basin - Those waters, substrates, and biological communities living on or within 20 meters (11 fm) overlying the substrates of the continental slope and basin below the shelf break (~200 meters or 109 fm) and extending to the westward boundary of the EEZ.

6. Neritic Zone - Those waters and biological communities living in the water column more than ten meters (5.5 fm) above the continental shelf.

7. Oceanic Zone - Those waters and biological communities living in the water column more than 20 meters (11 fm) above the continental slope and abyssal plain, extending to the westward boundary of the EEZ.

Management measure alternatives that affect fishing activities having potential adverse effects on EFH must be evaluated. Evaluation of fishery effects on EFH is done through a consultation process with NMFS Office of Habitat Conservation. One method of evaluating fishery effects is based on fishing effects on habitat types. As discussed in section 11.10.3.1 of the Groundfish FMP, fishing gear can damage benthic habitat, which may contribute to the kinds of ecological effects described in the previous section. Altered habitat may favor some species, contributing to a change in community structure, and more broadly, to the population productivity of fish populations caught in fisheries.

3.1.3 Biodiversity of Managed Fish Stocks

Biodiversity, shorthand for biological diversity, is a measure of the number of coexisting species and variability or genetic diversity within a population. The biodiversity concept may also be used to evaluate other aspects of variation and complexity, such as ecosystem diversity or species provenance—distinguishing between native and invasive species, for example. Biodiversity is, therefore, another way of thinking about ecosystem structure, which can be an important factor in population productivity. (See the discussion above and under cumulative impacts in Chapter 4.) This link is reflected in the similarity between principles outlined by the Council on Environmental Quality (CEQ) for ecosystem management (CEQ 1993) and those found in a recent panel report on ecosystem-based fishery management (EPAP 1999). Fishery harvests primarily affect local or regional species abundance rather than being directly implicated in species extinctions, although nationally a few marine fish species have been listed under the ESA (including numerous salmon runs on the West Coast, see section 3.2.3.1). Overfished species are the most salient biodiversity concern in the context of groundfish management, because substantially reduced stock sizes could correlate with changes in the range or distribution of a species (implying local or temporary "extinctions").

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. The duration of larval and juvenile phases, and the degree to which they are pelagic and subject to current dispersal, also influences recruitment to a particular area or region. In fact, processes of dispersion and isolation contribute to speciation. For example, two rougheye rockfish forms, which may be cryptic species, are found in the Gulf of Alaska and the Aleutian Islands. A current gyre in the Gulf of Alaska may control larval dispersal, isolating the two populations from one another (Love *et al.* 2002, p. 14). The effect of local depletion on long-term abundance is thus influenced by a variety of often not well-understood processes: recruits may be transported from elsewhere to repopulate the area, and the concept of local depletion may have little meaning when considering a highly mobile species. Conversely, sedentary species—like cowcod—may be quite vulnerable to local extinction, especially if juvenile recruitment is wholly local. Ecological factors can also "tip the balance" for depleted populations. As discussed in the cumulative effects section of Chapter 4, researchers are beginning to identify cultivation/depensation effects that run counter to traditional ideas of density-dependent population response (Pauly *et al.* 2002). Adults of a given species may control the abundance of species preying on their juveniles. If the number of adults is reduced below some level, this predation is unchecked, leading to serial recruitment failure. This process is hypothesized for large-sized rockfish species; declines in several of these species is correlated with increases in the abundance of smaller-sized rockfish species. The latter may be preying on the former's juveniles (K. Piner, pers. comm.)

Currently, the southern bocaccio stock is thought to present the greatest risk for the localized or possibly stock-wide extinction. Although this risk is remote, a petition has been submitted to have it listed under the ESA. Concern about this stock has intensified, because the most recent rebuilding analysis concluded that even in the absence of fishing there is a less than 50% chance of the stock rebuilding within the maximum specified time period. This anomalous situation results from a re-analysis taking into account harvests occurring after its declaration as an overfished species. (It should be noted that many anecdotal reports suggest strong recent recruitment, but these events are not reflected in the data that were used to assess the stock and may not be by themselves sufficient to substantially alter the population's status.) As discussed in section 3.2.1.1, this bocaccio stock was evaluated in a population viability or extinction risk analysis. The 20 mt total harvest mortality cap used to structure the alternatives for 2003 represents a greater than 80% probability the stock will not decline in the next 100 years.

3.1.4 Current Research on the Fishery Ecosystem

In 2002 the NMFS Northwest Fisheries Science Center established a new ecosystem-based management research group--Science for Ecosystem-based Management Initiative (SEMI). This group will perform research on the ecological interactions and processes necessary to sustain ecosystem composition, structure and function in the environments in which fish and fisheries exist. SEMI will investigate interactions of a target fish stock with predators, competitors, and prey, effects of weather and climate on target species and their ecological communities, effects of fishing on marine ecosystems and fish habitat, interactions between fishes and their habitat, and Marine Protected Areas as a fisheries conservation and management tool.

NMFS Northwest Region is also current preparing a comprehensive EIS evaluating impacts to EFH. This assessment will consider alternative designations of groundfish Essential Fish Habitat, Habitat Areas of Particular Concern, and alternative measures to minimize adverse effects caused by fishing on such designated areas. It will also update and refine work done to date on these topics by NMFS and the Council. It is expected that this EFH EIS will improve the Council's and NMFS' ability to evaluate the impacts of groundfish management actions.

There are also numerous academic research projects underway focusing on fishery ecosystem dynamics in the northeast Pacific.

3.2 Biological Environment - Managed Species

This section describes the species that may be directly or indirectly affected by the proposed action. They are divided into three groups. Section 3.2.1 describes the principal groundfish species directly subject to the annual specifications and management measures evaluated in this EIS. Section 3.2.2 reviews nongroundfish species that may be affected, because they are caught incidentally in groundfish fisheries, or conversely because the fisheries targeting them catch groundfish incidentally, and therefore, may be regulated to reduce or eliminate this incidental catch (thus indirectly affecting the catch of these nongroundfish species). Section 3.2.3 describes various legally protected species covered by the ESA, Marine Mammal Protection Act, and the Migratory Bird Treaty Act.

3.2.1 Groundfish Resources

There are over 80 species of groundfish managed under the Groundfish FMP. These species include over 60 species of rockfish in the family *Scorpaenidae*, 7 roundfish species, 12 flatfish species, assorted shark, skate, and a few miscellaneous bottom-dwelling marine fish species. Management of these groundfish species is based on principles outlined in the Magnuson-Stevens Act, Groundfish FMP, and National Standards Guidelines, which interpret the tenets of the Magnuson-Stevens Act. Stock assessments are based on resource surveys, catch trends in West Coast fisheries, and other sources of informative data. Section 3.4.1 describes, in general terms, how stock assessments are conducted and reviewed before they are applied in West Coast groundfish management. Table 3.2-1 depicts the latitudinal and depth distributions of groundfish species managed under the Groundfish FMP.

The passage of the Sustainable Fisheries Act in 1996 incorporated current conservation and rebuilding mandates into the Magnuson-Stevens Act. These mandates—including abundance-based standards for declaring a stock overfished, in a ?precautionary" status, or at levels that can support maximum sustainable yield (MSY) (healthy or ?rebuilt")—were subsequently incorporated in the Groundfish FMP with adoption of Amendments 11 and 12. The abundance-based reference points for managing West Coast groundfish species are relative to an estimate of ?virgin" or unexploited biomass of the stock, which is denoted as B_0 and is defined as the average equilibrium abundance of a stock's spawning biomass before it is affected by fishing-related mortality. The Magnuson-Stevens Act and National Standards Guidelines employ the MSY concept, to frame management objectives. MSY represents a theoretical maximum surplus production from a population of constant size; National Standards Guidelines define it as “the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.” Thus, for a given population, and set of ecological conditions, there is a biomass that produces MSY (denoted as B_{MSY}), which is less than the equilibrium size in the absence of fishing (B_0). (Generally, population sizes above B_{MSY} are less productive, because of competition for resources.) The harvest rate used to specify harvest levels designed to achieve or sustain B_{MSY} is referred to as the Maximum Fishing Mortality Threshold (MFMT, denoted as F_{MSY}). There are two harvest specification reference points defined in the Groundfish FMP, a total catch OY and an acceptable biological catch (ABC). The OY is typically the management target and is usually less than the ABC, based on the need to rebuild stocks to B_{MSY} (see the following discussion). The ABC, which is the maximum allowable harvest, is calculated by applying an estimated or proxy F_{MSY} harvest rate to the estimated abundance of the stock.

The Council-specified proxy MSY abundance for most West Coast groundfish species is 40% of B_0 (denoted as $B_{40\%}$). The Council-specified threshold for declaring a stock overfished is when the stock's spawning biomass declines to less than 25% of B_0 (denoted as $B_{25\%}$). The Magnuson-Stevens Act and National Standards Guidelines refer to this threshold as the Minimum Stock Size Threshold or MSST. A rebuilding plan that specifies how total fishing-related mortality is constrained to achieve an MSY abundance level within the legally allowed time is required by the Magnuson-Stevens Act and Groundfish FMP when a stock is declared overfished. The harvest levels considered for overfished groundfish stocks in 2003 are based on a range of harvest rates estimated to rebuild these stocks within the requisite time at different probabilities.

Stocks estimated to be above the overfishing threshold yet below an abundance level that supports MSY are considered to be in the ?precautionary zone.” The Council has specified precautionary reductions in harvest rate for such stocks to increase abundance to $B_{40\%}$. The methodology for determining this precautionary reduction is described in the Groundfish FMP and is referred to as the ”40-10” adjustment. As the stock declines below $B_{40\%}$, the total catch OY is reduced from the ABC until, at 10% of B_0, the OY is set to zero. However, in practice the 40-10 adjustment only applies to stocks above $B_{25\%}$ (the MSST), because once a stock falls below this level, an adopted rebuilding plan supplants it. Most stocks with an estimated abundance greater than $B_{40\%}$ are managed by setting harvest to the ABC. Figure 3.2-1 presents this framework graphically.

The remainder of section 3.2.1 describes groundfish stocks according to the categories just described: overfished, precautionary zone, and healthy. However, it is important to realize that of the more than 80 species in the management unit only a portion are individually managed. Thus, section 3.2.1.3, covering stocks at or above target stock size, describes five species managed under separate harvest specifications. The remaining species are managed and accounted for in groupings or stock complexes, because individually they comprise a small part of the landed catch; and there is, thus, insufficient information to develop the stock assessments necessary to set an OY based on yield estimates. (The Groundfish FMP identifies the OY for these species as an average of historical catch, based on the assumption that this is below MSY.)

3.2.1.1 Overfished Stocks

Based on the Groundfish FMP’s standards for defining overfished groundfish species, nine West Coast groundfish species have been declared overfished by NMFS. These nine species are bocaccio, canary rockfish, cowcod, darkblotched rockfish, lingcod, Pacific ocean perch, Pacific whiting, widow rockfish, and yelloweye rockfish. Rebuilding parameters estimated for these stocks are found in Tables 3.2-2 and 3.2-3.

Bocaccio

Distribution and Life History: Bocaccio (*Sebastes paucispinis*) are found in the Gulf of Alaska off Krozoff and Kodiak Islands, south as far as Sacramento Reef, Baja, California (Hart 1988; Miller and Lea 1972). In survey catches, Allen and Smith (1988) found bocaccio to be most common at 100 m to 150 m over the outer continental shelf. Casillas *et al.* (1998) determined the depth zone where the southern bocaccio stock is most prevalent is 54 fm to 82 fm. Sakuma and Ralston (1995) categorized bocaccio as both a nearshore and offshore species. Larvae and small juveniles are pelagic (Garrison and Miller 1982) and are commonly found in the upper 100 m of the water column, often far from shore (MBC 1987). Large juveniles and adults are semi-demersal and are most often found in shallow coastal waters over rocky bottoms associated with algae (Sakuma and Ralston 1995). Adults are commonly found in eelgrass beds, or congregated around floating kelp beds (Love *et al.* 1990; Sakuma and Ralston 1995). Young and adult bocaccio also occur around artificial structures, such as piers and oil platforms (MBC 1987.) Although juveniles and adults are usually found around vertical relief, adult aggregations also occur over firm sand-mud bottoms (MBC 1987). Bocaccio move into shallow waters during their first year of life (Hart 1988), then move into deeper water with increased size and age (Garrison and Miller 1982).

Bocaccio are ovoviviparous (Garrison and Miller 1982; Hart 1988). Love *et al.* (1990) reported the spawning season to be protracted and last almost year-round (>10 months). Parturition occurs during January to April off Washington, November to March off Northern and Central California, and October to March off Southern California (MBC 1987). Two or more broods may be born in a year in California (Love *et al.* 1990). The spawning season is not well known in northern waters. Males mature at three years to seven years with 50% mature in four years to five years. Females mature at three years to eight years with 50% mature in four years to six years (MBC 1987).

Larval bocaccio often eat diatoms, dinoflagellates, tintinnids, and cladocerans (Sumida and Moser 1984). Copepods and euphausiids of all life stages (adults, nauplii and egg masses) are common prey for juveniles (Sumida and Moser 1984). Adults eat small fishes associated with kelp beds, including other species of rockfishes, and occasionally small amounts of shellfish (Sumida and Moser 1984). Bocaccio are eaten by sharks, salmon, other rockfishes, lingcod, albacore, sea lions, porpoises, and whales (MBC 1987). Bocaccio directly compete with chilipepper and widow rockfish, yellowtail, and shortbelly rockfishes for both food and habitat resources (Reilly *et al.* 1992).

Stock Status and Management History: There are two separate West Coast bocaccio populations. The southern stock exists south of Cape Mendocino and the northern stock north of 48° N latitude in northern Washington (off Cape Flattery). It is unclear whether the southern and northern stock separation implies stock structure. The disjoint distribution of the two populations and evidence of lack of genetic intermixing suggests stock structure, although MacCall (2002a), spoke to some recent evidence for limited genetic mixing between the two populations. Nonetheless, assessment scientists and managers have treated the two populations as independent stocks north and south of Cape Mendocino.

The northern stock has not been assessed. The southern stock has been assessed (Bence and Hightower 1990; Bence and Rogers 1992; MacCall *et al.* 1999; Ralston *et al.* 1996b) and has suffered poor recruitment during the warm water conditions that have prevailed off Southern California since the late 1980s. The 1996 assessment (Ralston *et al.* 1996b) indicated the stock was in severe decline and overfished. NMFS formally declared the stock overfished in March 1999 after the Groundfish FMP was amended to incorporate the tenets of the Sustainable Fisheries Act. MacCall *et al.* (1999) confirmed the overfished status of bocaccio and estimated spawning output of the southern stock to be 2.1% of its unfished biomass and 5.1% of the MSY level.

While previous assessments only used data from Central and Northern California, the newest assessment (MacCall 2002b) also includes data for Southern California. While relative abundance increased slightly from the last assessment (4.8% of unfished biomass), potential productivity appears lower than previously thought, making for a more pessimistic outlook. The Council assumed a medium recruitment scenario for the 1999 year class, which was not assessed MacCall *et al.* (1999). But the new assessment revealed the 1999 year class experienced relatively lower recruitment. Therefore, the 1999 year class—though contributing a substantial quantity of fish to the population—did not contribute as much to rebuilding as was previously thought.

<u>Canary Rockfish</u>

Distribution and Life History: Canary rockfish (*Sebastes pinniger*) are found between Cape Colnett, Baja, California, and southeastern Alaska (Boehlert 1980; Boehlert and Kappenman 1980; Hart 1988; Love 1991; Miller and Lea 1972; Richardson and Laroche 1979). There is a major population concentration of canary rockfish off Oregon (Richardson and Laroche 1979). Canary rockfish primarily inhabit waters 91 m to 183 m (50 fm to 100 fm) deep (Boehlert and Kappenman 1980). In general, canary rockfish inhabit shallow water when they are young, and deep water as adults (Mason 1995). Adult canary rockfish are associated with pinnacles and sharp drop-offs (Love 1991) and are most abundant above hard bottoms (Boehlert and Kappenman 1980). Canary rockfish appear to be a reef-associated species in the southern part of its range (Boehlert 1980). In Central California, newly settled canary rockfish are first observed at the seaward sand-rock interface and farther seaward in deeper water (18 m to 24 m).

Canary rockfish off the West Coast exhibit a protracted spawning period from September through March, probably peaking in December and January off Washington and Oregon (Hart 1988; Johnson *et al.* 1982). Female canary rockfish reach sexual maturity at roughly eight years of age. Like many members of *Sebastes*, canary rockfish are ovoviviparous, whereby eggs are internally fertilized within females, and hatched eggs are released as live young (Bond 1979; Golden and Demory 1984; Kendall and Lenarz 1986). Canary rockfish are a relatively fecund species, with egg production being correlated with size, (e.g., a 49-cm female can produce roughly 0.8 million eggs, and a female that has realized maximum length (approximately 60 cm) produces approximately 1.5 million eggs (Gunderson 1971). Very little is known about the early life history strategies of canary rockfish, but limited research indicates larvae which are strictly pelagic (near ocean surface) for a short period of time, begin to migrate to demersal waters during the summer of their first year of life and develop into juveniles around nearshore rocky reefs, where they may congregate for up to three years (Boehlert 1980; Sampson 1996). Evaluations of length distributions by depth developed from NMFS shelf trawl survey data generally supported other research that suggests this species is characterized by an increasing trend in mean size of fish with depth (Archibald *et al.* 1981; Boehlert 1980). Female canary rockfish generally grow faster and reach slightly larger sizes than males, but do not appear to live longer than males. Adult canary rockfish feed primarily on small fishes, as well as planktonic creatures, such as krill and euphausiids (Love 1991; Phillips 1964).

Stock Status and Management History: From 1983 through 1994, canary rockfish were managed as part of the *Sebastes* complex, with various trip limits imposed over this period. In 1995, limits specific to canary rockfish (cumulative monthly landing limit of 6,000 pounds) were imposed, and commercial vessels were expected to sort the canary rockfish from the mixed species categories such as the *Sebastes* complex. For 1998, catches of canary rockfish were regulated using a two-month cumulative landing limit of 40,000 pounds for the *Sebastes* complex, of which, no more than 15,000 pounds (38%) could be composed of canary rockfish. From 1998 to present, commercial groundfish fishing for canary rockfish has been drastically reduced, and the only significant take is that from incidental bycatch. Canary rockfish has become a limiting factor for other nongroundfish fisheries on the West Coast shelf.

The 1999 stock assessment documented the stock had declined below the overfished level ($B_{25\%}$) in the northern area (Columbia and U.S. Vancouver International North Pacific Fishery Commission (INPFC) areas Crone *et al.* 1999) and in the southern area (Conception, Monterey, and Eureka areas Williams *et al.* 1999) and was declared overfished in January. The first rebuilding analysis (Methot 2000a) used results from the northern area assessment to project rates of potential stock recovery. The stock was found to have extremely low productivity, defined as production of recruits in excess of the level necessary to maintain the stock at its current, low level. Rates of recovery were highly dependent upon the level of recent recruitment, which could not be estimated with high certainty. The initial rebuilding OY for 2001 and 2002 was set at 93 mt based upon a 50% probability of rebuilding by the year 2057, a medium level for these recent recruitments, and maintaining a constant annual catch of 93 mt through 2002 (see Table 3.2.-2).

A new assessment was done coastwide this year for canary rockfish, treating the stock as a single unit from the Monterey INPFC area north through the U.S. Vancouver INPFC area, and thus, departing from the methodologies of past assessments (Methot and Piner 2002b). Although there is some evidence of genetic separation of the northern and southern stocks (Boehlert and Kappenman 1980; Wishard *et al.* 1980), the observed variability in growth rate by sex and area was not significantly different at small versus large spatial scales. They also determined the areas of highest canary rockfish density were off headlands that separate

INPFC areas, which would tend to bias results if the assessment was stratified by area. A critical uncertainty in canary rockfish assessments is the lack of older, mature females in surveys and other assessment indices. The are two competing explanations for this observation. Older females could have a higher natural mortality rate, resulting in their disproportionate disappearance from the population. Alternatively, survey and fishing gears may be less effective at catching them, because older females hide in places inaccessible to the gear, for example. If this is the case, then these fish (which, because of their higher spawning output may make an important contribution to future recruitment) are part of the population, but remain un-sampled. Methot and Piner (2002b) combined these two hypotheses in a single age-structured version of the SSC-endorsed stock synthesis assessment model (Methot 2000b) by allowing female natural mortality to increase with the maturity function, but also allowing selectivity to be domed (the model determines the selectivity of survey and fishery gear as opposed to assuming a fixed selectivity). They estimated the current abundance of canary rockfish coastwide is about 8% of B_0.

<u>Cowcod</u>

Distribution and Life History: Cowcod *(Sebastes levis)* occur from Ranger Bank and Guadalupe Island, Baja, California to Usal, Mendocino County, California (Miller and Lea 1972). Cowcod range from 21 m to 366 m in depth (Miller and Lea 1972) and are considered to be parademersal (transitional between a midwater pelagic and benthic species). Adults are commonly found at depths of 180 m to 235 m and juveniles are most often found in 30 m to 149 m of water (Love *et al.* 1990). MacGregor (1986) found that larval cowcod are almost exclusively found in Southern California and may occur many miles offshore. Adult cowcod are primarily found over high relief rocky areas (Allen 1982). They are generally solitary, but occasionally aggregate (Love *et al.* 1990). Solitary subadult cowcod have been found in association with large white sea anemones on outfall pipes in Santa Monica Bay (Allen 1982). Juveniles occur over sandy bottom areas and solitary ones have been observed resting within a few centimeters of soft-bottom areas where gravel or other low relief was found (Allen 1982). Although cowcod are generally not migratory; it may move, to some extent, to follow food (Love 1991). Cowcod are ovoviviparous, and large females may produce up to three broods per season (Love *et al.* 1990). Spawning peaks in January in the Southern California Bight (MacGregor 1986). Cowcod grow to 94 cm (Allen 1982). Larvae are extruded at about 5.0 mm (MacGregor 1986). Juveniles eat shrimp and crabs, and adults eat fish, octopus, and squid (Allen 1982).

Stock Status and Management History: The cowcod stock south of Cape Mendocino has experienced a long-term decline. Abundance indices decreased approximately ten-fold between the 1960s and the 1990s based on commercial passenger fishing vessel (CPFV) logs (Butler *et al.* 1999). Recreational and commercial catch also declined substantially from peaks in the 1970s and 1980s, respectively.

The cowcod stock in the Conception INPFC area (Point Conception to the U.S./Mexico border) was assessed for the first time in 1998 (Butler *et al.* 1999). Unfished spawning biomass (B_0) was estimated to be 3,370 mt, and 1998 spawning biomass was estimated at 7% of B_0, well below the 25% overfishing threshold. As a result, NMFS declared cowcod in the Conception and Monterey management areas overfished in January 2000. The stock's low productivity and declined spawning biomass necessitates an extended rebuilding period, estimated at 62 years with no fishing-related mortality (T_{MIN}) , to achieve a 1,350 mt B_{MSY} for the Conception management area (see Table 3.2.-2).

<u>Darkblotched Rockfish</u>

Distribution and Life History: Darkblotched rockfish *(Sebastes crameri)* are found from Santa Catalina Island off Southern California to the Bering Sea (Miller and Lea 1972; Richardson and Laroche 1979). Off Oregon, Washington, and British Columbia it is primarily an outer shelf/upper slope species (Richardson and Laroche 1979). Distinct population groups have been found off the Oregon coast between 44°30' N latitude and 45°20' N latitude (Richardson and Laroche 1979). Adults occur in depths of 25 m to 600 m, and 95% are between 50 m and 400 m (Allen and Smith 1988). Off Central California, young darkblotched rockfish recruit to soft substrate and low (<1 m) relief reefs (Love *et al.* 1991). Darkblotched rockfish make limited migrations after they have recruited to the adult stock (Gunderson 1997).

Darkblotched rockfish are viviparous (Nichol and Pikitch 1994). Insemination of female darkblotched rockfish occurs from August to December, fertilization and parturition occurs from December to March off Oregon and California, primarily in February off Oregon and Washington (Hart 1988; Nichol and Pikitch 1994; Richardson and Laroche 1979). Females attain 50% maturity at a greater size (36.5 cm) and age (8.4 years) than males (29.6 cm and 5.1 years) (Nichol and Pikitch 1994). Adults can grow to 57 cm (Hart 1988). Pelagic young are food for albacore (Hart 1988).

Stock Status and Management History: Darkblotched rockfish were managed as part of the coastwide *Sebastes* complex, which was later segregated into north and south management units divided at 40°30' N latitude The first assessment of darkblotched rockfish estimated the proxy MSY harvest rate and overfishing rate for the stock (Lenarz 1993). Lenarz (1993) estimated a range of likely natural mortalities (M = 0.025-0.05) for darkblotched rockfish based on a range of maximum ages (60 years to 105 years). He also estimated fishery selectivity from length compositions from the California fishery, which he converted to an age-based selectivity function. He then plotted the relative fecundity per recruit as a function of fishing-related and natural mortality to estimate an F_{MSY} of $F_{35\%}$ (the target MSY proxy harvest rate at that time) and $F_{20\%}$ (the overfishing harvest rate) relative to fecundity per recruit. He estimated the range of likely harvest rates (F) at the MSY target ($F_{35\%}$) was 0.04 to 0.06, and the overfishing harvest rate ($F_{20\%}$) ranged between 0.07 and 0.11. While Lenarz did not calculate an ABC for darkblotched rockfish, he did note the estimated harvest rates at MSY and overfishing were lower than expected. He also noted a trend of decreasing size of darkblotched rockfish from the length composition data he evaluated.

The next assessment that was informative for darkblotched rockfish addressed all West Coast *Sebastes* without individual ABCs (Rogers *et al.* 1996). Two methodologies were explored for estimating an ABC for darkblotched rockfish (1) fishing-related mortality was assumed to equal natural mortality (F=M) to estimate an $F_{35\%}$ harvest rate, and (2) estimation of $F_{35\%}$ using a simple stock synthesis model. In the F=M approach, a proxy adjustment (Q) to triennial survey data was calculated to estimate relative biomass of generic *Sebastes*. It was determined that adjusting Q by 0.5 and then by M approximated $F_{35\%}$ estimates from stock synthesis models for most rockfish. A Q of 0.8 (instead of 0.5) was assumed for darkblotched rockfish, since the survey swept most of the depth range of darkblotched rockfish and caught smaller fish than the fishery. The other factors that influenced the magnitude of Q was a noted decreasing trend in estimated survey biomass over time, and the estimated size at 50% maturity was greater than estimated size at 50% selectivity (i.e., the survey caught darkblotched rockfish at sizes less than those estimated for most maturing and mature fish). The F=M method was compared to a stock synthesis modeling approach that incorporated triennial survey data and a Pacific ocean perch bycatch effort index.

Rogers *et al.* (2000) assessed the stock's status in 2000 and determined the stock was at 14% of its unfished level ($B_{14\%}$). They incorporated five relative abundance indices in a length-based stock synthesis model (Methot 2000a) to derive current estimates of abundance and productivity. The five indices included three NMFS surveys with different latitudinal and depth coverages, the Pacific ocean perch effort index developed in the generic *Sebastes* assessment (Rogers *et al.* 1996), and a logbook index derived from California trawl logbook and species composition data stratified by major California port (Ralston 1999). Major uncertainties in the assessment model included the uncertain foreign catch composition, which had a significant effect on estimated unfished biomass (B_0), and assumptions regarding maturity, discard rates, and unchanging selectivity over time. Of these, the foreign catch of darkblotched rockfish influences our understanding of stock status the most; larger assumed historical catches increase estimates of B_0. Four accepted model runs varied the assumed foreign catch proportion from 0% to 20%, which resulted in significant differences in B_0 and the spawning index. Only one of those model runs (assuming 0% foreign catch of darkblotched rockfish) estimated the stock was not overfished.

<u>Lingcod</u>

Distribution and Life History: Lingcod (*Ophiodon elongatus*), a top order predator of the family Hexagrammidae, ranges from Baja, California to Kodiak Island in the Gulf of Alaska. Lingcod are demersal at all life stages (Allen and Smith 1988; NOAA 1990; Shaw and Hassler 1989). Adult lingcod prefer two main habitat types: slopes of submerged banks 10 m to 70 m below the surface with seaweed, kelp, and eelgrass beds and channels with swift currents that flow around rocky reefs (Emmett *et al.* 1991; Giorgi and Congleton

1984; NOAA 1990; Shaw and Hassler 1989). Juveniles prefer sandy substrates in estuaries and shallow subtidal zones (Emmett *et al.* 1991; Forrester 1969; Hart 1988; NOAA 1990; Shaw and Hassler 1989). As the juveniles grow they move to deeper waters. Adult lingcod are considered a relatively sedentary species, but there are reports of migrations of greater than 100 km by sexually immature fish (Jagielo 1990; Mathews and LaRiviere 1987; Matthews 1992; Smith *et al.* 1990).

Mature females live in deeper water than males and move from deep water to shallow water in the winter to spawn (Forrester 1969; Hart 1988; Jagielo 1990; LaRiviere *et al.* 1980; Mathews and LaRiviere 1987; Matthews 1992; Smith *et al.* 1990). Mature males may live their whole lives associated with a single rock reef, possibly out of fidelity to a prime spawning or feeding area (Allen and Smith 1988; Shaw and Hassler 1989). Spawning generally occurs over rocky reefs in areas of swift current (Adams 1986; Adams and Hardwick 1992; Giorgi 1981; Giorgi and Congleton 1984; LaRiviere *et al.* 1980). After the females leave the spawning grounds, the males remain in nearshore areas to guard the nests until the eggs hatch. Hatching occurs in April off Washington, but as early as January and as late as June at the geographic extremes of the lingcod range. Males begin maturing at about two years (50 cm), whereas females mature at three plus years (76 cm). In the northern extent of their range, fish mature at an older age and larger size (Emmett *et al.* 1991; Hart 1988; Mathews and LaRiviere 1987; Miller and Geibel 1973; Shaw and Hassler 1989). The maximum age for lingcod is about 20 years (Adams and Hardwick 1992).

Lingcod are a visual predator, feeding primarily by day. Larvae are zooplanktivores (NOAA 1990). Small demersal juveniles prey upon copepods, shrimps, and other small crustaceans. Larger juveniles shift to clupeids and other small fishes (Emmett *et al.* 1991, NOAA 1990). Adults feed primarily on demersal fishes (including smaller lingcod), squids, octopi, and crabs (Hart 1988, Miller and Geibel 1973, Shaw and Hassler 1989). Lingcod eggs are eaten by gastropods, crabs, echinoderms, spiny dogfish, and cabezon. Juveniles and adults are eaten by marine mammals, sharks, and larger lingcod (Miller and Geibel 1973, NOAA 1990).

Stock Status and Management History: In 1997, U.S. scientists assessed the size and condition of the portion of the stock in the Columbia and Vancouver areas (including the Canadian portion of the Vancouver management area), and concluded the stock had fallen to below 10% of its unfished size (Jagielo *et al.* 1997). The Council responded by imposing substantial harvest reductions coastwide, reducing the harvest targets for the Eureka, Monterey, and Conception areas by the same percentage as in the north. In 1999, scientists assessed the southern portion of the stock and concluded the condition of the southern stock was similar to the northern stock, thus confirming the Council had taken appropriate action to reduce harvest coastwide (Adams *et al.* 1999).

Jagielo (2000) conducted a coastwide lingcod assessment and determined the total biomass increased from 6,500 mt in the mid-1990s to about 8,900 mt in 2000. In the south, the population has also increased slightly from 5,600 mt in 1998 to 6,200 mt in 2000. In addition, the assessment concluded previous aging methods portrayed an older population; whereas new aging efforts showed the stock to be younger and more productive. Therefore, the ABC and OY were increased in 2001 on the basis of the new assessment. A revised rebuilding analysis of coastwide lingcod (Jagielo and Hastie 2001) was adopted by the Council in September 2001. It confirmed the major conclusions of the 2000 assessment and rebuilding analysis, but slightly modified recruitment projections to stay on the rebuilding trajectory that reaches target biomass in 2009. This modification resulted in a slight decrease in the 2002 ABC and OY.

<u>Pacific Ocean Perch</u>

Distribution and Life History: Pacific ocean perch (POP, *Sebastes alutus*) are found from La Jolla (Southern California) to the western boundary of the Aleutian Archipelago (Eschmeyer *et al.* 1983; Gunderson 1971; Ito 1986; Miller and Lea 1972), but are common from Oregon northward (Eschmeyer *et al.* 1983). Pacific ocean perch primarily inhabit waters of the upper continental slope (Dark and Wilkins 1994) and are found along the edge of the continental shelf (Archibald *et al.* 1983). Pacific ocean perch occur as deep as 825 m, but usually are at 100 m to 450 m and along submarine canyons and depressions (NOAA 1990). Larvae and juveniles are pelagic; subadults and adults are benthopelagic. Adults form large schools 30 m wide, to 80 m deep, and as much as 1,300 m long (NOAA 1990). They also form spawning schools (Gunderson 1971). Juvenile Pacific ocean perch form ball-shaped schools near the surface or hide in rocks (NOAA 1990).

Throughout its range, Pacific ocean perch are generally associated with gravel, rocky, or boulder type substrate found in and along gullies, canyons, and submarine depressions of the upper continental slope (Ito 1986).

Pacific ocean perch winter and spawn in deeper water (>275 m). In the summer (June through August) they move to feeding grounds in shallower water (180 m to 220 m) (June through August) to allow gonads to ripen (Archibald *et al.* 1983; Gunderson 1971; NOAA 1990). Pacific ocean perch are slow-growing and long-lived. The maximum age has been estimated at about 98 years (Heifetz *et al.* 2000). Largest size is about 54 cm and 2 kg (Archibald *et al.* 1983; Beamish 1979; Eschmeyer *et al.* 1983; Ito 1986; Mulligan and Leaman 1992; NOAA 1990). Pacific ocean perch are carnivorous. Larvae eat small zooplankton. Small juveniles eat copepods, and larger juveniles feed on euphausiids. Adults eat euphausiids, shrimps, squids, and small fishes. Immature fish feed throughout the year, but adults feed only seasonally, mostly April through August (NOAA 1990). Predators of Pacific ocean perch include sablefish and Pacific halibut.

Stock Status and Management History: POP were harvested exclusively by U.S. and Canadian vessels in the Columbia and Vancouver INPFC areas prior to 1965. Large Soviet and Japanese factory trawlers began fishing for POP in 1965 in the Vancouver area and in the Columbia area a year later. Intense fishing pressure by these foreign fleets occurred during the 1966 through 1975 period. The foreign fishery ended in 1977 after passage of the Magnuson-Stevens Act and the transition to a domestic fishery.

The POP resource off the West Coast was overfished before implementation of the Groundfish FMP. Large removals of POP in the foreign trawl fishery, followed by significant declines in catch and abundance led the Council to limit harvest beginning in 1979. A 20-year rebuilding plan for POP was adopted in 1981. Rebuilding under the original plan was largely influenced by a cohort analysis of 1966 through 1976 catch and age composition data (Gunderson 1979), updated with 1977 through 1980 data (Gunderson 1981), and an evaluation of trip limits as a management tool (Tagart *et al.* 1980). This was the first time trip limits were used by the Council to discourage targeting and overharvest of an overfished stock. This is a management strategy still in use today in the West Coast groundfish fishery. The OY for POP was also lowered significantly. After twenty years of rebuilding under the original plan, the stock stabilized at a lower equilibrium than estimated in the pre-fishing condition. While continuing stock decline was abated, rebuilding was not achieved as the stock failed to increase in abundance to B_{MSY}.

Ianelli (1998) estimated POP female spawning biomass in 1997 was 13% of its unfished level, thereby confirming the stock was overfished. NMFS formally declared POP overfished in March 1999 after the Groundfish FMP was amended to incorporate the tenets of the Sustainable Fisheries Act. The Council adopted and NMFS enacted more conservative management measures in 1999 as part of a redoubled rebuilding effort.

A new assessment for POP was done in 2000 which suggests the stock was more productive than originally thought (Ianelli *et al.* 2000). A revised POP rebuilding analysis was completed and adopted by the Council in 2001 (Punt and Ianelli 2001). This analysis estimated a T_{MIN} of 12 years and a T_{MAX} of 42 years. (See Table 3.2-3 for a list of rebuilding parameter values.) It was noted in the rebuilding analysis the ongoing retrospective analysis of historic foreign fleet catches (Rogers In prep) is likely to change projections of POP rebuilding downward.

<u>Pacific Whiting</u>

Distribution and Life History: Pacific whiting (*Merluccius productus*), also known as Pacific hake, are a semi-pelagic merlucciid (a cod-like fish species) that range from Sanak Island in the western Gulf of Alaska to Magdalena Bay, Baja, California Sur. They are most abundant in the California Current System (Bailey 1982; Hart 1988; Love 1991; NOAA 1990). Smaller populations of Pacific whiting occur in several of the larger semi-enclosed inlets of the northeast Pacific Ocean, including the Strait of Georgia, Puget Sound, and the Gulf of California (Bailey *et al.* 1982; Stauffer 1985). The highest densities of Pacific whiting are usually between 50 m and 500 m, but adults occur as deep as 920 m and as far offshore as 400 km (Bailey 1982; Bailey *et al.* 1982; Dark and Wilkins 1994; Dorn 1995; Hart 1988; NOAA 1990). Pacific whiting school at depth during the day, then move to the surface and disband at night for feeding (McFarlane and Beamish

1986; Sumida and Moser 1984; Tanasich *et al.* 1991). Coastal stocks spawn off Baja, California in the winter, then the mature adults begin moving northward and inshore following food supply and Davidson Currents (NOAA 1990). Pacific whiting reach as far north as southern British Columbia by fall. They then begin a southern migration to spawning grounds further offshore (Bailey *et al.* 1982; Dorn 1995; Smith 1995; Stauffer 1985).

Spawning occurs from December through March, peaking in late January (Smith 1995). Pacific whiting are oviparous with external fertilization. Eggs of the Pacific whiting are neritic and float to neutral buoyancy (Baily 1981, Bailey *et al.* 1982, NOAA 1990). Hatching occurs in five days to six days, and within three months to four months juveniles are typically 35 mm (Hollowed 1992). Juveniles move to deeper water as they get older (NOAA 1990). Females mature at three years to four years (34 cm to 40 cm) and nearly all males are mature by three years (28 cm). Females grow more rapidly than males after four years; growth ceases for both sexes at 10 years to 13 years (Bailey *et al.* 1982).

All life stages feed near the surface late at night and early in the morning (Sumida and Moser 1984). Larvae eat calanoid copepods, as well as their eggs and nauplii (McFarlane and Beamish 1986; Sumida and Moser 1984). Juveniles and small adults feed chiefly on euphausiids (NOAA 1990). Large adults also eat amphipods, squid, herring, smelt, crabs, and sometimes juvenile whiting (Bailey 1982, Dark and Wilkins 1994, McFarlane and Beamish 1986, NOAA 1990). Eggs and larvae of Pacific whiting are eaten by pollock, herring, invertebrates, and sometimes Pacific 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 (Fiscus 1979; McFarlane and Beamish 1986; NOAA 1990).

Stock Status and Management History: The history of the coastal whiting fishery is characterized by rapid changes brought about by the development of foreign fisheries in 1966, joint-venture fisheries in the early 1980s, and domestic fisheries in 1990s. (See section 3.3.1.1 for a description.) Whiting are assessed annually by a joint technical team of U.S. and Canadian scientists. This year's assessment (Helser *et al.* 2002), incorporating 2001 hydroacoustic survey data, was completed and examined by the Council's groundfish stock assessment review (STAR) Team for whiting in late February. The new whiting stock assessment shows the spawning stock biomass declined substantially and has been lower during the past several years than previously estimated. The stock assessment estimated the biomass in 2001 was 0.7 million mt, and the female spawning biomass was less than 20% of the unfished biomass. This is substantially lower than the 1998 assessment, which estimated the biomass to be at 39% of its unfished biomass. Therefore, NMFS declared the whiting stock overfished in April 2002. The stock was projected to be near 25% of the unfished biomass in 2002 and above $B_{25\%}$ in 2003. In retrospect, revised biomass estimates based on the results of the new assessment indicate the exploitation rates in 1999 (28%), 2000 (24%) and 2001 (31%) were above the overfishing level.

Although a large amount of juvenile fish, spawned in 1999, are expected to mature and enter the fishery in the near future, the spawning biomass is not expected to increase above the MSY biomass level of $B_{40\%}$ for several years. Any increases in biomass will depend on the vigor of juvenile fish that mature and enter the fishery and the exploitation rates as well.

<u>Widow Rockfish</u>

Distribution and Life History: Widow rockfish (*Sebastes entomelas*) range from Albatross Bank of Kodiak Island to Todos Santos Bay, Baja, California (Eschmeyer *et al.* 1983; Miller and Lea 1972; NOAA 1990). Widow rockfish occur over hard bottoms along the continental shelf (NOAA 1990). Widow rockfish prefer rocky banks, seamounts, ridges near canyons, headlands, and muddy bottoms near rocks. Large widow rockfish concentrations occur off headlands such as Cape Blanco, Cape Mendocino, Point Reyes, and Point Sur. Adults form dense, irregular, midwater and semi-demersal schools deeper than 100 m at night and disperse during the day (Eschmeyer *et al.* 1983, NOAA 1990, Wilkins 1986). All life stages are pelagic, but older juveniles and adults are often associated with the bottom (NOAA 1990). All life stages are fairly common from Washington to California (NOAA 1990). Pelagic larvae and juveniles co-occur with yellowtail rockfish, chilipepper, shortbelly rockfish, and bocaccio larvae and juveniles off Central California (Reilly *et al.* 1992).

Widow rockfish are viviparous, have internal fertilization, and brood their eggs until released as larvae (NOAA 1990; Ralston *et al.* 1996a; Reilly *et al.* 1992). Mating occurs from late fall-early winter. Larval release occurs from December through February off California, and from February through March off Oregon. Juveniles are 21 mm to 31 mm at metamorphosis, and they grow to 25 cm to 26 cm over three years. Age and size at sexual maturity varies by region and sex, generally increasing northward and at older ages and larger sizes for females. Some mature in three years (25 cm to 26 cm), 50% are mature by four years to five years (25 cm to 35 cm), and most are mature in eight years (39 cm to 40 cm) (NOAA 1990). The maximum age of widow rockfish is 28 years, but rarely over 20 years for females and 15 years for males (NOAA 1990). The largest size is 53 cm and about 2.1 kg (Eschmeyer *et al.* 1983, NOAA 1990).

Widow rockfish are carnivorous. Adults feed on small pelagic crustaceans, midwater fishes (such as age-one or younger Pacific whiting), salps, caridean shrimp, and small squids (Adams 1987; NOAA 1990). During spring, the most important prey item is salps, during the fall fish are more important, and during the winter widow rockfish primarily eat sergestid shrimp (Adams 1987). Feeding is most intense in the spring after spawning (NOAA 1990). Pelagic juveniles are opportunistic feeders, and their prey consists of various life stages of calanoid copepods, and euphausiids (Reilly *et al.* 1992).

Stock Status and Management History: The most recent assessment of the widow rockfish stock occurred in 2000 (Williams *et al.* 2000). The spawning output level (8,223 mt), based on that assessment and a revised rebuilding analysis (Punt and MacCall 2002) adopted by the Council in June 2001, was at 24.6% of the unfished level (33,490 mt) in 1999, which was computed using the average recruitment from 1968 to 1979 multiplied by the spawning output-per-recruit at F = 0. The analysis concluded the rebuilding period in the absence of fishing is 22 years, and with a mean generation time of 16 years, the maximum allowable time to rebuild (T_{MAX}) is 38 years.

The 2002 widow rockfish ABC (3,727 mt) was based on estimated biomass and an $F_{50\%}$ harvest rate. The 2002 OY for widow rockfish was 856 mt, which conforms with a 60% probability of rebuilding within T_{MAX}.

<u>Yelloweye Rockfish</u>

Distribution and Life History: Yelloweye rockfish *(Sebastes ruberrimus*) range from the Aleutian Islands, Alaska to northern Baja, California and are common from Central California northward to the Gulf of Alaska (Eschmeyer *et al.* 1983; Hart 1988; Love 1991; Miller and Lea 1972; O'Connell and Funk 1986). Yelloweye rockfish occur in water 25 m to 550 m deep with 95% of survey catches occurring from 50 m to 400 m (Allen and Smith 1988). Yelloweye rockfish are bottom dwelling, generally solitary, rocky reef fish, found either on or just over reefs (Eschmeyer *et al.* 1983; Love 1991; O'Connell and Funk 1986). Boulder areas in deep water (>180 m) are the most densely populated habitat type, and juveniles prefer shallow-zone broken-rock habitat (O'Connell and Carlile 1993). They also reportedly occur around steep cliffs and offshore pinnacles (Rosenthal *et al.* 1982). The presence of refuge spaces is an important factor affecting their occurrence (O'Connell and Carlile 1993).

Yelloweye rockfish are ovoviviparous and give birth to live young in June off Washington (Hart 1988). The age of first maturity is estimated at six years and all are estimated to be mature by eight years (Wyllie Echeverria 1987). Yelloweye rockfish can grow to 91 cm (Eschmeyer *et al.* 1983; Hart 1988). Males and females probably grow at the same rates (Love 1991, O'Connell and Funk 1986). The growth rate of yelloweye rockfish levels off at approximately 30 years of age (O'Connell and Funk 1986). Yelloweye rockfish can live to be 114 years old (Love 1991, O'Connell and Funk 1986). Yelloweye rockfish are a large predatory reef fish that usually feeds close to the bottom (Rosenthal *et al.* 1988). They have a widely varied diet, including fish, crabs, shrimps and snails, rockfish, cods, sand lances, and herring (Love 1991). Yelloweye rockfish have been observed underwater capturing smaller rockfish with rapid bursts of speed and agility. Off Oregon the major food items of the yelloweye rockfish include cancroid crabs, cottids, righteye flounders, adult rockfishes, and pandalid shrimps (Steiner 1978). Quillback and yelloweye rockfish have many trophic features in common (Rosenthal *et al.* 1988).

Stock Status and Management History: The first ever yelloweye rockfish stock assessment was conducted in 2001 (Wallace 2002). This assessment incorporated two area assessments: one from Northern California using catch per unit of effort (CPUE) indices constructed from Marine Recreational Fisheries Statistical Survey (MRFSS) sample data and California Department of Fish and Game (CDFG) data collected on board commercial passenger fishing vessels, and the other from Oregon using Oregon Department of Fish and Wildlife (ODFW) sampling data. The assessment concluded current yelloweye rockfish stock biomass is about 7% of unexploited biomass in Northern California and 13% of unexploited biomass in Oregon. The assessment revealed a thirty-year declining biomass trend in both areas with the last above average recruitment occurring in the late 1980s. The assessment's conclusion that yelloweye rockfish biomass was well below the 25% of unexploited biomass threshold for overfished stocks led to this stock being separated from the rockfish complexes in which it was previously listed. Until 2002, when yelloweye rockfish were declared overfished, they were listed in the ?remaining rockfish" complex on the shelf in the Vancouver, Columbia, and Eureka INPFC areas and the ?other rockfish" complex on the shelf in the Monterey and Conception areas. As with the other overfished stocks, yelloweye rockfish harvest is now tracked separately.

In June 2002 the SSC recommended that managers should carry out a new assessment incorporating Washington catch and age data. This recommendation was based on evidence the biomass distribution of yelloweye rockfish on the West Coast was centered in waters off Washington and that workable data from Washington were available. The Council received that testimony and recommended completing a new assessment in the summer of 2002, before a final decision is made on 2003 management measures Methot *et al.* (2002) did the assessment, which was reviewed by a STAR Panel in August. The assessment result was much more optimistic than the one prepared by Wallace (2002), largely due to the incorporation of Washington fishery data. While the overfished status of the stock was confirmed (24% of unfished biomass), Methot *et al.* (2002) provided evidence of higher stock productivity than originally assumed. The assessment also treated the stock as a coastwide assemblage. The SSC and Council are scheduled to review this assessment at the September Council meeting before deciding 2003 management measures.

3.2.1.2 ?Precautionary Zone" Stocks

Dover Sole

Distribution and Life History: Dover sole (*Microstomus pacificus*) are distributed from the Navarin Canyon in the northwest Bering Sea and westernmost Aleutian Islands to San Cristobal Bay, Baja, California (Hagerman 1952; Hart 1988; NOAA 1990). Dover sole are a dominant flatfish on the continental shelf and slope from Washington to Southern California. Adults are demersal and are found from 9 m to 1,450 m, with highest abundance below 200 m to 300 m (Allen and Smith 1988). Adults and juveniles show a high affinity toward soft bottoms of fine sand and mud. Juveniles are often found in deep nearshore waters. Dover sole are considered to be a migratory species. In the summer and fall, mature adults and juveniles can be found in shallow feeding grounds, as shallow as 55 m off British Columbia (Westrheim and Morgan 1963). By late fall, Dover sole begin moving offshore into deep waters (400 m or more) to spawn. Although there is an inshore-offshore seasonal migration, little north-south coastal migration occurs (Westrheim and Morgan 1963).

Spawning occurs from November through April off Oregon and California (Hart 1988; NOAA 1990; Pearcy *et al.* 1977) in waters 80 m to 550 m depth at or near the bottom (Hagerman 1952; Hart 1988; Pearcy *et al.* 1977). Dover sole are oviparous and fertilization is external. Larvae are planktonic and are transported to offshore nursery areas by ocean currents and winds for up to two years. Settlement to benthic living occurs mid-autumn to early spring off Oregon, and February through July off California (Markle *et al.* 1992). Juvenile fish move into deeper water with age and begin seasonal spawning and feeding migrations upon reaching maturity.

Dover sole larvae eat copepods, eggs, and nauplii, as well as other plankton. Juveniles and adults eat polychaetes, bivalves, brittlestars, and small benthic crustaceans. Dover sole feed diurnally by sight and smell (Dark and Wilkins 1994; Gabriel and Pearcy 1981; Hart 1988; NOAA 1990). Dover sole larvae are eaten by pelagic fishes like albacore, jack mackerel and tuna, as well as sea birds. Juveniles and adults are preyed upon by sharks, demersally feeding marine mammals, and to some extent by sablefish (NOAA 1990). Dover sole compete with various eelpout species, rex sole, English sole, and other fishes of the mixed species flatfish assemblage (NOAA 1990).

Stock Status and Management History: The 1997 Dover sole assessment north of the Conception area provided landed catch OYs based on the $F_{40\%}$ harvest rate (Brodziak *et al.* 1997). The Groundfish Management Team (GMT) recommended a 2001 total catch OY of 7,151 mt, which is the average of yields calculated for 2000 through 2002 at $F_{40\%}$ (with the 40-10 adjustment), inflated to reflect 5% discard. The Groundfish FMP set the original ABC for the Conception Area at 1,000 mt based on average landings. For 1998, this was inflated to reflect 5% discard for a total catch ABC of 1,053 mt. The coastwide total catch ABC is 8,204 mt. To calculate the total catch OY (7,677 mt), the GMT reduced the Conception area's OY contribution by 50% (to 526 mt), consistent with the new harvest policy. The coastwide landed catch target was then calculated to be 95% of OY, or 7,293 mt.

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 expected 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.

Researchers carried out a new Dover sole stock assessment in 2001, resulting in an estimated spawning stock size that is about 29% of the unexploited biomass (Sampson and Wood 2001). Although there is no recent clear trend in abundance, stocks steadily declined from the 1950s until the mid-1990s. The 1991 year class was the last strong one, 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 Council adopted an ABC of 8,510 mt and an OY of 7,440 mt, which is calculated using the current F_{MSY} proxy and the 40-10 adjustment.

<u>Sablefish</u>

Distribution and Life History: Sablefish (*Anoplopoma fimbria*) are abundant in the north Pacific, from Honshu Island, Japan, north to the Bering Sea, and southeast to Cedros Island, Baja, California. There are at least three genetically distinct populations off the West Coast of North America: one south of Monterey characterized by slower growth rates and smaller average size, one that ranges from Monterey to the U.S./Canada border that is characterized by moderate growth rates and size, and one ranging off British Columbia and Alaska characterized by fast growth rates and large size. Large adults are uncommon south of Point Conception (Hart 1988; Love 1991; McFarlane and Beamish 1983a; McFarlane and Beamish 1983b; NOAA 1990). Adults are found as deep as 1,900 m, but are most abundant between 200 m and 1,000 m (Beamish and McFarlane 1988; Kendall and Matarese 1987; Mason *et al.* 1983). Off Southern California , sablefish are abundant to depths of 1,500 m (MBC 1987). Adults and large juveniles commonly occur over sand and mud (McFarlane and Beamish 1983a; NOAA 1990) in deep marine waters. They were also reported on hard-packed mud and clay bottoms in the vicinity of submarine canyons (MBC 1987).

Spawning occurs annually in the late fall through winter in waters greater than 300 m (Hart 1988; NOAA 1990). Sablefish are oviparous with external fertilization (NOAA 1990). Eggs hatch in about 15 days (Mason *et al.* 1983; NOAA 1990) and are demersal until the yolk sac is absorbed (Mason *et al.* 1983). Age-zero juveniles become pelagic after the yolk sac is absorbed. Older juveniles and adults are benthopelagic. Larvae and small juveniles move inshore after spawning and may rear for up to four years (Boehlert and Yoklavich 1985; Mason *et al.* 1983). Older juveniles and adults inhabit progressively deeper waters. Estimates indicate that 50% of females are mature at five years to six years (24 inches) and 50% of males are mature at five years (20 inches).

Sablefish larvae prey on copepods and copepod nauplii. Pelagic juveniles feed on small fishes and cephalopods- mainly squids (Hart 1988; Mason *et al.* 1983). Demersal juveniles eat small demersal fishes, amphipods, and krill (NOAA 1990). Adult sablefish feed on fishes like rockfishes and octopus (Hart 1988;

McFarlane and Beamish 1983a). Larvae and pelagic juvenile sablefish are heavily preyed upon by seabirds and pelagic fishes. Juveniles are eaten by Pacific cod, Pacific halibut, lingcod, spiny dogfish, and marine mammals, such as Orca whales (Cailliet *et al.* 1988; Hart 1988; Love 1991; Mason *et al.* 1983; NOAA 1990). Sablefish compete with many other co-occurring species for food, mainly Pacific cod and spiny dogfish (Allen 1982).

Stock Status and Management History: There are at least three genetically distinct populations on 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. The Council actively assesses and manages the stock found between California and Washington.

The 2001 sablefish ABC (7,661 mt) was based on the proxy $F_{45\%}$ harvest rate, and the OY (6,895 mt) on application of the 40-10 harvest policy (the stock was estimated at 37% of the initial biomass). The OY applied north of 36° N latitude. A 22% trawl discard rate was based on discard rates observed in the mid to late 1980s. The GMT assumed an average mortality rate of 70% for discarded fish, which may have been too low for a predominantly summer fishery and too high for a winter fishery.

In 2001 two stock assessments were done for the sablefish stock north of Monterey (Hilborn *et al.* 2001; Schirripa and Methot 2001). The assessments incorporated new survey and fishery data and extended the assessment area south from 36° N latitude to 34°27' N latitude (Point Conception). Both assessments indicated a normal decline in biomass since the late 1970s due to the fishing down of the unfished stock and an unexpected decline in recruitment during the early 1990s. A change in environmental conditions may have been responsible for the abrupt decline in recruitment in the 1990s (see section 3.3.1), 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. Recruitment scenarios in both assessments hinge on two different hypotheses: whether sablefish recruitment has been most affected by density dependence, or by environmental regime shifts. Because of this uncertainty, two 2002 ABC estimates were produced and reviewed by the Council: an ABC of 4,786 mt based on the current F_{MSY} proxy of $F_{45\%}$, and an ABC of 4,062 mt based on a reduced harvest rate of $F_{50\%}$. The Council adopted the ABC based on the proxy harvest rate, but adjusted it to reflect the distribution north and south of 36° N latitude. This was done, because a plan amendment would be needed to change the management area since Groundfish FMP Amendment 14, permit stacking, specified only the area north of 36° N latitude. The OY was based on the 40-10 adjustment. The Council also wanted to verify industry reports of a large abundance of juvenile sablefish; an observation that was confirmed to some extent by preliminary results from the 2001 NMFS slope survey. Based on these considerations, the Council recommended a new expedited assessment be done in 2002.

Schirripa (2002) recently re-assessed the stock under the Terms of Reference developed by the SSC for Expedited Stock Assessments. Under these Terms of Reference, the assessment would be updated with new survey and fishery data, but would not be restructured in any substantive fashion. This allowed an expedited but less rigorous review of the updated assessment, compared to an assessment that uses a new model. The expedited assessment confirmed fishers' anecdotal reports of a large 1999 year class, which is also apparent in the preliminary results of the 2001 slope survey. This new assessment also suggests that 2000 produced a relatively strong year class.

<u>Shortspine Thornyhead</u>

Distribution and Life History: Shortspine thornyhead (*Sebastolobus alascanus*) are found from northern Baja, California to the Bering Sea and occasionally to the Commander Islands north of Japan (Jacobson and Vetter 1996). They are common from Southern California northward (Love 1991). Shortspine thornyhead inhabit areas over the continental shelf and slope (Erickson and Pikitch 1993; Wakefield and Smith 1990). Although they can occur as shallow as 26 m (Eschmeyer*et al.* 1983), shortspine thornyhead mainly occur between 100 m and 1,400 m off Oregon and California, most commonly between 100 m to 1,000 m (Jacobson and Vetter 1996).

Spawning occurs in February and March off California (Wakefield and Smith 1990). Shortspine thornyhead are thought to be oviparous (Wakefield and Smith 1990), although there is no clear evidence to substantiate this (Erickson and Pikitch 1993). Eggs rise to the surface to develop and hatch. Larvae are pelagic for about 12 months to 15 months. During January to June, juveniles settle onto the continental shelf and then move into deeper water as they become adults (Jacobson and Vetter 1996). Off California, they begin to mature at five years; 50% are mature by 12 years to 13 years; and all are mature by 28 years (Owen and Jacobson 1992). Although it is difficult to determine the age of older individuals, Owen and Jacobson (1992) report that off California, they may live to over 100 years of age. The mean size of shortspine thornyhead increases with depth and is greatest at 1,000 m to 1,400 m (Jacobson and Vetter 1996).

Benthic individuals are ambush predators that rest on the bottom and remain motionless for extended periods of time (Jacobson and Vetter 1996). Off Alaska, shortspine thornyhead eat a variety of invertebrates such as shrimps, crabs, and amphipods, as well as fishes and worms (Owen and Jacobson 1992). Longspine thornyhead are a common item found in the stomachs of shortspine thornyhead. Cannibalism of newly settled juveniles is important in the life history of thornyheads (Jacobson and Vetter 1996).

Stock Status and Management History: Shortspine thornyhead is a major component of the deepwater fishery on the continental slope, especially the trawl fishery for Dover sole, thornyheads, and sablefish (referred to as the DTS complex). The status of this stock is subject to substantial public debate; the species is one of the most numerous components of the slope ecosystem. However, this is an especially long-lived species and cannot sustain aggressive harvest rates. It is taken coincidentally with Dover sole, sablefish, and longspine thornyhead, especially in the upper slope and lower shelf; in deeper water, longspine thornyhead is a more predominate species. The two thornyhead species are often difficult to distinguish, and historical landings data combine the two into a single category. Shortspine thornyhead is a ?constraining species" in the deepwater fishery; that is, coincidental catch of this species prevents full harvest of Dover sole and sablefish.

The individual assessments for shortspine thornyhead and longspine thornyhead in 1997 covered the area from Central California at 36° N latitude (the southern boundary of the Monterey management area) to the U.S./Canada border (the northern boundary of the U.S./Vancouver management area) (Rogers *et al.* 1997). The STAR Panel expressed concern that management requires more detailed information on thornyheads than could be obtained from the available data. Given the kinds and quality of data, the more accurate assessments are difficult because, (1) growth and natural mortality for shortspine thornyhead is uncertain, (2) it is difficult to differentiate between longspine and shortspine thornyheads in the historic landings, (3) year class strength is not easily estimated, and (4) true discard rates are unknown.

The 2001 shortspine thornyhead ABC (757 mt) was based on a synthesis of two stock assessments prepared in 1998 (NMFS STAT and OT STAT 1998; Rogers *et al.* 1998) and application of the $F_{50\%}$ harvest rate. The 2001 shortspine thornyhead ABCs and OYs were separately specified north and south of 36° N latitude, which is the northern boundary of the Conception area. The stock size was estimated to be 32% of the unfished abundance in 1999. The 2001 OY (689 mt) was based on $F_{50\%}$ and the 40-10 policy. The landed catch equivalent reflected a 20% reduction for discard.

There were a range of uncertainties in the most recent assessment of shortspine thornyhead, in 2001, not the least of which was the estimated biomass (Piner and Methot 2001). The assessment was extended south to Point Conception (in contrast to past surveys, which were limited to stocks north of 36° N latitude management area boundary). The authors concluded the 2001 spawning biomass ranged between 25% and 50% of unexploited spawning biomass. The uncertainty in abundance largely revolved around the uncertainty in recruitment and survey Q, or catchability, of shortspine thornyhead in slope surveys. The authors also concluded the trend in stock biomass was increasing and the stock was not overfished. Based on estimated biomass and application of the GMT-recommended F=0.75M principle (which approximates an $F_{50\%}$ proxy harvest rate for shortspine thornyhead), the assessment authors and GMT recommended a slight increase in the ABC and OY for 2002 and combining the previous Monterey area north and Conception area specifications to a coastwide one. Despite the uncertainty in biomass estimates and determination of whether shortspine thornyhead should be treated as a ?precautionary zone" stock, these recommendations did treat the stock as such by applying the 40-10 adjustment. The Council adopted the GMT-recommended coastwide ABC of 1,004 mt, and the associated total catch OY of 955 mt for 2002 management.

3.2.1.3 Stocks at or Above Target Levels

Arrowtooth Flounder

Distribution and Life History: Arrowtooth flounder (*Atheresthes stomias*) range from the southern coast of Kamchatka to the northwest Bering Sea and Aleutian Islands to San Simeon, California. Arrowtooth flounder is the dominant flounder species on the outer continental shelf from the western Gulf of Alaska to Oregon. Eggs and larvae are pelagic; juveniles and adults are demersal (Garrison and Miller 1982; NOAA 1990). Juveniles and adults are most commonly found on sand or sandy gravel substrates, but occasionally occur over low-relief rock-sponge bottoms. Arrowtooth flounder exhibit a strong migration from shallow water summer feeding grounds on the continental shelf to deep water spawning grounds over the continental slope (NOAA 1990). Depth distribution may vary from as little as 50 m in summer to more than 500 m in the winter (Garrison and Miller 1982; NOAA 1990; Rickey 1995).

Arrowtooth flounder are oviparous with external fertilization. Spawning may occur deeper than 500 m off Washington (Rickey 1995). Larvae eat copepods, their eggs, and copepod nauplii (Yang 1995; Yang and Livingston 1985). Juveniles and adults feed on crustaceans (mainly ocean pink shrimp and krill) and fish (mainly gadids, herring, and pollock) (Hart 1988; NOAA 1990). Arrowtooth flounder exhibit two feeding peaks, at noon and midnight.

Bank Rockfish

Distribution and Life History: Bank rockfish (*Sebastes rufus*) are found from Newport, Oregon, to central Baja, California, most commonly from Fort Bragg southward (Love 1992). Bank rockfish occur offshore (Eschmeyer*et al.* 1983) from depths of 31 m to 247 m (Love 1992), although adults prefer depths over 210 m (Love *et al.* 1990). Observations of commercial catches indicate juveniles occupy the shallower part of the species range (Love *et al.* 1990). Bank rockfish are a midwater, aggregating species and are found over hard bottoms (Love 1992), over high relief or on bank edges (Love *et al.* 1990), and along the ledge of Monterey Canyon (Sullivan 1995). They also frequent deep water over muddy or sandy bottoms (Miller and Lea 1972). Spawning occurs from December to May (Love *et al*. 1990). Peak spawning of bank rockfish in the Southern California Bight occurs in January and a month later in Central and Northern California. Off California, bank rockfish are multiple brooders (Love *et al.* 1990). Females grow to a larger maximum size (50 cm) than males (44 cm), but grow at a slightly slower rate (Cailliet *et al.* 1996). Males reach first maturity at 28 cm, 50% maturity at 31 cm, and 100% at 38 cm. Females reach first maturity at 31 cm, 50% at 36 cm, and 100% maturity at 39 cm (Love *et al.* 1990). Bank rockfish are midwater feeders, eating mostly gelatinous planktonic organisms such as tunicates, but also preying on small fishes and krill (Love 1992).

Black Rockfish

Distribution and Life History: Black rockfish (*Sebastes melanops*) are found from Southern California (San Miguel Island) to the Aleutian Islands (Amchitka Island) and they occur most commonly from San Francisco northward (Hart 1988; Miller and Lea 1972; Phillips 1957; Stein and Hassler 1989). Black rockfish occur from the surface to greater than 366 m; however, they are most abundant at depths less than 54 m (Stein and Hassler 1989). Off California, black rockfish are found along with the blue, olive, kelp, black-and-yellow, and gopher rockfishes (Hallacher and Roberts 1985). Adults are usually observed well up in the water column (Hallacher and Roberts 1985). The abundance of black rockfish in shallow water declines in the winter and increases in the summer (Stein and Hassler 1989). Densities of black rockfish decrease with depth during both the upwelling and non-upwelling seasons (Hallacher and Roberts 1985; PFMC 1996). Off Oregon, larger fish seem to be found in deeper water (20 m to 50 m) (Stein and Hassler 1989). Black rockfish off the northern Washington coast and outer Strait of Juan de Fuca exhibit no significant movement. However, fish appear to move from the Central Washington coast southward to the Columbia River, but not into waters off Oregon. Movement displayed by black rockfish off the northern Oregon coast is primarily northward to the Columbia River (Culver 1986). Black rockfish form mixed sex, midwater schools, especially in shallow water

(Hart 1988; Stein and Hassler 1989). Black rockfish larvae and young juveniles (<40 mm to 50 mm) are pelagic, but are benthic at larger sizes (Laroche and Richardson 1980).

Black rockfish have internal fertilization and annual spawning (Stein and Hassler 1989). Parturition occurs from February through April off British Columbia, January through March off Oregon, and January through May off California (Stein and Hassler 1989). Spawning areas are unknown, but spawning may occur in offshore waters because gravid females have been caught well offshore (Dunn and Hitz 1969; Hart 1988; Stein and Hassler 1989). Black rockfish can live to be more than 20 years in age. The maximum length attained by the black rockfish is 60 cm (Hart 1988; Stein and Hassler 1989). Off Oregon, black rockfish primarily prey on pelagic nekton (anchovies and smelt) and zooplankton such as salps, mysids, and crab megalops. Off Central California, juveniles eat copepods and zoea, while adults prey on juvenile rockfish, euphausiids, and amphipods during upwelling periods. During periods without upwelling they primarily consume invertebrates. Black rockfish feed almost exclusively in the water column (Culver 1986). Black rockfish are known to be eaten by lingcod and yelloweye rockfish (Stein and Hassler 1989).

<u>Blackgill Rockfish</u>

Distribution and Life History: Blackgill rockfish *(Sebastes melanostomus)* are distributed from Washington to Punta Abreojos in central Baja, California (Love 1991; Moser and Ahlstrom 1978). Adult blackgill rockfish are found offshore at depths of 219 m to 768 m (Eschmeyer *et al.* 1983). Blackgill rockfish usually inhabit rocky or hard bottom habitats along steep drop-offs, such as the edges of submarine canyons and over seamounts (Love 1991). However, they may also occur over soft bottoms (Eschmeyer *et al.* 1983). Blackgill rockfish are a transitional species, occupying both midwater and benthic habitats (Love *et al.* 1990), although they are rarely taken at more than 9 m above the bottom (Love 1991). Blackgill are considered an aggregating species (Love 1991).

Blackgill rockfish spawn from January to June (peaking in February) off Southern California , and in February off Central and northern California (Love 1991; Love *et al.* 1990; Moser and Ahlstrom 1978). The largest blackgill rockfish on record is 61 cm (Eschmeyer *et al.* 1983, Love 1991, Love *et al.* 1990). Blackgill rockfish primarily prey on such planktonic prey as euphausiids and pelagic tunicates, as well as small fishes (e.g., juvenile rockfishes and Pacific whiting, anchovies, and lantern fishes), and squid (Love *et al.* 1990).

<u>Chilipepper Rockfish</u>

Distribution and Life History: Chilipepper rockfish (*Sebastes goodei*) are found from Magdalena Bay, Baja, California, to as far north as the northwest coast of Vancouver Island, British Columbia (Allen 1982); Hart, 1988 #231, (Miller and Lea 1972). Chilipepper have been taken as deep as 425 m, but nearly all in survey catches were taken between 50 and 350 m (Allen and Smith 1988). Adults and older juveniles usually occur over the shelf and slope; larvae and small juveniles are generally found near the surface. In California, chilipepper are most commonly found associated with deep, high relief rocky areas and along cliff drop-offs (Love *et al.* 1990), as well as on sand and mud bottoms (MBC 1987). They are occasionally found over flat, hard substrates (Love *et al.* 1990). Love (1991) does not consider this to be a migratory species. Chilipepper may migrate as far as 45 m off the bottom during the day to feed (Love 1991).

Chilipeppers are ovoviviparous and eggs are fertilized internally (Reilly *et al.* 1992). Chilipepper school by sex just prior to spawning (MBC 1987). In California, fertilization of eggs begins in October and spawning occurs from September to April (Oda 1992) with the peak occurring during December to January (Love *et al.* 1990). Chilipepper may spawn multiple broods in a single season (Love *et al.* 1990). Females of the species are significantly larger, reaching lengths of up to 56 cm (Hart 1988). Males are usually smaller than 40 cm (Dark and Wilkins 1994). Males mature at two years to six years of age, and 50% are mature at three years to four years. Females mature at two years to five years with 50% mature at three years to four years (MBC 1987). Females may attain an age of about 27 years, whereas the maximum age for males is about 12 years (MBC 1987).

Larval and juvenile chilipepper eat all life stages of copepods and euphausiids, and are considered to be somewhat opportunistic feeders (Reilly *et al.* 1992). In California, adults prey on large euphausiids, squid, and small fishes such as anchovies, lanternfish, and young hake (Hart 1988; Love *et al.* 1990). Chilipepper are found with widow rockfish, greenspotted rockfish, and swordspine rockfish (Love *et al.* 1990). Juvenile chilipepper compete for food with bocaccio, yellowtail rockfish, and shortbelly rockfish (Reilly *et al.* 1992).

<u>English Sole</u>

Distribution and Life History: English sole (*Parophrys vetulus*) are found from Nunivak Island in the southeast Bering Sea and Agattu Island in the Aleutian Islands, to San Cristobal Bay, Baja, California Sur (Allen and Smith 1988). In research survey data, nearly all occurred at depths <250 m (Allen and Smith 1988). Adults and juveniles prefer soft bottoms composed of fine sands and mud (Ketchen 1956), but also occur in eelgrass habitats (Pearson and Owen 1992). English soles use nearshore coastal and estuarine waters as nursery areas (Krygier and Pearcy 1986; Rogers *et al.* 1988)). Adults make limited migrations. Those off Washington show a northward post-spawning migration in the spring on their way to summer feeding grounds and a southerly movement in the fall (Garrison and Miller 1982). Tagging studies have identified separate stocks based on this species' limited movements and meristic characteristics (Jow 1969).

Spawning occurs over soft-bottom mud substrates (Ketchen 1956) from winter to early spring depending on the stock. Eggs are neritic and buoyant, but sink just before hatching (Hart 1988), juveniles and adults are demersal (Garrison and Miller 1982). Small juveniles settle in the estuarine and shallow nearshore areas all along the coast, but are less common in southerly areas, particularly south of Point Conception. Large juveniles commonly occur up to depths of 150 m. Although many postlarvae may settle outside of estuaries, most will enter estuaries during some part of their first year of life (Gunderson *et al.* 1990). Some females mature as three-year-olds (26 cm), but all females over 35 cm long are mature. Males mature at two years (21 cm).

Larvae are planktivorous. Juveniles and adults are carnivorous, eating copepods, amphipods, cumaceans, mysids, polychaetes, small bivalves, clam siphons, and other benthic invertebrates (Allen 1982; Becker 1984; Hogue and Carey 1982; Simenstad *et al.* 1979). English sole feed primarily by day, using sight and smell, and sometimes dig for prey (Allen 1982; Hulberg and Oliver 1979). A juvenile English sole's main predators are probably piscivorous birds such as great blue heron (*Ardia herodias*), larger fishes, and marine mammals. Adults may be eaten by marine mammals, sharks, and other large fishes.

<u>Longspine Thornyhead</u>

Distribution and Life History: Longspine thornyhead (*Sebastolobus altivelis*) are found from the southern tip of Baja, California to the Aleutian Islands (Eschmeyer *et al.* 1983, Jacobson and Vetter 1996, Love 1991, Miller and Lea 1972, Smith and Brown 1983), but are abundant from Southern California northward (Love 1991). Juvenile and adult longspine thornyhead are demersal and occupy the benthic surface (Smith and Brown 1983). Off Oregon and California, longspine thornyhead mainly occur at depths of 400 m to 1,400 plus m, most between 600 m and 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 600 m to 1,200 m (Jacobson and Vetter 1996). Longspine thornyhead live on soft bottoms, preferably sand or mud (Eschmeyer *et al.* 1983, Jacobson and Vetter 1996, Love 1991). Longspine thornyheads neither school nor aggregate (Jacobson and Vetter 1996).

Spawning occurs in February and March at 600 m to 1,000 m (Jacobson and Vetter 1996, Wakefield and Smith 1990). Longspine thornyhead are oviparous and are multiple spawners, spawning two to four batches per season (Love 1991, Wakefield and Smith 1990). Eggs rise to the surface to develop and hatch. Floating egg masses can be seen at the surface in March, April, and May (Wakefield and Smith 1990). Juveniles (<5.1 cm long) occur in midwater (Eschmeyer *et al.* 1983). After settling, longspine thornyhead are completely benthic (Jacobson and Vetter 1996). Longspine thornyhead can grow to 38 cm (Eschmeyer *et al.* 1983, Jacobson and Vetter 1996, Miller and Lea 1972) and live more than 40 years (Jacobson and Vetter 1996). Longspine thornyhead reach the onset of sexual maturity at 17 cm to 19 cm total length (10% of females mature) and 90% are mature by 25 cm to 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 in newly settled longspine thornyhead may occur, because juveniles settle directly onto adult habitat (Jacobson and Vetter 1996). Sablefish commonly prey on longspine thornyhead.

Pacific Cod

Distribution and Life History: Pacific cod (*Gadus macrocephalus*) are widely distributed in the coastal north Pacific, from the Bering Sea to Southern California in the east, and to the Sea of Japan in the west. Adult Pacific cod occur as deep as 875 m (Allen and Smith 1988), but the vast majority occurs between 50 m and 300 m (Allen and Smith 1988, Hart 1986, 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). 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 1988; NOAA 1990; Shimada and Kimura 1994).

Pacific cod have external fertilization (Hart 1986, NOAA 1990) with spawning occurring from late fall to early spring. Their eggs are demersal. Larvae may be transported to nursery areas by tidal currents (Garrison and Miller 1982). Half of females are mature by three years (55 cm) and half of males are mature by two years (45 cm) (Dunn and Matarese 1987, Hart 1986). Juveniles and adults are carnivorous and feed at night (Allen and Smith 1988; Palsson 1990) with the main part of the adult Pacific cod diet being whatever prey species is most abundant (Kihara and Shimada 1988; Klovach *et al.* 1995). Larval feeding is poorly understood. Pelagic fish and sea birds eat Pacific cod larvae, while juveniles are eaten by larger demersal fishes, including Pacific cod. Adults are preyed upon by toothed whales, Pacific halibut, salmon shark, and larger Pacific cod (Hart 1986, Love 1991, NOAA 1990, Palsson 1990). The closest competitor of the Pacific cod for resources is the sablefish (Allen 1982).

Petrale Sole

Distribution and Life History: Petrale sole (*Eopsetta jordani*) are found from Cape Saint Elias, Alaska to Coronado Island, Baja, California. The range may possibly extend into the Bering Sea, but the species is rare north and west of southeast Alaska and in the inside waters of British Columbia (Garrison and Miller 1982, Hart 1986). Nine separate breeding stocks have been identified, although stocks intermingle on summer feeding grounds (Hart 1986, NOAA 1990). Of these nine, one occurs off British Columbia, two off Washington, two off Oregon, and four off California (NOAA 1990). Adults are found from the surf line to 550 m, but their highest abundance is <300 m (NOAA 1990). Adults migrate seasonally between deepwater, winter spawning areas to shallower, spring feeding grounds (NOAA 1990). They show an affinity to sand, sandy mud, and occasionally muddy substrates (NOAA 1990).

Spawning occurs over the continental shelf and continental slope to as deep as 550 m. Spawning occurs in large spawning aggregations in the winter. Eggs are pelagic and juveniles and adults are demersal (Garrison and Miller 1982). Eggs and larvae are transported from offshore spawning areas to nearshore nursery areas by oceanic currents and wind. Larvae metamorphose into juveniles at six months (22 cm) and settle to the bottom of the inner continental shelf (Pearcy *et al.* 1977). Petrale sole tend to move into deeper water with increased age and size. Petrale sole begin maturing at three years. Half of males mature by seven years (29 cm to 43 cm) and half of the females are mature by eight years (>44 cm) (Pearcy *et al.* 1977; Pedersen 1975a; Pedersen 1975b). Near the Columbia River, petrale sole mature one to two years earlier (Pedersen 1975a; Pedersen 1975b).

Larvae are planktivorous. Small juveniles eat mysids, sculpins, and other juvenile flatfishes. Large juveniles and adults eat shrimps and other decapod crustaceans, as well as euphausiids, pelagic fishes, ophiuroids, and juvenile petrale sole (Garrison and Miller 1982; Hart 1988; Pearcy *et al.* 1977; Pedersen 1975a; Pedersen 1975b). Petrale sole eggs and larvae are eaten by planktivorous invertebrates and pelagic fishes. Juveniles are preyed upon (sometimes heavily) by adult petrale sole, as well as other large flatfishes. Adults are preyed upon by sharks, demersally feeding marine mammals, and larger flatfishes and pelagic fishes (NOAA 1990). Petrale sole competes with other large flatfishes. It has the same summer feeding grounds as lingcod, English sole, rex sole, and Dover sole (NOAA 1990).

<u>Shortbelly Rockfish</u>

Distribution and Life History: Shortbelly rockfish (*Sebastes jordani*) are found from San Benito Islands, Baja, California, Mexico to La Perouse Bank, British Columbia (Eschmeyer *et al.* 1983; Lenarz 1980). The habitat of the shortbelly rockfish is wide ranging (Eschmeyer *et al.* 1983). Shortbelly rockfish inhabit waters from 50 m to 350 m in depth (Allen and Smith 1988) on the continental shelf (Chess *et al.* 1988) and upper-slope (Stull and Tang 1996). Adults commonly form very large schools over smooth bottoms near the shelf break (Lenarz 1992). Shortbelly rockfish have also been observed along the Monterey Canyon ledge (Sullivan 1995). During the day shortbelly rockfish are found near the bottom in dense aggregations. At night they are more dispersed (Chess *et al.* 1988). During the summer shortbelly rockfish tend to move into deeper waters and to the north as they grow, but they do not make long return migrations to the south in the winter to spawn (Lenarz 1980).

Shortbelly rockfish are viviparous, bearing advanced yolk sac larvae (Ralston *et al.* 1996a). Shortbelly rockfish spawn off California during January through April (Lenarz 1992). Larvae metamorphose to juveniles at 27 mm and appear to begin forming schools at the surface at that time (Laidig *et al.* 1991; Lenarz 1980). A few shortbelly rockfish mature at age two, while 50% are mature at age three, and nearly all are mature by age four (Lenarz 1992). They live to be about ten years old (Lenarz 1980; MacGregor 1986) with the maximum recorded age being 22 years (Lenarz 1992).

Shortbelly rockfish feed primarily on various life stages of euphausiids and calanoid copepods both during the day and night (Chess *et al.* 1988; Lenarz *et al.* 1991). Shortbelly rockfish play a key role in the food chain as they are preyed upon by chinook and coho salmon, lingcod, black rockfish, Pacific whiting, bocaccio, chilipepper, pigeon guillemots, western gull, marine mammals, and other taxa (Chess *et al.* 1988; Eschmeyer *et al.* 1983; Hobson and Howard 1989; Lenarz 1980).

<u>Splitnose Rockfish</u>

Distribution and Life History: Splitnose rockfish (*Sebastes diploproa*) occur from Prince William Sound, Alaska to San Martin Island, Baja, California (Miller and Lea 1972). Splitnose rockfish occur from zero m to 800 m, with most survey catches occurring in depths of 100 m to 450 m (Allen and Smith 1988). The relative abundance of juveniles (<21 cm) is quite high in the 91 m to 272 m depth zone and then decreases sharply in the 274 m to 475 m depth zone (Boehlert 1980). Splitnose rockfish have a pelagic larval stage, a prejuvenile stage, and a benthic juvenile stage (Boehlert 1977). Benthic splitnose rockfish associate with mud habitats (Boehlert 1980). Young occur in shallow water, often at the surface under drifting kelp (Eschmeyer *et al.* 1983). The major types of vegetation juveniles are found under are *Fucus* spp. (dominant), eelgrass, and bull kelp (Shaffer *et al.* 1995). Juvenile splitnose rockfish off Southern California are the dominant rockfish species found under drifting kelp (Boehlert 1977).

Splitnose rockfish are ovoviviparous and release yolk sac larvae (Boehlert 1977). They may have two parturition seasons, or may possibly release larvae throughout the year (Boehlert 1977). In general, the main parturition season get progressively shorter and later toward the north (Boehlert 1977). Splitnose rockfish growth rates vary with latitude, being generally faster in the north. Splitnose rockfish mean sizes increase with depth in a given latitudinal area. Mean lengths of females are generally greater than males (Boehlert 1980). Off California, 50% maturity occurs at 21 cm, or five years of age, whereas off British Columbia 50% of males and females are mature at 27 cm (Hart 1988). Adults can achieve a maximum size of 46 cm (Boehlert 1980, Eschmeyer *et al.* 1983, Hart 1986). Females have surface ages to 55 years and section ages to 81 years.

Adult splitnose rockfish off Southern California feed on midwater plankton, primarily euphausiids (Allen 1982). Juveniles feed mainly on planktonic organisms, including copepods and cladocerans during June and August. In October, their diets shift to larger epiphytic prey and are dominated by a single amphipod species. Juvenile splitnose rockfish actively select prey (Shaffer *et al.* 1995)) and are probably diurnally active (Allen 1982). Adults are probably nocturnally active, at least in part (Allen 1982).

<u>Yellowtail Rockfish</u>

Distribution and Life History: Yellowtail rockfish (*Sebastes flavidus*) range from San Diego, California, to Kodiak Island, Alaska (Fraidenburg 1980; Gotshall 1981; Lorz *et al.* 1983; Love 1991; Miller and Lea 1972; Norton and MacFarlane 1995). The center of yellowtail rockfish abundance is from Oregon to British Columbia (Fraidenburg 1980). Yellowtail rockfish are a common, demersal species abundant over the middle shelf (Carlson and Haight 1972; Fraidenburg 1980; Tagart 1991; Weinberg 1994). Yellowtail rockfish are most common near the bottom, but not on the bottom (Love 1991; Stanley *et al.* 1994). Yellowtail rockfish adults are considered semi-pelagic (Stanley *et al.* 1994; Stein *et al.* 1992) or pelagic, which allows them to range over wider areas than benthic rockfish (Pearcy 1992). Adult yellowtail rockfish occur along steeply sloping shores or above rocky reefs (Hart 1986). They can be found above mud with cobble, boulder and rock ridges, and sand habitats; they are not, however, found on mud, mud with boulder, or flat rock (Love 1991, Stein *et al.* 1992). Yellowtail rockfish form large (sometimes greater than 1,000 fish) schools and can be found alone or in association with other rockfishes (Love 1991, Pearcy 1992, Rosenthal *et al.* 1982, Stein *et al.* 1992, Tagart 1991). These schools may persist at the same location for many years (Pearcy 1992).

Yellowtail rockfish are viviparous (Norton and MacFarlane 1995) and mate from October to December. Parturition peaks in February and March and from November to March off California (Westrheim 1975). Young-of-the-year pelagic juveniles often appear in kelp beds beginning in April and live in and around kelp in midwater during the day, descending to the bottom at night (Love 1991, Tagart 1991). Male yellowtail rockfish are 34 cm to 41 cm in length (five years to nine years) at 50% maturity, females are 37 cm to 45 cm (six years to ten years) (Tagart 1991). Yellowtail rockfish are long-lived and slow-growing; the oldest recorded individual was 64 years old (Fraidenburg 1981, Tagart 1991). Yellowtail rockfish have a high growth rate relative to other rockfish species (Tagart 1991). They reach a maximum size of about 55 cm in approximately 15 years (Tagart 1991). Yellowtail rockfish feed mainly on pelagic animals, but are opportunistic, occasionally eating benthic animals as well (Lorz *et al.* 1983). Large juveniles and adults eat fish (small Pacific whiting, Pacific herring, smelt, anchovies, lanternfishes, and others), along with squid, krill, and other planktonic organisms (euphausiids, salps, and pyrosomes) (Love 1991, Phillips 1964, Rosenthal *et al.* 1982, Tagart 1991).

<u>Other Groundfish Stocks</u>

?Other Flatfish" are those species that do not have individual ABC/OYs and include butter sole, curlfin sole, flathead sole, Pacific sanddab, rex sole, rock sole, sand sole, and starry flounder. Life history descriptions of these species may be found in the EFH appendix document described in section 3.1.2.

3.2.2 Nongroundfish Fish Stocks

As noted at the beginning of section 3.2, the proposed action could potentially affect these species in two ways. They may be caught incidentally in fisheries targeting groundfish. Thus, management measures that change total fishing effort in groundfish fisheries could increase or decrease fishing mortality on incidentally-caught species. Alternatively, those fisheries targeting nongroundfish species (described in section 3.3.1.3) may be affected by management measures intended to reduce or eliminate incidental catches of overfished groundfish species in these fisheries.

3.2.2.1 California Halibut

California halibut (*Paralichthys californicus*) are a left-eyed flatfish of the family *Bothidae*. They range from Northern Washington at approximately the Quileuete River to southern Baja, California (Eschmeyer *et al.*

1983), but are most common south of Oregon. They are predominantly associated with sand substrates from nearshore areas just beyond the surf line to about 183 m.

California halibut feed on fishes and squids and can take their prey well off the bottom. They are an important sport and commercial species, especially in California where they are targeted using hook-and-line and trawl gear.

3.2.2.2 California Sheephead

California sheephead (*Semicossyphus pulcher*) are a large member of the wrasse family *Labridae*. They range from Monterey Bay south to Guadalupe Island in central Baja, California and in the Gulf of California, but are uncommon north of Point Conception. They are associated with rocky bottom habitats, particularly in kelp beds to 55 m, but more commonly at depths of 3 m to 30 m.

They can live to 50 years of age and a maximum length of 91 cm (16 kg). Like some other wrasse species, California sheephead change sex starting first as a female, but changing to a male at about 30 cm in length.

3.2.2.3 Coastal Pelagic Species (CPS)

CPS are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. These species include: northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), Pacific (chub) mackerel (Scomber japonicus), jack mackerel (*Trachurus symmetricus*), and market squid (Decapoda spp.). Until 1999, northern anchovy was managed under the Council's Northern Anchovy FMP. Amendment 8 to the Northern Anchovy FMP brought the remaining CPS species under federal management and renamed the FMP the Coastal Pelagic Species FMP. This FMP was implemented in December 1999.

Sardines inhabit coastal subtropical and temperate waters, and at times, have been the most abundant fish species in the California current. During times of high abundance, Pacific sardine range from the tip of Baja, California to southeastern Alaska. When abundance is low, Pacific sardine do not occur in large quantities north of Point Conception, California. Pacific mackerel in the northeastern Pacific range from Banderas Bay, Mexico to southeastern Alaska. They are common from Monterey Bay, California to Cabo San Lucas, Baja, California, and most abundant south of Point Conception, California. The central subpopulation of northern anchovy ranges from San Francisco, California to Punta Baja, Mexico. Jack mackerel are a pelagic schooling fish that range widely throughout the northeastern Pacific; however, much of their range lies outside the U.S. EEZ. Adult and juvenile market squid are distributed throughout the Alaska and California current systems, but are most abundant between Punta Eugenio, Baja, California and Monterey Bay, Central California.

Recent (December 1999 and July 1999, respectively) stock assessments indicate Pacific sardine and Pacific mackerel are increasing in relative abundance. Pacific sardine biomass in U.S. waters was estimated to be 1,581,346 mt in 1999; Pacific mackerel biomass (in U.S. waters) was estimated to be 239,286 mt. Pacific sardine landings for the directed fisheries off California and Baja, California reached the highest level in recent history during 1999, with a combined total of 115,051 mt harvested. In 1998 70,799 mt of Pacific mackerel were landed, representing near-record levels for the combined directed fisheries off California and Baja, California. Population dynamics for market squid are poorly understood, and annual fluctuations in commercial catch vary from <10,000 mt to 90,000 mt. Amendment 10 to the CPS FMP describes and analyzes several approaches for estimating an MSY-proxy for market squid. Amendment 10 was adopted by the Council in June 2002 and is currently under review by NMFS. They are thought to have an annual mortality rate approaching 100%, which means the adult population is almost entirely new recruits and successful spawning is crucial to future years' abundance.

3.2.2.4 Dungeness Crab

The Dungeness crab (*Cancer magister*) is distributed from the Aleutian Islands, Alaska, to Monterey Bay, California. They live in bays, inlets, around estuaries, and on the continental shelf. Dungeness crab are found to a depth of about 180 m. Although it is found at times on mud and gravel, this crab is most abundant on sand bottoms; frequently it occurs among eelgrass. The Dungeness crab, which are typically harvested using traps (crab pots), ring nets, by hand (scuba divers), or dip nets are incidentally taken or harmed unintentionally by groundfish gears. Dungeness crab are managed by the states of Oregon and California, and by the State of Washington in cooperation with Washington Coast treaty tribes.

3.2.2.5 Highly Migratory Species (HMS)

Highly migratory species (HMS) include tunas, billfish, dorado, and sharks—species that range great distances during their lifetime, extending beyond national boundaries into international waters and among the EEZs of many nations in the Pacific. The Council is adopting a Highly Migratory Species FMP to federally regulate the take of HMS within and outside the EEZ. The draft HMS FMP/DEIS (PFMC 2001a) describes species proposed for active management in detail; these are five tuna species, five shark species, striped marlin, swordfish, and dorado or dolphinfish. A much longer list of species, constituting all those that have been caught in HMS fisheries and not already under state or federal management, will be monitored, but are not part of the management unit.

3.2.2.6 Ocean Whitefish

Ocean whitefish (*Caulolatilus princeps)* occurs as far north as Vancouver Island in British Columbia, but is rare north of Central California. A solitary species, it inhabits rocky bottoms and is also found on soft sand and mud bottoms. Whitefish dig into the substrate for food.

3.2.2.7 Pacific Pink Shrimp

Pacific pink shrimp (*Pandalus jordani*) are found from Unalaska in the Aleutian Islands to San Diego, California, at depths of 25 fm to 200 fm (46 m to 366 m). Off the U.S. West Coast these shrimp are harvested with trawl gear from Northern Washington to Central California between 60 fm and 100 fm (110 m to 180 m). The majority of the catch is taken off the coast of Oregon. Concentrations of pink shrimp are associated with well-defined areas of green mud and muddy-sand bottoms. Shrimp trawl nets are usually constructed with net mesh sizes smaller than the net mesh sizes for legal groundfish trawl gear. Thus, it is shrimp trawlers that commonly take groundfish in association with shrimp, rather than the reverse. Pacific shrimp fisheries are managed by the states of Washington, Oregon, and California.

3.2.2.8 Pacific Halibut

Pacific halibut (*Hippoglossus stenolepis*) belong to a family of flounders called *Pleuronectidae*. Pacific halibut can be found along the continental shelf in the North Pacific and Bering Sea. They have flat, diamond-shaped bodies and are able to migrate long distances. Most adult fish tend to remain on the same grounds year after year, making only a seasonal migrations from the more shallow feeding grounds in summer to deeper spawning grounds in winter. Halibut are usually found in deep water (40 m to 200 m).

Pacific halibut are managed by the bilateral (U.S./Canada) International Pacific Halibut Commission (IPHC). The Pacific Halibut Catch Sharing Plan for waters off Washington, Oregon, and California (Area 2A) specifies IPHC management measures for Pacific halibut on the West Coast. Implementation of IPHC catch levels and regulations is the responsibility of the Council, the states of Washington, Oregon, and California, and the Pacific halibut treaty tribes.

3.2.2.9 Ridgeback Prawn

Ridgeback prawns (*Sicyonia ingentis*) are found south of Monterey, California to Baja, California in depths of 145 metric feet to 525 metric feet (Sunada *et al.* 2001). They are more abundant south of Point Conception and are the most common invertebrate appearing in trawls. Their preferred habitat is sand, shell and green mud substrate, and relatively sessile. Although information about their feeding habits is limited, these prawns probably are detritus feeders. In turn, they are prey for sea robins, rockfish, and lingcod. Unlike other shrimp species, which carry their eggs during maturation, ridgeback prawns release their eggs into the water column. They spawn seasonally from June to October. Surveys recorded increasing abundance of ridgeback prawns from 1982, when surveys began, to 1985; the population then declined; more recent CPUE data suggest increased abundance in the 1990s. These changes may be due to climate phenomena, particularly El Niño events.

3.2.2.10 Sea Cucumber

Two sea cucumber species are targeted commercially: the California sea cucumber (*Parastichopus californicus*) and the warty sea cucumber (*P. parvimensis*) (Rogers-Bennett and Ono 2001). These species are tube-shaped Echinoderms, a phylum that also includes sea stars and sea urchins. The California sea cucumber occurs as far north as Alaska, while the warty sea cucumber is uncommon north of Point Conception and does not occur north of Monterey. Both species are found in the intertidal zone to as deep as 300 metric feet (the California sea cucumber). These bottom-dwelling organisms feed on detritus and small organisms found in the sand and mud. Because sea cucumbers consume bottom sediment and remove food from it, they can alter the substrate in areas where they are concentrated. They can also increase turbidity as they excrete ingested sand or mud particles. They are preyed upon by sea stars, crabs, various fishes, and sea otters. They spawn by releasing gametes into the water column, and spawning occurs simultaneously for different segments of a population. During development, they go through several planktonic larval stages, settling to the bottom two months to three months after fertilization of the egg. Little is known about the population status of these two species; and assessment is difficult, because of their patchy distribution. However, density surveys suggest abundance has declined since the late 1980s. This is not unexpected since a commercial fishery for these species began in the late 1970s and expanded substantially after 1990.

3.2.2.11 Spot Prawn

Spot prawn (*Pandalus platyceros*) are the largest of the pandalid shrimp and range from Baja, California north to the Aleutian Islands and west to the Korean Strait (Larson 2001). They inhabit rocky or hard bottoms including coral reefs, glass sponge reefs, and the edges of marine canyons. They have a patchy distribution, which may result from active habitat selection and larval transport. Spot prawn are hermaphroditic, first maturing as males at about three years of age. They enter a transition phase after mating at about four years of age when they metamorphose into females.

Spot prawns are taken by both traps and trawls on the West Coast with the fishery taking predominantly older females. These fisheries are open access and managed by the West Coast states.

3.2.2.12 White Seabass

White seabass are primarily targeted with driftnet gear since the setnet fishery for white seabass was prohibited in 1994. White seabass may also be caught with commercial hook-and-line gear in the early spring, when large seabass are available. Regulations covering white seabass have been in effect since 1931 and have included a minimum size limit, closed seasons, bag limits, and fishing gear restrictions. Such regulations are in effect today, with slight variations. An FMP for white seabass is presently being adopted, and the need for additional regulations will be considered (Vojkovich and Crooke 2001).

3.2.2.13 Miscellaneous Species

Little information is available on nongroundfish species that are incidentally captured in the groundfish fishery. Other than those species mentioned above, documentation from the whiting fishery indicates that species such as American shad (*Alosa sapidissima*) and walleye pollock (*Theragra chalcogramma*) are taken incidentally. According to preliminary data, about 112 mt of shad and 280 mt of pollock were taken as incidental catch in the at-sea sector of the Pacific whiting fishery in 2001, through October. American shad was also taken in the shore-based whiting fishery. Introduced in 1885, they have flourished throughout the lower Columbia River, producing a record run of 2.2 million fish in 1988 (ODFW and WDF 1989). Walleye pollock are found in the waters of the Northeastern Pacific Ocean from the Sea of Japan, north to the Sea of Okhotsk, east in the Bering Sea and Gulf of Alaska, and south in the Northwestern Pacific Ocean along the Canadian and U.S. West Coast to Carmel, California. In 2002 trawlers began targeting this species off Washington after the primary whiting fishery closed, based on reports of larger concentrations of the fish in these waters. Since this species is not managed under any of the Council's FMPs, there are no harvest levels, management measures, or observer requirements specified for this fishery.

3.2.3 Protected Species

Protected species fall under three overlapping categories, reflecting four mandates: the Endangered Species Act of 1973 (ESA), the Marine Mammal Protection Act of 1972 (MMPA), the Migratory Bird Treaty Act (MBTA) and EO 13186. These mandates, and the species thus protected, are described below.

3.2.3.1 ESA-listed Species

The ESA protects species in danger of extinction throughout all or a significant part of their range and mandates the conservation of the ecosystems on which they depend. ?Species" is defined by the Act to mean a species, a subspecies, or—for vertebrates only—a distinct population. 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 part, of its range.

Salmon

Salmon caught in West Coast fisheries have life cycle ranges that include coastal streams and river systems from Central California to Alaska and marine waters along the U.S. and Canada seaward into the north central Pacific Ocean, including Canadian territorial waters and the high seas. Some of the more critical portions of these ranges are the freshwater spawning grounds and migration routes.

Chinook, or king salmon (*Oncorhynchus tshawytscha*), and coho, or silver salmon (*O. kisutch*), are the main species caught in Council-managed ocean salmon fisheries. In odd-numbered years, catches of pink salmon (*O. gorbuscha*) can also be significant, primarily off Washington and Oregon. NMFS issues a Biological Opinion for fisheries with a potential interaction with protected salmon species listed under the ESA (Table 3.2.-4), specifying the allowable take given ESA conservation constraints. Additional information on Council-managed salmon fisheries and affected stocks may be found in the most recent environmental assessment for the ocean salmon fishery, prepared by the Council (PFMC 2002).

Salmon are caught incidentally in both the at-sea and shore-based segments of the whiting fishery. This bycatch is closely monitored through an at-sea observer program and dockside sorting of shore deliveries. A salmon bycatch reduction plan has also been implemented in this fishery.

Sea Turtles

Sea turtles are highly migratory; four of the six species found in U.S. waters have been sighted off the West Coast. Little is known about the interactions between sea turtles and West Coast fisheries. Directed fishing for sea turtles in West Coast groundfish fisheries is prohibited because of their ESA listings (Table 3.2.-5); however, incidental take of sea turtles by longline or trawl gear may occur. The management and conservation of sea turtles is shared between NMFS and the U.S. Fish and Wildlife Service (FWS).

3.2.3.2 Marine Mammals

The waters off Washington, Oregon, and California support a wide variety of marine mammals. Approximately 30 species, including seals and sea lions, sea otters, whales, dolphins, and porpoise, occur within the EEZ. Many marine mammal species seasonally migrate through West Coast waters, while others are year-round residents.

In addition to the ESA, the federal MMPA guides marine mammal species protection and conservation policy. Under the MMPA, on the West Coast NMFS is responsible for the management of cetaceans and pinnipeds, while the FWS manages sea otters. Stock assessment reports review new information every year for strategic stocks. (Strategic stocks are those whose human-caused mortality and injury exceeds the potential biological removal [PBR] and every three years for non-strategic stocks.) Marine mammals, whose abundance falls below the optimum sustainable population (OSP), are listed as "depleted" according to the MMPA.

Fisheries that interact with species listed as depleted, threatened, or endangered (Table 3.2.-6) may be subject to management restrictions under the MMPA and ESA. NMFS publishes an annual list of fisheries in the *Federal Register* separating commercial fisheries into one of three categories based on the level of serious injury and mortality of marine mammals occurring incidentally in that fishery. The categorization of a fishery in the list of fisheries determines whether participants in that fishery are subject to certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. West Coast groundfish fisheries are in Category III, denoting a remote likelihood of, or no known, serious injuries or mortalities to marine mammals.

3.2.3.3 Seabirds

Over sixty species of seabirds occur off the West Coast. These species include loons, grebes, albatross, fulmars, petrels, shearwaters, storm-petrels, pelicans, cormorants, frigate birds, phalaropes, skuas, jaegers, gulls, kittiwakes, skimmers, terns, guillemots, murrelets, auklets, and puffins. The migratory range of these species includes the entire West Coast EEZ. Fishing also occurs near the breeding colonies of many of these species.

The MBTA implements various treaties and conventions between the U.S. and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is unlawful. In addition to the MBTA, an Executive Order, Responsibilities of Federal Agencies to Protect Migratory Birds, (EO 13186) directs federal agencies to negotiate Memoranda of Understanding with the U.S. Fish and Wildlife Service that would obligate agencies to evaluate the impact on migratory birds as part of any NEPA process. NOAA is also preparing a National Plan of Action to Reduce the Incidental Take of Seabirds in Longline Fisheries. This document contains guidelines that are applicable to relevant groundfish fisheries and would require seabird incidental catch mitigation if a significant problem is found to exist. The FWS is the primary federal agency responsible for seabird conservation and management. Under the Magnuson-Stevens Act, NMFS must ensure 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 listed as endangered or threatened. Taken together, these laws and directives underscore the need to consider impacts to seabirds in decision making and consider ways to reduce potential impacts of the proposed action. Four bird species are also ESA-listed, as noted in Table 3.2.-7.

3.3 Socioeconomic Environment

This section is subdivided into seven sub-sections, describing fishery sectors and fishing communities. Section 3.3.1 provides an overview of fisheries that catch groundfish as either a target species or incidentally; the markets for fishery products, including the recreational or "experiential" values; and other non-market values, including those social values that, for example, give coastal communities their unique character and play a central role in residents' lives. The subsequent sub-sections, 3.3.2 through 3.3.6, describe, respectively, commercial fishing and marketing, the recreational and tribal fishery sectors, and the characteristics of fishing communities substantially dependent on or engaged in groundfish fishing. Finally, sub-section 3.3.7 describes health and safety issues that could be affected by the proposed action.

3.3.1 Overview

3.3.1.1 West Coast Fisheries

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. These include fisheries that target groundfish, which for the most part are regulated under a license limitation program implemented in 1994, and other fisheries that, while targeting other species, may catch groundfish. This latter category is termed open access, because it is not license limited. (There are some small-scale fishers targeting groundfish in the open access sector, as described below.) The Council allocates harvest specifications (OYs) between these two regulatory categories. Marine recreational fisheries consist of both charter and private vessels. Charter vessels are larger vessels for hire that can typically fish farther offshore than most vessels in the private recreational fleet. Both nearshore and shelf opportunities are important for West Coast recreational groundfish fisheries. Recreational fisheries are detailed in sub-section 3.3.4. In addition to these fisheries, Indian tribes in Washington, primarily the Makah, Quileuete, and Quinault, harvest groundfish in the EEZ. There are set tribal allocations for sablefish and Pacific whiting, while the other groundfish species' allocations are determined through the Council process in coordination with the tribes, states, and NMFS. Commercial tribal groundfish fisheries are described in this overview and in sub-section 3.3.5, which describes ceremonial and substance harvests. Tables 3.3-1 list historical landings for the target species fishery sectors described in this overview section. (Refer also to Tables 3.3-2 through 3.3-6 for additional information.)

Of 4,579 vessels active during November 2000 through October 2001 (a period that will be used as a base period in this analysis), 1,341 (37% of the fleet) landed some groundfish (Table 3.3-7). This segment of the fleet was responsible for 47% of the value of all West Coast landings (groundfish and nongroundfish species).

3.3.1.2 Overview of the Access System for the Commercial Harvest Groundfish Fisheries

License Limitation

Most of the Pacific Coast non-tribal, commercial groundfish harvest is taken by the limited entry fleet. The groundfish limited entry program was established in 1994 for trawl, longline, and trap (or pot) gears. There are also several open access fisheries that take groundfish incidentally or in small amounts; participants in those fisheries may use, but are not limited to longline, vertical hook-and-line, troll, pot, setnet, trammel net, shrimp and prawn trawl, California halibut trawl, and sea cucumber trawl. Directed open access fisheries are described below in this section, and fisheries that harvest groundfish incidentally or serve as part of the economic make-up for West Coast groundfish vessels are discussed in section 3.3.1.3.

In 1994, NMFS implemented Amendment 6 to the Groundfish FMP, a license limitation program intended to restrict vessel participation in the directed commercial groundfish fisheries off Washington, Oregon, and California. The limited entry permits that were created through that program specify the gear type a permitted vessel may use to participate in the limited entry fishery and the vessel length associated with the permit. A vessel may only participate in the fishery with the gear designated on its permit(s) and may only be registered to a permit appropriate to the vessel's length. Since 1994, the Council has created further license restrictions for the limited entry fixed gear (longline and fishpot gear) fleet that restrict the number of permits useable in the primary sablefish fishery (Amendment 9) and that allow up to three sablefish-endorsed permits to be used per vessel (Amendment 14.)

As of March, 2002, there were 450 vessels with Pacific Coast groundfish limited entry permits, of which approximately 54% were trawl vessels, 40% were longline vessels, and 6% were trap vessels. The number of vessels registered for use with limited entry permits has decreased since the 2001 implementation of the permit stacking program for sablefish-endorsed limited entry fixed gear permits. Of the approximately 164 sablefish-endorsed permits, 83 are held by vessels registered with more than one sablefish-endorsed permit. Of the vessels that are registered with multiple sablefish-endorsed permits, 25 are registered with two permits and 11 are registered with three permits.

Limited entry permits may be sold and leased out by their owners, so the distribution of permits between the three states often shifts. In 2002, roughly 23% of the limited entry permits were assigned to vessels making landings in California, 39% to vessels making landings in Oregon, and 37% to vessels making landings in Washington (Figure 3.3-1). In 1999, this division of permits was approximately 41% for California, 37% for Oregon, and 21% for Washington. This change in state distribution of limited entry permits may also be due to the implementation of the permit stacking program. Vessels operating from northern ports may have purchased or leased sablefish-endorsed permits from vessels that had been operating out of California ports.

Limited entry fishers focus their efforts on many different species, with the largest landings by volume (other than Pacific whiting) from the following species: Dover sole, arrowtooth flounder, petrale sole, sablefish, thornyheads, and yellowtail rockfish. There are 55 plus rockfish species managed by the Groundfish FMP, of which seven species have been declared overfished in the past four years. Protective fisheries regulations intended to reduce the directed and incidental catch of overfished rockfish and other depleted species have significantly reduced the harvest of rockfish in recent years.

<u>The Directed Commercial Open Access (Non-Tribal) Groundfish Fisheries</u>

Unlike the limited entry sector, the open access fishery has unrestricted participation and is comprised of vessels targeting or incidentally catching groundfish with a variety of gears, excluding groundfish trawl gear. While the open access groundfish fishery is under federal management and does not have participation restrictions, some state and federally-managed fisheries that land groundfish in the open access fishery have implemented their own limited entry (restricted access) fisheries or enacted management provisions that have affected participation in groundfish fisheries.

The commercial open access groundfish fishery consists of vessels that do not necessarily depend on revenue from the fishery as a major source of income. Many vessels that predominately fish for other species inadvertently catch and land groundfish. Or, in times and areas when fisheries for other species are not profitable, some vessels will transition into the groundfish open access fishery for short periods. The commercial open access fishery for groundfish is split between vessels targeting groundfish (*directed fishery*) and vessels targeting other species (*incidental fishery*). The number of unique vessels targeting groundfish in the open access fishery between 1995 and 1998 coastwide was 2,723, while 2,024 unique vessels landed groundfish as incidental catch (1,231 of these vessels participated in both) (SSC's Economic Subcommittee, 2000).

More information is provided on the commercial groundfish fishery in section 3.3.2.

3.3.1.3 Other Fisheries

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. Managers use the inverse set of criteria outlined above to identify landings and vessels in the directed open access fishery. 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. A range of fisheries, identified by the target species, comprise this sector. These include pink shrimp, spot prawn, ridgeback prawn, California and Pacific halibut, Dungeness crab, salmon, sea cucumber, coastal pelagic species, California sheephead, highly migratory species, and the gillnet complex. A review of these fisheries follows, including their management, gear, regions fished, and participation. Estimates of the incidental groundfish catch in these fisheries are reviewed in section 3.4.

California Halibut: The commercial California halibut fishery extends from Bodega Bay in northern California to San Diego in Southern California, and across the international border into Mexico. California halibut, a state-managed species, is targeted with hook-and-line, setnets and trawl gear, all of which intercept groundfish. Fishing with 4.5-inch minimum mesh size trawl nets is permitted in federal waters, but prohibited within state waters, except in the designated "California halibut trawl grounds," where a 7.5-inch minimum mesh size must be used. These areas are also closed seasonally. Historically, commercial halibut fishers have preferred setnets, because of these restrictions. Setnets with 8.5-inch mesh and maximum length of

9,000 feet are the main gear type used in Southern California. Setnets are prohibited in certain designated areas, including a Marine Resources Protection Zone (MRPZ), covering state waters (to 3 nm) south of Point Conception and waters around the Channel Islands to 70 fm, but extending seaward no more than 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 (Kramer *et al.* 2001).

Dungeness Crab: The Dungeness crab fishery is divided between treaty sectors, covering catches by Indian Tribes, and a non-treaty sector. The crab fishery is managed by the states of Washington, Oregon, and California with inter-state coordination through the Pacific States Marine Fisheries Commission. This fishery is managed on the basis of simple "3-S" principles: sex, season, and size. Only male crabs may be retained in the commercial fishery (thus protecting the reproductive potential of the populations), the fishery has open and closed seasons, and a minimum size limit is imposed on commercial landings of male crabs (Hankin and Warner 2001). In Washington, the Dungeness crab fishery is managed under a limited entry system with two tiers of pot limits and a December 1 through September 15 season. In Oregon, 306 vessels made landings in 1999 during a season that generally starts on December 1. In California, distinct fisheries occur in Northern and Central California, with the northern fishery covering a larger area. California implemented a limited entry program in 1995 and as of March 2000, about 600 California residents and 70 non-residents had limited entry permits. Nonetheless, effort has increased with the entry of larger multipurpose vessels from other fisheries. Landings have not declined, but this effort increase has resulted in a "race for fish" with more than 80% of total landings made during the month of December (Hankin and Warner 2001).

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, swordfish, and sharks. Driftnets are used for California halibut, white croaker, and angel shark. Southeast Asian refugees (mainly Vietnamese), many of whom had fished with this gear in their home country, entered this fishery and began targeting white croaker resulting in a shift in fishing effort from Southern California to Central California. Most of the commercial catch is sold in the fresh fish market, although a small amount is used for live bait (Moore and Wild 2001). Currently, the only restriction on catches of white croaker off California is a small no-take zone off Palos Verdes peninsula. In the early 1990s, California's set gillnet fishery was subject to increasingly restrictive state regulations addressing high marine bird and mammal bycatch mortality. This forced the fleet into deeper water where shelf rockfish became their primary target. However, as open access rockfish limits became smaller, there was a shift from targeting shelf rockfish with setnets to the use of line gear in the more lucrative nearshore live-fish fishery. Thus, many fishers that were historically setnet fishers have changed their target strategy in response to increasing restrictions and changing market value. Table 3.3-8 summarizes catch and bycatch of rockfish species by depth strata for the gillnet fishery

Pink Shrimp: The pink shrimp fishery is managed by the states of Washington, Oregon, and California. The Council has no direct management authority. In 1981, the three coastal states established uniform coastwide regulations for the pink shrimp fishery. The season runs from April 1 through October 31. Pink shrimp may be taken for commercial purposes only by trawl nets or pots. Most of the pink shrimp catch is taken with trawl gear with minimum mesh size of 1 inches to 3/8 inches between knots. In some years the pink shrimp trawl fishery has accounted for a significant share of canary rockfish incidental catch. The Council has discussed methods to control shrimp fishing activities, such as requiring all vessels to use bycatch reduction devices (finfish excluders). In 2002, finfish excluders in the pink shrimp fisheries were mandatory in California and Washington and were voluntary in Oregon until attainment of a specified groundfish incidental catch allowance at which point finfish excluders become mandatory. Many vessels that participate in the shrimp trawl fishery also have groundfish limited entry permits. When participating in the pink shrimp fishery, they must abide by the same rules as vessels that do not have limited entry permits. However, all groundfish landed by vessels with limited entry permits are included in the limited entry total. Table 3.3-9 summarizes logbook information on fishing effort by depth for the pink shrimp trawl fishery south of Cape Mendocino.

Pacific Halibut: The Pacific halibut fishery is managed by the International Pacific Halibut Commission (IPHC) with implementing regulations set by Canada and the U.S. in their own waters. A license from the IPHC is required to participate in the commercial Pacific halibut fishery. The commercial sector off the Pacific Coast, IPHC Area 2A, has both a treaty and non-treaty sector. The directed commercial fishery in Area 2A is confined to south of Point Chehalis, Washington, Oregon, and California. In the non-treaty commercial sector, 85% of the harvest is allocated to the directed halibut fishery and 15% to the salmon troll fishery to cover incidental catch. When the Area 2A total allowable catch (TAC) is above 900,000 pounds, halibut may be retained in the limited entry primary sablefish fishery north of Point Chehalis, Washington (46/53'18" N latitude). In 2001, the TAC was above this level for the first time, and 56% (47,946 pounds) of the allocation was harvested. Area 2A licenses, issued for the directed commercial fishery, have decreased from 428 in 1997 to 320 in 2001.

Salmon Troll: The ocean commercial salmon fishery, both non-treaty and treaty, is under federal management with a suite of seasons and total allowable harvest. The Council manages fisheries in the EEZ while the states manage fisheries in their waters (zero nm to three nm). All ocean commercial salmon fisheries off the West Coast states use troll gear. Chinook and coho are the principle target species with limited pink salmon landings in odd-years. However, commercial coho landings fell precipitously in the early 1990s and remain very low. Reductions in landings are mainly due to diminished opportunity as salmon populations declined. Poor ocean conditions, high harvest rates, and freshwater habitat degradation are contributing factors in this decline. Consequently, many natural salmon runs on the West Coast have been listed under the ESA. Because of these listings, the management regime is largely structured around so-called "no jeopardy standards" developed through the ESA-mandated consultation process. Ocean fisheries are managed based on zones which reflect the distribution of salmon stocks and are structured to allow and encourage capture of hatchery-produced stocks while depressed natural stocks are avoided. The Columbia River, on the Oregon/Washington border, the Klamath River in Southern Oregon, and the Sacramento River in Central California support the largest runs of returning salmon.

Spot Prawn: Spot prawn are targeted with both trawl and pot gear. Although these fisheries are state-managed, for the purposes of managing incidentally-caught groundfish, the trawl fishery is categorized in the open access sector. California has the largest and oldest trawl fishery with about 54 vessels operating from Bodega Bay south to the U.S./Mexico border. (Most vessels operate out of Monterey, Morro Bay, Santa Barbara, and Ventura, although some Washington-based vessels participate in this fishery during the fall and winter.) 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 in order to discourage incidental catch. Three trawl permits remain and these are slated for conversion by the beginning of 2003. (There are currently 13 active permits, 3 for trawl gear and 10 for pot/trap.) In California, area and season closures for the trawl fleet were instituted in 1984 to protect spot prawns during their peak egg-bearing months of November through January. In 1994, the trawl area and season closure was expanded to include the entire Southern California Bight. These closures, along with the development of ridgeback prawn, sea cucumber, and other fisheries, and also greater demand for fresh fish, have kept spot prawn trawl landings low and facilitated growth of the trap fishery. The trap fishery began in 1985 with a live prawn segment developing subsequently. The fleet operates from Monterey Bay—where 6 boats are based—to Southern California , where a 30 to 40 boat fleet results in higher production. In both fishing areas traps are set at depths of 600 feet to 1,000 feet along submarine canyons or along shelf breaks. Between 1985 and 1991 trapping accounted for 75% of statewide landings; trawling accounted for the remaining 25% (Larson 2001). Landings continued to increase through 1998, when they reached a historic high of 780,000 pounds. Growth in participation and a subsequent drop in landings led to the development of a limited entry program, 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. Tables 3.3-10 and 3.3-11 summarize logbook information on fishing effort by depth for the spot prawn fishery trawl and trap fisheries, respectively.

Ridgeback Prawn: Ridgeback prawns occur from Monterey, California to Cedros Island, Baja, California, at depths ranging from less than 145 feet to 525 feet. According to Sunada *et al.* (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 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.

Following a 1981 decline in landings, the California Fish and Game Commission adopted a June through September closure to protect spawning female and juvenile ridgeback prawns. An incidental take of 50 pounds of prawns or 15% by weight is allowed during the closed period. During the season, a maximum of 1,000 pounds of other finfish may be landed with ridgeback prawns, of which federal regulations require no more than 300 pounds per trip be groundfish. Any amount of sea cucumbers may be landed with ridgeback prawns as long as the vessel owner/operator possesses a sea cucumber permit. Other regulations include a prohibition on trawling within state waters, a minimum fishing depth of 25 fm, a minimum mesh size of 1.5 inches for single-walled codends or 3 inches for double-walled codends and a logbook requirement. Ridgeback prawn trawl logs have been required since 1986. Table 3.3-12 shows the depth distribution of effort in this fishery.

Sea Cucumber: Along the West Coast, sea cucumbers are harvested by diving or trawling. Only the trawl fishery for sea cucumbers lands an incidental catch of groundfish. Sea cucumbers are managed by the states. In Washington, the sea cucumber fishery only occurs inside Puget Sound and the Straight of Juan de Fuca. Most of the harvest is taken by diving, although the tribes can also trawl for sea cucumbers in these waters.

Two species of sea cucumbers are fished in California: the California sea cucumber, also known as the giant red sea cucumber, and the warty sea cucumber. The warty sea cucumber is fished almost exclusively by divers. The California sea cucumber is caught principally by trawling in Southern California , but is targeted by divers in Northern California. Sea cucumber fisheries have expanded worldwide and, on this coast, there is a dive fishery for warty sea cucumbers in Baja, California, Mexico, and dive fisheries for California sea cucumbers in Washington, Oregon, Alaska, and British Columbia, Canada (Rogers-Bennett and Ono 2001). California implemented a permit program in 1992. In 1997 the state established separate, limited entry permits for the dive and trawl sectors. Permit rules encourage transfer to the dive sector, and this has lead to growth in this sector, which now accounts for 80% of landings. 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 (also see Table 3.4-7 for effort and harvest information for this fishery by depth strata).

Coastal Pelagic Species (CPS): CPS are largely landed with round haul gear (purse seines and lampara nets). Vessels using round haul gear are responsible for 99% of total CPS landings and revenues per year. These fisheries are concentrated in California, but CPS fishing also occurs in Washington and Oregon. In Washington, the sardine fishery is managed under the Emerging Commercial Fishery provisions as a trial commercial fishery. The target of the trial fishery is sardines; however, anchovy, mackerel, and squid are also landed. The fishery is limited to vessels using purse seine gear. It is also prohibited inside of three miles and logbooks are required. Eleven of the 45 permits holders participated in the fishery in 2000, landing 4,791 mt of sardines (Robinson 2000). Three vessels accounted for 88% of the landings. Of these, two fished out of Ilwaco and one out of Westport. In Oregon, the sardine fishery is managed under the Development Fishery Program under annually-issued permits, which have ranged from 15 in 1999 and 2000 to 20 in 2001. Landings, almost all by purse seine vessels, have rapidly increased in Oregon: from 776 mt in 1999 to 12,798 mt in 2001. The number of vessels increased from three to 18 during this period (McCrae 2001; McCrae 2002). The Southern California round haul fleet is the most important sector of the CPS fishery in terms of landings. This fleet is primarily based in Los Angeles Harbor, along with fewer vessels in the Monterey and Ventura areas. The fishery harvests Pacific bonito, market squid, and tunas as well as CPS. The fleet consists of about 40 active purse seiners averaging 20 m in length. Approximately one-third of the this fleet are steel-hull boats built during the last 20 years, the remainder are wooden-hulled vessels built from 1930 to 1949, during the boom of the Pacific sardine fleet. The Council manages these fisheries under its CPS FMP. Because stock sizes of these species can radically change in response to ocean conditions, the FMP takes a flexible management approach. Pacific mackerel and Pacific sardine are actively managed through annual harvest guidelines based on periodic assessments. Northern anchovy, jack mackerel, and market squid are monitored through commercial catch data. If appropriate, one third of the harvest guideline is allocated to Washington, Oregon, and northern California (north of 35°40' N latitude) and two-thirds is allocated to Southern California (south of 35°40' N latitude). An open access CPS fishery is in place north of 39° N latitude and a limited entry fishery is in place south of 39° N latitude. The Council does not set harvest guidelines for anchovy, jack mackerel, or market squid (PFMC 1998). Table 3.3-13 summarizes log book data on groundfish catch and bycatch in the market squid fishery.

Highly Migratory Species (HMS): Management of HMS is complex due to the multiple management jurisdictions, users, and gear types targeting these species. Adding to this complexity are oceanic regimes that play a major role in determining species availability and which species will be harvested off the U.S. West Coast in a given year. The states currently regulate the harvest of HMS but, as mentioned above, 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 the oldest and most common. Other gear types used to target HMS are driftnet, pelagic longline, purse seine, and harpoon. While hook-and-line can be used to take any HMS species, traditionally it has been used to harvest tunas. As mentioned in section 3.2.2.5, the principal target species in these fisheries include albacore and other tunas, swordfish and other billfish, several shark species, and dorado. Albacore is the most important species, in terms of landings and is commonly caught with troll gear. The majority of albacore are taken by troll and jig-and-bait gear (92% in 1999), with a small portion of fish landed by gillnet, drift longline, and other gear. These gears vary in the incidence of groundfish interception depending on the area fished, time of year, as well as gear type. Overall, nearly half of the total landings of albacore in millions of pounds coastwide were landed in California. Other gear includes pelagic longline, used to target swordfish, shark and tunas; drift gillnet gear for swordfish, tunas, and sharks off California and Oregon; purse seine gear for tuna off California and Oregon; and harpoon for swordfish off California and Oregon. Some vessels, especially longliners and purse seiners, fish outside of the U.S. EEZ, but may deliver to West Coast ports. Drift gillnet is most likely to intercept groundfish, including whiting, spiny dogfish, and yellowtail rockfish (Tables 3.3-14 and 3.3-15 show the historical and geographical distribution of HMS harvests, vessels and effort).

3.3.1.4 Foodfish Markets

<u>The World Market and Production</u>

West Coast groundfish compete in a global market, not only with similar species produced in other regions of the world, but also with other fish species such as salmon and tuna. In addition, fish compete with other sources of protein in consumers' budgets. More than 4.7 million metric tons (mt) of fish and other seafood were landed in the U.S. in 2000, approximately the same amount landed in each of the prior two years (DOC 2001). West Coast groundfish contributed about 0.14 million mt, 0.13 million mt, and 0.12 million mt to this total in 1998, 1999, and 2000, respectively. Pacific Whiting, a relatively abundant but low value species, comprises about two thirds of West Coast groundfish landings by weight, but only around 10% of groundfish exvessel revenue.

Production of farm-raised fish has increased rapidly in recent years. In 2000, more than 0.4 million mt of cultured fishery products were produced in the U.S., and more than 45 million mt were raised worldwide. An example of the emerging importance of farmed species is demonstrated by salmon. While commercial salmon harvest is still near the 1980 to 1997 annual average, world salmon supply has tripled since 1980 due to a ninefold increase in farmed salmon to 1.5 million mt in 2000.

An objective of groundfish management has been to spread harvest of the annual OY over as much of the year as possible. Consequently, harvest of West Coast groundfish occurs in every month, although it takes on increased importance during the summer months when sablefish harvest has traditionally peaked in recent years during the primary limited entry fixed gear fishery. (Table 3.3-16).

Groundfish has historically provided West Coast commercial fisheries participants with a relatively steady source of income over the year, supplementing the other more seasonal fisheries (Table 3.3-16). Although groundfish contributed only about 17% of total annual exvessel revenue during 2000, seasonally groundfish played a more significant role, providing one-fifth to one-third of exvessel revenue coastwide during April and also each of the three summer months. The peak contribution by the groundfish fishery in 2000 was sablefish during August (20% of exvessel revenue). Flatfish harvest supplied between 3% and 9% of monthly exvessel revenue throughout the year, and rockfish contributed an additional 2.5% to 6.8% to monthly exvessel revenue. For northern parts of the coast, groundfish is particularly important just before the start of the December crab fishery (also see sections 3.3.3.2 and 4.3.2.4).

Trade

In 2000 the U.S. imported 1.8 million mt of edible fishery products (17% from Canada and 14% from Thailand), and exported about one million mt of edible fishery products, one third of this to Japan. Japan is the world's largest importer of fish, and Japanese demand drives much of the trade patterns in the world markets (Wessells 1992). Altogether Japan imported more than $14 billion of fishery products from the rest of the world in 1999. The U.S. is the second largest importer of fishery products in 1999 at $9.4 billion. While the (current) dollar value of U.S. edible fishery product exports remained fairly flat from 1995 to 1999 at approximately $3 billion, the (current) dollar cost of imports increased by one third over the same period to $9 billion. In 1999 the U.S. was the fourth largest exporter by value of fishery products after Thailand, Norway, and China.

Imports

Most West Coast groundfish compete in the fresh and frozen fish product markets. In 2000 the U.S. imported 1.5 million mt of edible fresh and frozen fish products. One hundred seventy one thousand mt (11%) consisted of flatfish and groundfish. An additional 283 thousand mt of canned and cured edible fishery products were also imported. Fresh and frozen shrimp was by far the largest edible fishery import item in 2000, both in terms of tonnage (343 thousand mt) and value ($3.7 billion). Thailand supplied one half of this tonnage, earning $1.5 billion. In terms of value, U.S. imports of non-edible fishery products are almost as important as edible products. In 2000, nearly $9 billion of non-edible fishery products were imported along with $10 billion in edible products.

Exports

In 2000 the U.S. exported 190,000 mt of edible, fresh or frozen flatfish and groundfish products, about 22% of total edible fresh or frozen fishery exports by weight, or 19% by value. Surimi was the single largest component of total fresh and frozen imports by weight, accounting for another 150 thousand mt. However, salmon was the most valuable export, generating $353 million on the 100 thousand mt of fresh and frozen product shipped, and another $146 million from exports of canned product. Asia was the largest export region, absorbing 61% of U.S. fishery exports by volume. Japan alone bought 34% of total fishery exports, and South Korea and China took 11% and 10%, respectively.

Domestic Demand

From 1910 through the early 1970s, annual per-capita fish consumption in the U.S. generally ran between 10 pounds and 12 pounds edible weight. Beginning in the early 1970s, per-capita consumption increased to 12 pounds to 13 pounds. In the mid 1980s, it began shifting upward again to the 15-pound to 16-pound range where it has generally remained since 1985. In 2000 annual per-capita U.S. fish consumption was estimated to be 15.6 pounds. Internationally the U.S. ranks just above average in terms of per-capita fish consumption along with countries like the United Kingdom, Italy, Russia, and Canada, and not far below China, but less than half the level of Japan and South Korea.

Exvessel Prices

Table 3.3-17 shows recent annual exvessel prices for major commercial West Coast fishery species groups over the past five years. Through 2001, prices for most species groups were within their five year ranges, except for non-whiting groundfish and California halibut, which were at five-year highs in 2001, and shrimp/prawns and shellfish, which were at five-year lows.

Exprocessor and Wholesale Prices

While producer prices for groundfish products have not fared quite as badly as for other frozen fish (including salmon), they still are significantly below recent highs. The trend may be flat or still lower in the future (Table 3.3-18). Increasing production of farmed salmon is probably at least partly responsible for a continuing slump in salmon commodity prices. Producer prices for meat products in general have been relatively weak, thereby helping to hold down prices received for competitive fish protein.

3.3.1.5 Recreational Fishing Experience Markets

Just as West Coast commercial groundfish is only one segment of a broader food market, the groundfish recreational fishery represents only one segment of a broader recreational market. Other types of marine recreational angler trips, freshwater angling, and other recreational activities are, to varying degrees, potential substitutes ocean groundfish fishing.

Demand for recreational trips and estimates of the economic impacts resulting from recreational fishing are related to numbers of anglers. Unfortunately, reliable data are not available on the number of West Coast anglers targeting specific species.

However, data are available on the total number of saltwater anglers, and it is evident the presence of opportunities to catch species other than directly targeted ones increases the propensity of anglers to fish and the value of the overall recreational fishing experience. In the U.S., over 9 million anglers took part in 76 million marine recreational fishing trips in 2000. The Pacific coast accounted for about 22% of these participants and 12% of trips. Seventy percent of West Coast trips were made off California, 19% off Washington, and 11% from Oregon.

Table 3.3-19 shows the numbers of marine anglers by West Coast state in 2000. The table shows that although California's marine recreational fishery dominates the other West Coast states both in terms of numbers of anglers and trips, Oregon attracts the largest share of non-resident anglers, probably chiefly due to the access it affords to the seasonal salmon fisheries at the mouth of the Columbia River.

Table 3.3-20 shows the relative importance of groundfish in West Coast states' recreational fisheries between 1996 and 2001. Although only a relatively minor share of West Coast recreational effort overall, in three of the four regions, groundfish catch, either targeted or incidental, accompanied a significant share of both charter and private recreational trips. This effect was greatest in Oregon where groundfish catch was consistently associated with well over half the recreational trips each year. Only in Southern California did groundfish appear to be a relatively minor part of regional marine recreational effort.

3.3.1.6 Non-Market Values (Existence Values, Bequethal Values, and Option Values)

This section discusses nonmarket values (other than the recreational fishing experience). Offsite nonconsumptive uses of resources that are protected by management and preservation of fish stocks are public in nature in that no one is excluded from deriving the identified benefits. Total value placed on offsite nonconsumptive use of the stock or component of the ecosystem set aside will also depend on:

1. The size of the human population.
2. The level of income.
3. Education levels.
4. Environmental perceptions and preferences.

(After Spurgeon, 1992, as cited in Caribbean Fishery Management Council, 1998).

The above relationships imply that as human populations and the welfare of those populations increase and as the fish stocks and their ecosystem remaining in good condition decreases, the nonconsumptive values associated with maintaining ocean resources is likely to increase. Also implied is that once the basic integrity of ecosystem processes and marine fisheries components are preserved, the likely additional benefit from incremental increases will decrease.

Value may also be placed on biological diversity. The value of biological diversity may be part of the value placed on a site by nonconsumptive users (onsite or offsite). Three levels of biological diversity have been identified, (1) genetic diversity within a species, (2) species diversity (richness, abundance, and taxonomic diversity), and (3) ecosystem diversity. Ecosystem diversity encompasses the variety of habitats, biotic communities, and ecological processes (Caribbean Fishery Management Council 1998).

3.3.2 Directed Commercial Groundfish Fisheries

Limited Entry Fisheries

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 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 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 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). Whiting landings are mostly caught by trawlers, with the majority of the harvest occurring in the Columbia INPFC. A large part of the harvest also occurs in the U.S. portion of the Vancouver INPFC area.

West Coast limited entry trawl vessels use midwater gear to target Pacific whiting and yellowtail and widow rockfish, or bottom gear for flatfish species (on the shelf and the slope) and DTS species in deep water. Some slope and shelf rockfish species have been important targets in the limited entry trawl fishery.

Large-scale harvesting of Pacific whiting in the U.S. EEZ began in 1966 when factory trawlers from the then Soviet Union began targeting Pacific whiting. During the mid 1970s, factory trawlers from Poland, the Federal Republic of Germany, the former German Democratic Republic, and Bulgaria also participated in the fishery. During 1966 through 1979, the catch in U.S. waters averaged 137,000 mt per year. A joint-venture fishery was initiated in 1978 between two U.S. trawlers and Soviet factory trawlers acting as motherships. By 1982, the joint-venture catch surpassed the foreign catch. In the late 1980s, joint-ventures involved fishing companies from Poland, Japan, the former Soviet Union, the Republic of Korea, and the People's Republic of China. In 1989 the U.S. fleet capacity had grown to a level sufficient to harvest the entire quota, and no foreign fishing was allowed.

Historically, the foreign and joint-venture fisheries produced fillets and headed-and-gutted products. In 1989, Japanese motherships began producing surimi from Pacific whiting, using a newly developed process to inhibit deterioration of the flesh resulting from myxozoan-induced proteolysis. In 1990, domestic catcher-processors and motherships entered the Pacific whiting fishery in the U.S. zone. Previously, these vessels had engaged primarily in Alaskan pollock fisheries. The development of surimi production techniques made Pacific whiting a viable alternative. In 1991 the joint-venture fishery for Pacific whiting ended, because of the high level of participation by domestic catcher-processors and motherships and the growth of shore-based processing capacity. Shore-based processors of Pacific whiting had been constrained historically by a limited domestic market for Pacific whiting fillets and headed-and-gutted products. The construction of surimi plants in Newport and Astoria led to a rapid expansion of shore-based landings in the early 1990s.

While possessing about 230 permits, only about 180 limited entry fixed gear vessels are active in a given year. These vessels use longline or trap (including pots) 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. While longline and pot vessels have been grouped into the "fixed gear" limited entry sector, this grouping has largely been driven by allocational issues surrounding groundfish. The size selectivity and species selectivity of the gears vary, with longline gear being somewhat more bycatch of nonsablefish species during the sablefish fishery and being capable of targeting nonsablefish groundfish.

Directed Open Access- Groundfish

In the directed open access fishery, 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; while pot gear generally targets sablefish and some thornyheads and rockfish. In Southern and Central California, setnet gear targets rockfish, including chilipepper, widow rockfish, bocaccio, yellowtail rockfish, and olive rockfish, and to a lesser extent vermillion rockfish.

Generally, managers cannot directly determine whether a fisher is targeting groundfish in this sector since his intentions or strategy are nowhere stated in the available data (landings receipts and logbooks). Managers must, therefore, somewhat arbitrarily classify a given trip or vessel as part of the directed fishery based on the species composition detailed in these data sources. 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. Participation in the directed fishery has decreased from 1,357 vessels in 1994 to 1,032 in 1999. Reasons for this trend could include movement from the groundfish open access sector into other more profitable fisheries, or movement out of fishing all together. Based on this definition, 2,723 vessels targeted groundfish in the open access sector between 1995 and 1998. In comparison, managers classified 2,024 vessels as landing groundfish incidentally (because groundfish made up less than 50% of their catch) during this period (SSC Economic Subcommittee 2000). However, there is substantial overlap between these categories—1,231 vessels show up in both totals. In summary, fishers do not abide by managers' desire for easy classification. Probably in response to falling harvest guidelines and concomitant management measures, participation in the directed fishery has decreased from 1,357 vessels in 1994 to 1,032 in 1999 (Hastie 2000).

In the directed open access fishery, fishers target groundfish in the "dead" and/or "live" fish fishery using a variety of gears. The terms dead and live fish fisheries refers to the state of the fish when they are landed. The dead fish fishery has historically been the most common way to land fish. The dead fish fishery made up 80% of the directed open access landings by weight coastwide in 2001. More recently, the market value for live fish has increased landings of live groundfish.

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. Managers are faced with a similar problem as discussed above in determining landings from this fishery. Landings data do distinguish live fish sales, but the price information suggests that this classification is inaccurate. Therefore, 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 (Table 3.3-21). 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. Currently, Oregon and California are drafting nearshore fishery management plans (FMPs) that would transition some species of groundfish landed in the live fish fishery from federal to state management.

Landings, Revenue, and Participation by State. Fisheries are generally distributed along the coast in patterns governed by factors such as location of target species, location of ports with supporting marine supplies and services, and restrictions/regulations of various state and federal governments. For the open access directed groundfish fishery, the majority of landings by weight that target groundfish occur off California. Oregon's directed groundfish open access fishery has the next highest landings, followed by Washington's. In the incidental groundfish fisheries, Oregon and California both have similar landings in their open access fisheries. Washington again has the lowest landings by weight of incidental groundfish (PFMC 2001e). Participation in "both directed and bycatch components of the open access fishery is much greater in California than in Oregon and Washington combined. For instance, in 1998, 779 California boats, 232 Oregon boats, and 50 Washington boats participated in the directed fishery. In that same year, 520 California boats, 305 Oregon boats, and 40 Washington boats participated in the bycatch fishery" (SSC's Economic Subcommittee, 2000).

Open access fisheries have been examined for their landings in the years 1996 and 2001, two randomly chosen years following the implementation of the limited entry program (Table 3.3-22). Overall and in each individual state, open access landings decreased between 1996 and 2001. Federally, open access landings limits were sharply reduced between 1996 and 2001. Exvessel value for open access groundfish fisheries also decreased coastwide between 1996 and 2001. The directed fishery decreased from over $7 million in 1996 to under $5 million in 2001, and the incidental fishery decreased by half, from roughly $800,000 in 1996 to roughly $400,000 in 2001.

3.3.2.1 Fishery Participation

Catcher vessel owners and captains employ a variety of strategies to fill out a year of fishing. Fishers from the northern ports may fish in waters off of Alaska, as well as in the West Coast groundfish fishery. Others may change their operations throughout the year, targeting on salmon, shrimp, crab, or albacore, in addition to various high-value groundfish species, so as to spend more time in waters close to their communities. Factory trawlers and motherships fishing for or processing Pacific whiting off of the West Coast usually also participate in the Alaska pollock seasons, allowing the vessels and crews to spend a greater percentage of the year at work on the ocean. Commercial fisheries landings for species other than groundfish vary along the length of the coast. Dungeness crab landings are particularly high in Washington state, squid, anchovies, and other coastal pelagics figure heavily in California commercial landings, with salmon, shrimp, and highly migratory species like albacore more widely distributed, and varying from year to year.

3.3.2.2 Vessel Type and Participation

Figures 3.3-2 a through c show the approximate concentration of groundfish vessels in fisheries for nongroundfish West Coast species, 1994 through 1998. These bar charts exclude some nongroundfish fisheries where participation by groundfish vessels was so minimal that a viewer could not reasonably see the corresponding portion of the bar chart. Data for these charts came from an ongoing Council staff project to create a socioeconomic profile of groundfish fishery participants.

It is clear from these three charts there is some degree of gear loyalty for groundfish vessels participating in nongroundfish fisheries. For example, a notable proportion of the nongroundfish fishery participation by groundfish trawl vessels occurs in the shrimp and prawn trawl fisheries. Similarly, the hook-and-line groundfish fisheries show high participation in the troll albacore and troll salmon fisheries. And, while all three gear groups participate in pot fisheries for crab, groundfish pot vessels show the greatest percentage of gear group participation in pot fisheries for crab and other crustaceans.

3.3.2.3 Vessel Groups: Gears, Size, Dependence and Involvement

Table 3.3-23 (a and b) provides information on the number of vessels and gross revenues by level of dependence in the fishery. The fleet subdivisions provided here will be used in Chapter 4 to provide more information on the effects of the alternatives on different segments of the fleet. Table 3.3-7 provided information on vessel involvement in groundfish and other West Coast fisheries. Table 3.3-24 (a and b) provides similar information by vessel size and level of dependence. Table 3.3-25 relates vessel size to gear type and the species harvested by typical depth range for the species.

3.3.3 Buyers and Processors

The boxed text in this sub-section describes processing capacity trends and processing costs. This information was provided to the Council by the West Coast Seafood Processors Association (WCSPA). Comment is sought from the industry and general public on the degree to which the economic survey data on processing capacity is representative of trends on the West Coast and the degree to which the reported processing costs and recovery rates appear reasonable and reflect costs experienced by others along the West Coast.

3.3.3.1 Exvessel Purchases by Processor Type

Several thousand entities have permits to buy fish on the West Coast. Of these 1,780[2/] purchased fish caught in the ocean area and landed on Washington, Oregon, or California state fishtickets in the year 2000 (excluding tribal catch) and 732 purchased groundfish (Table 3.3-26).[3/]

Larger buyers tend to handle groundfish more than smaller buyers. Of the 546 buyers purchasing in excess of $20,000 of West Coast landings, 59% bought groundfish. These 546 buyers bought 99% of all Council-managed groundfish (Table 3.3-27). Of the 1,234 buyers purchasing less than $20,000 from West Coast vessels, 33% bought groundfish.

The number of buyers handling groundfish from trawl vessels is substantially lower than all of those handling groundfish. Only 17% (125) of all groundfish buyers (732) handled fish from trawl vessels (Table 3.3-26). These 125 vessels comprise only 7% of all buyers (1,780). Buyers of trawl-caught groundfish are important to nontrawl vessels as well, handling 60% (by value) of the groundfish caught by nontrawl vessels (Table 3.3-28).

The largest buyers tend to handle trawl vessels more than smaller buyers. Of the 38 largest buyers of groundfish (those with purchases in excess of $1 million), 73% (28) bought from trawl vessels (Table 3.3-26). Seventy-eight percent of all groundfish purchases from trawl vessels (Table 3.3-28) go to the 28 trawl buyers with total purchases of all species in excess of $1 million. These 28 buyers also handle 39% of the exvessel value of the nontrawl purchases.

Mid-size buyers tend to have greater importance for nontrawl vessels than for trawl vessels. Fifty percent of all nontrawl sales go to buyers with total purchases of between $20 thousand and $1 million, as compared to 22% for trawl vessels (Table 3.3-28).

Absent cost and exprocessor sale price data, very rough assumptions must be made to consider possible levels of dependence of processors on groundfish. As illustrated in a sidebar on a following page, processor margins differ for different species and product forms. However, absent the needed data it is assumed here gross exvessel value of purchases is a rough indicator of relative levels of dependence. Large buyers of groundfish tend to have a lesser percentage of their overall purchases from groundfish than smaller buyers (Table 3.3-29). In Table 3.3-29 buyers are placed in categories by the proportion of their purchases that are groundfish purchases. The distribution of large buyers has a single mode (a single peak) in the 5% to 35% range. The distribution of smaller buyers tends to be bimodal with peaks in the 0% to 5% range and the 95% to 100% range. For smaller buyers this may indicate that groundfish are purchased as part of the incidental catch from fisheries targeted on other species (the buyers with 0% to 5% of their purchases from groundfish) or the buyers are specialty buyers or handling their own catch (the small buyers with 95% to 100% of their purchases from groundfish).

3.3.3.2 Seasonality

Groundfish buyers tend to have more of a year-round presence in the fishery than nongroundfish buyers, particularly larger buyers. Eighty percent of the larger groundfish buyers (those with over $1 million in purchases) made purchases in every month in the year 2000 while only 31% of the nongroundfish buyers made purchases in every month (Table 3.3-30).

2/ For this analysis a ?buyer" was defined as a unique combination of Pacific Coast Fisheries Information Network (PacFIN) port code and state buyer code on the fishticket. For California, a single company may have several buying codes that vary only by the last two digits. The last two digits on these codes were truncated and would appear as separate buying units only if they appear on fishtickets for different ports.

3/ Unless otherwise noted, this section provides quantitative information on nontribal landings or fish caught in the ocean area and landed on West Coast WOC fishtickets.

For the 75 processors active at least 9 months of the year, but not year-round, the most common months to be inactive are November (22 buyers inactive), followed by February, January, March, and December (with between 10 and 14 buyers inactive in each month) (Table 3.3-31).

Of the larger buyers handling groundfish, 60% of those making some fish purchases every month made purchases of groundfish in every month (Table 3.3-30 compared to Table 3.3-32).

In most port areas on the West Coast there are generally six or fewer buyers purchasing from limited entry vessels. In the north, the primary exception is Astoria; and in the south, the exceptions are San Francisco, Monterey, and San Luis Obispo (Table 3.3-33). In San Francisco and from San Luis Obispo south there tend to be more buyers of fixed gear rockfish and other groundfish than there are buyers of trawl-caught species.

3.3.3.3 Processor Capacity

In an effort to collect data for the 2002 fishery, port biologists were asked to report their observations on the number of fillet and cutting stations in the plants from which they sampled. A census of this measure of capacity, and the ratio of capacity to available product over time, might provide an indicator of trends and economic health of the processing industry. While the data collected in this initial effort is not sufficient for analysis, it does provide something of a baseline for certain areas of the coast. The survey found that in 2001, there were 44 fillet stations and two cutting tables in the Puget Sound region; 27 fillet stations (and an additional 26 in storage) on the Southern and Central Washington Coast; and 130 fillet stations between Crescent City and Fort Bragg in Northern California.

3.3.3.4 Processing Costs and Labor

Information on processing costs is being collected by the Pacific States Marine Fisheries Commission Economic Fishery Information Network project. It is hoped some of this information will be available soon for economic analysis. In the mean time, the WCSPA has provided information on costs, labor, and exprocessor prices from members of their organization. This information is displayed in the following box:

In 2001, WCSPA surveyed member processing plants to determine the cost of producing Dover sole and rockfish fillets and the range of prices for which those fillets were sold. Dover sole was chosen because it is the most common, most available, and most valuable (other than petrale sole at certain times of the year) of the flatfish species. They did not specify what species of rockfish the data represented, but instead asked the plants to give the most common values.

The WCSPA notes that processing costs for groundfish products have increased 22% between 1997 and 2000 from $1.55 per pound to $1.89 per pound. The profitability of rockfish is greater ($0.38 per pound to $0.73 per pound) than the profitability of Dover sole ($0.42 per pound to $0.60 per pound). When fish must be frozen rather than sold fresh associated profits decline substantially. While the profitability of Dover sole appeared to be somewhat less for rockfish, the degree of loss that occurs when Dover sole must be frozen (a loss of $0.18 per pound to $0.43 per pound) appeared to be less than the loss when rockfish must be frozen ($0.19 per pound to $0.54 per pound).

Information supplied by the WCSPA indicates a decline of 13% between 1997 and 2000 in the total number of filleting stations among association members (from 259 to 224); and a 46% decline in the number of filleting stations used (from 215 to 115).

Over the same period, the WCSPA indicates a decline of 18% in the number of unskilled processing employees (from 566 to 464), and a decline of 37% in the number of skilled employees (from 412 to 259).

Data for this survey were supplied by: Alioto-Lazio Fish Co.; Bandon Pacific Seafood; Bornstein Seafoods-Bellingham, Newport; Eureka Fisheries-Brookings, Crescent City, Fields Landing, Fort Bragg; Hallmark Fisheries; Olds Port Fisheries; Pacific Choice-Eureka; and Quality-Pak; Washington Crab Producers.

In 2002, WCSPA surveyed eight member processing plants north of Mendocino, California for their employment, payroll, and processing capacity during the prior year. These facilities employed a total of 1,810 combined full-time and part-time workers during the year. August was the month of greatest employment (1,212) and November the lowest (617). This number varies seasonally, with increases in January for crab processing and in April / May for shrimp. Most notable is also a significant jump in employment and payroll during the summer whiting season. The facilities reported total payroll of $15 million for the year.

In terms of capacity, the facilities reported a total of 122 filleting stations and 21 shrimp peelers available during the year.

3.3.4 Recreational Fishery

Recreational fishing has been part of the culture and economy of West Coast fishing communities for more than 50 years. Along the northern coast, most recreational fishing targeted salmon, but the abundant rockfish often provided a bonus to anglers. Recreational fisheries have contributed substantially to fishing communities, bringing in outside dollars and contributing to tourism in general.

Recreational fishing in the open ocean has been on an increasing trend since 1996 (Table 3.3-20); however, charter effort has decreased while private effort increased during that period. Part of this increase is likely the result of longer salmon seasons associated with increased abundance. Some effort shift from salmon to groundfish likely occurred prior to 1996 when salmon seasons were shortened. Groundfish are both targeted and caught incidentally when other species, such as salmon, are targeted. The contribution of groundfish catches to the overall incentive to engage in a recreational fishing trip is uncertain. However, it seems likely the frequency of groundfish catch on a trip adds to overall enjoyment and perceived value.

3.3.4.1 Allocation by Region or Gear Groups, Charter and Private Recreational

A similar number of angler trips for groundfish are taken by private anglers as charter anglers (Table 3.3-34), although the percentage of groundfish trips to total trips is much greater for charter anglers than for private anglers (43% versus 16% respectively, coastwide). Total catch of all groundfish species is very similar between charter and recreational anglers coastwide, although in Washington, charter and private anglers take about the same number of trips, but charter anglers harvest about 80% of the groundfish (Table 3.3-34).

3.3.4.2 Catch and Imputed Value

For the purpose of reviewing the effects of the groundfish fisheries on communities, income impacts associated with fish landings for the port areas of the West Coast are estimated. Three different types of income are included in the estimate of income impacts (1) direct income, income paid directly to business owners and employees of fish harvesting and fish processing firms; (2) indirect income, income paid to business owners and employees of firms supplying the fish harvesting and processing firms (e.g., engine repair and bait businesses); and (3) induced income, income that is generated for owners and employees of other firms when recipients of direct and indirect income spend their money in the community (e.g., grocery stores and theaters). These effects should be thought of as those “associated with” the fishery rather than “generated by” the fishery, because in the absence of the fishing opportunity some of the income would still be generated in the community or elsewhere in the economy. For example, tourists at the coast for primary reasons other than fishing might spend their time and money on other activities, fishers not traveling to the coast to fish for groundfish might spend their time and money on some alternative activity in another community, and the crew on vessels would seek an alternative source of income either within the community or elsewhere.

The recreational fishery in Washington, Oregon, and California is associated with $254 million in personal income and almost 10,000 jobs; the groundfish fishery represented $71 million and 2,800 jobs, respectively or about 28% of the total (Table 3.3-35). The proportion of income associated with groundfish ranged from 17% in Washington to 45% in Oregon. Groundfish opportunity has continued to decline as restrictions to protect overfished species have increased (Figures 3.3-3 through 3.3-6).

3.3.4.3 Seasonality and Use

Fishing effort, both private and charter, is related to weather, with relatively more effort occurring in the milder months of summer, and relatively less in winter (Table 3.3-36). As might be expected, this effect 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; lingcod season being closed from November through March (Figures 3.3-3 through 3.3-6).

3.3.4.4 Recreational Fishers

There are three groups of recreational fishers that will be considered here (1) those that travel to an area primarily because of the opportunity to fish for groundfish, (2) those that travel to an area to take part in a suite of activities which include groundfish fishing, and (3) those that live in an area and take part in the recreational groundfish fishery.

Recreational fishers from outside a fishing area are probably the most mobile part of the harvest effort. However, for those who travel to a particular area to go groundfish fishing, the decision to transfer their trip to a different area or time in response to a time/area or depth closure likely implies a change to a lower value experience. The fisher deciding to travel to an area at a particular time to go fishing has variety of choices available. Presumably, the first choice time and location offers the best value to the fisher. Thus, changing the trip to another area and/or time, in most cases, is likely to result in a lower value experience.

Those for whom recreational groundfish fishing is only one of the activities for which they travel to an area may exhibit somewhat less mobility. The elimination of their opportunity to fish may not change their travel plans, but may reduce the value of their experience forcing them into second choice activities. However, for some of these anglers, the elimination of the groundfish fishing activity will be the marginal change that changes their preferred location ("I can't go groundfish fishing at Port A, but Port B offers many things almost as nice as Port A, and at Port B I can go groundfish fishing too") or time of travel ("It's not the best time to take my vacation, but if I delay for a month I'll still be able to go to my favorite groundfish fishing area at Port A and do all the other things I like to do there as well").

Those that live in an area may respond to a time/area closure by, (1) not going groundfish fishing at all and spending their time and money in the same community on an alternative activity; (2) going groundfish fishing at a different, less optimal, time; or (3) traveling to a different area to go fishing or take part in an alternative recreational activity. All cases reflect a loss of value to the individual associated with a shift to second- choice activities.

In Washington, the majority of private anglers reside outside the county of the port in which the trip originated, while in Oregon and northern California the proportions are roughly equal, and in Southern California the majority of trips are taken by residents of the port county (Table 3.3-37). Ports with higher proportions of non-resident trips receive relatively more benefit from fishing activity since "out of town" dollars are being spent, and the per-trip expenses are greater. With less fishing activity, more of those dollars are likely to be spent on other activities in other areas.

3.3.4.5 Charter Industry

Recreational charter vessels are probably more dependent on their home port than commercial vessels, though recreational charter vessels are known to exhibit some mobility between ports. It is the marketing aspects of the charter operations that tend to depend on location. Thus the charter agents and vessels that serve as their own booking agents are less able to respond to local area closures by moving to a different port than vessels that rely on charter offices to recruit clientele. Charter vessel operators and crew which do attempt to move operations to a port in an open area will face obstacles in recruiting clientele or developing new relationships with booking agents. The operator and crew may experience social effects associated with distance from family and social networks.

The distribution of charter vessels in 2001 (Table 3.3-38) roughly coincides with the geographic distribution of trips (Table 3.3-35). The ratio of charter angler trips to vessel participation is much greater in Northern and Southern California than in Washington and Oregon, however, suggesting some differences in charter fleet characteristics, such as opportunity (e.g., season length, weather, etc.), or market factors. In Washington, Oregon, and Northern California the vast majority of charter anglers reside outside the port county, while in southern California slightly more trips are taken by residents of the port county (Table 3.3-37).

3.3.5 Tribal Fisheries

In 1994 the U.S. government formally recognized the four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish; and concluded, in general terms, they may take half of the harvestable surplus of groundfish available in the tribes' usual and accustomed (U&A) fishing areas (described at 60 CFR 660.324). West Coast treaty tribes have formal allocations for sablefish, black rockfish, and Pacific whiting. Members of the four coastal treaty tribes participate in commercial, ceremonial, and subsistence fisheries for groundfish off the Washington coast. Participants in the tribal commercial fisheries operate off Washington and use similar gear to non-tribal fishers. Groundfish caught in the tribal commercial fishery pass through the same markets as non-tribal commercial groundfish catch.

There are several groundfish species taken in tribal fisheries for which the tribes have no formal allocations and some species for which no specific allocation has been determined. Rather than try to reserve specific allocations of these species, the tribes annually recommend trip limits for these species to the Council, who try to accommodate these fisheries. Tribal trip limits for groundfish species without tribal allocations are usually intended to constrain direct catch and incidental retention of overfished species in the tribal groundfish fisheries.

3.3.6 Communities

Fishing communities, as defined in the Magnuson-Stevens Act, include not only the people who actually catch the fish, but also those who share a common dependency on directly related fisheries-dependent services and industries. In commercial fishing this may include boatyards, fish handlers, processors, and ice suppliers. Similarly, entities that depend on recreational fishing may include tackle shops, small marinas, lodging facilities catering to out-of-town anglers, and tourism bureaus advertising charter fishing opportunities. People employed in fishery management and enforcement make up another component of fishing communities.

Fishing communities on the West Coast depend on commercial and/or recreational fisheries for many species. Participants in these fisheries employ a variety of fishing gears and combinations of gears. Naturally, community patterns of fishery participation vary coastwide and seasonally, based on species availability, the regulatory environment, and oceanographic and weather conditions. Each community is characterized by its unique mix of fishery operations, fishing areas, habitat types, seasonal patterns, and target species. While each community is unique, there are many similarities. For example, all face danger, safety issues, dwindling resources, and a multitude of state and federal regulations.

Individuals make up unique communities with differing cultural heritages and economic characteristics. Examples include a Vietnamese fishing community of San Francisco Bay and an Italian fishing community of Southern California. Native American communities with an interest in the groundfish fisheries are also considered. In most areas, fishers with a variety of ethnic backgrounds come together to form the fishing communities within local areas, drawn together by their common interests in economic and physical survival in an uncertain and changing ocean and regulatory environment.

Preceding sections of this document have provided numbers of commercial vessels, fish buyers, and charter vessels for various geographic regions. To the extent allowed by constraints on confidentiality (commercial) and data validity (recreational), information is also provided on the value of product landed and amount of recreational effort.

Supplemental county level economic and demographic information has been compiled for a general baseline description of West Coast fishing communities (PFMC 1999). This information may be accessed on the Council website (http://www.pcouncil.org/communities/comdoc.html).

3.3.6.1 Geographic Distribution of Commercial Fishing Fleet and Revenue

A list of Pacific Fisheries Information Network (PacFIN) ports comprising each port area group used in this section is shown in Figure 3.3-7 and Table 3.3-39. For this discussion there are 17 port groups arrayed north to south. Port groups were identified by several criteria, (1) avoid most disclosure issues regarding confidential information, (2) include the whole counties surrounding the ports, and (3) allow breaks along state lines to allow aggregation and display of information at the state level. The port area groups in each state are: Washington--Puget Sound, Northwest Olympic Peninsula, Central Washington Coast, South Washington Coast; Oregon--Astoria/Tillamook, Newport, Coos Bay, Brookings; California--Crescent City, Eureka, Fort Bragg, San Francisco, Monterey, San Luis Obispo, Santa Barbara, Los Angeles, San Diego.

Table 3.3-40 shows the number of vessels operating in different fisheries from each PacFIN port and port area in the 2000 through 2001 base period. The table shows major concentrations of the coastwide total 244 limited entry trawl vessels operating from Oregon and Northern California ports. The largest groundfish limited entry trawl fleets are shown in Astoria, Charleston, Newport, Crescent City, Fort Bragg, Westport, and Fields Landing. These are primarily engaged in the shelf and slope fisheries, but a majority are also engaged nearshore. There were also 28 vessels operating only in the at-sea whiting fishery. The 178 vessels in the limited entry fixed gear fleet are concentrated in the northern ports of Bellingham, Port Angeles, Newport, Port Orford, Westport, Astoria, and Moss Landing. This group is dominated by the sablefish fleet operating primarily on the shelf and slope. Open access vessels deriving at least 5% of revenue from groundfish is the largest groundfish category in the table. These 771 vessels are distributed throughout the coast. In the North, these vessels are more engaged in shelf and slope fisheries. The southern fleet is more engaged nearshore.

The second most numerous groundfish category is composed of the open access vessels deriving less than 5% of revenue from groundfish. Major concentrations of these 517 vessels operate from Newport, Charleston, Santa Barbara, and Garibaldi. The southern fleet is more active nearshore. Altogether there were 1,710 vessels recorded as landing significant quantities of groundfish of the total 4,589 vessels operating in all fisheries coastwide. Table 3.3-41 shows the geographic distribution of vessels by length category.

Figure 3.3-8 shows the relative magnitude and geographical distribution of landings of groundfish species among West Coast port areas in 2001. The figure illustrates the areas with the highest volume of groundfish landings (diameter of the pie chart) are Newport, Astoria/Tillamook, and Central Washington coast. These landings are predominantly made by limited entry trawl vessels. Figure 3.3-9 shows the corresponding distribution of exvessel revenue resulting from the landings in figure 3.3-8. The figure shows the areas with the highest value of groundfish landings (diameter of the pie chart) are Astoria/Tillamook, Newport, and Coos Bay on the Oregon coast. These are also the areas most invested in the groundfish trawl fishery (size of shaded pie slice). The difference between the distribution of landings volume in figure 3.3-8 and value in figure 3.3-9 is due to the predominance of low-value whiting landings in Oregon and the presence of high-value, non-trawl sablefish landings along the entire coast. Groundfish and limited entry trawl, in particular, become relatively less important in terms of volume and value moving north or south from the Oregon and Washington coastal ports. In the Northern and Central California ports, limited entry trawl also dominates groundfish landings and value, although the magnitude is significantly less than in Oregon. Moving south from San Francisco, both the total value and the share of groundfish landed by the limited entry trawl fleet diminish. Along the northern coast, Brookings and Northwest Olympic Peninsula are somewhat unique in having nearly half of groundfish exvessel revenue landed by non-trawl sectors.

3.3.6.2 Geographic Distribution of Groundfish Buyers

Table 3.3-42 shows the number of buyers in West Coast ports purchasing groundfish and nongroundfish species from different categories of fisheries. The table shows that of the 1,283 total active buyers on the West Coast, 451 purchased groundfish from harvesters during the base period. Groundfish buyers are distributed all along the West Coast, but more heavily in some of the larger ports toward the south. The port area group with the greatest number of groundfish buyers was San Francisco with 96, led by the Port of San Francisco and Princeton with 31 and 29 buyers, respectively. Table 3.3-43 shows the distribution of buyers among ports broken down by the total value of exvessel purchases.

3.3.6.3 Geographic Distribution of Personal Income Impacts

Tables 3.3-44, 3.3-45, 3.3-46, and 3.3-47 display, for two recent years, income impacts attributable to commercial harvesting and shoreside processing of Council-managed species in major port areas along the West Coast . These are total income impacts (direct, indirect, and induced effects), composed of the wages and salaries paid to primary producers, processors, and suppliers, and the additional income generated when those wages and salaries are spent in the local economy.

Income impacts were generated using the Fisheries Economic Assessment Model (FEAM) (Jensen 1996). FEAM uses historical landings data, information on industry cost and margin structure (vessels and processors), and income multipliers generated by IMPLAN (MIG 2000) to produce estimates of "regionalized" local income impact after deducting for leakage of payments to non-residents and to non-local suppliers, wholesalers and manufacturers. Note that income multipliers measure the income received by participants in the local economy, not gross sales or "turnover." Also note that these multipliers assume changes in capital stock resulting from investment decisions are annualized, so the impact of purchasing or replacing capital assets (vessels, gear, buildings, plant, etc.) are amortized as a series of annual payments rather than treated as a lump sum purchase.

Table 3.3-44 shows the income in thousands of current U.S. dollars generated in 2001 from harvesting and shoreside processing activities. Table 3.3-45 displays these dollar impacts as the percentage of each port area's income that is derived from each species group. Tables 3.3-46 and 3.3-47 display analogous information for 1999.

From Table 3.3-44 and 3.3-46, the total income derived from commercial harvesting and shoreside processing of Council-managed species in 2001 was $579 million. California ports claimed $329 million, or 57% of this total. Oregon's share was $125 million (22%) and Washington's $82 million (14%). The West Coast at-sea whiting fishery was responsible for an additional $43 million (7%), much of which probably accrued to the Northern Oregon ports. In 1999 California's share of a total $686 million (not adjusted for inflation) was $417 million (61%), Oregon's share was $132 million (19%), and Washington's share was $80 million (12%). The remaining $57 million (8%) was attributable to the at-sea sector. West Coast commercial fishery-generated income declined 15% between 1999 and 2001, not adjusted for inflation. The change in groundfish-generated income over the same period was more severe: a decline of 21%.

Tables 3.3-45 shows that of the coastwide total $579 million income attributable to commercial harvesting and shoreside processing of Council-managed species groups in 2001, about 26% was due to groundfish-related activity. However, the distribution of groundfish-related activity was very uneven, with Oregon being most heavily dependent (43% of fishery-related income), Washington next (29% of fishery-related income), and California least dependent on groundfish relative to fishery-related income at 10%. Table 3.3-47 shows that compared with 2001, in 1999 groundfish were slightly more important coastwide, generating 28% of fishery-related income. Groundfish harvest in 1999 was also of significantly higher relative importance in Oregon and Washington than in California, accounting for 52% and 33% of total fishery-generated income in Oregon and Washington, respectively.

3.3.6.4 Dependence on and Engagement in Fishing and Fishing-related Activities

Table 3.3-48 displays estimated income and employment resulting from all commercial fishing activities for each port area group. The base for this table (and also the discussion of impacts in Chapter 4) is a 12-month period running from November 2000 through October 2001. Indices are calculated as the percentage of total area personal income or total employment that is generated by commercial fishing and processing activities via local economic linkages. Note that income and employment rankings for all commercial fishery activity are broadly consistent, but show slight discrepancies due to differing shares of wage and non-wage income in each area's total personal income. Also displayed in the table are estimates of total fishery-related income and employment derived from the groundfish fishery, and the split between limited entry trawl and other groundfish gear.

By examining the rankings in the first block of the table we get an idea of how engaged each port area is in commercial fishing relative to other opportunities in the regional economy. Both the income and employment measures indicate the area most heavily invested in commercial fishing relative to its economy is the south Washington coast. Next most engaged are Newport and Astoria/Tillamook in Oregon, and Crescent City, California. Brookings and central Washington coast alternate for 5th and 6th place depending on whether the income or employment measure is used. By this measure the least engaged port areas are the large, relatively urbanized centers of Puget Sound, San Diego, San Francisco, and Los Angeles. While these areas certainly include local pockets that are heavily engaged in fishing activities, the size and diversity of the surrounding economies tends to mask the significance of locally important factors.

The second block on the first page of the table shows how much of the total fishery-related income and employment in each region is generated by groundfish activity. This measure shows Puget Sound, Northwest Olympic Peninsula, Astoria/Tillamook, and Eureka all dependent on groundfish for at least 50% of fishery-related income and employment. In fact, all but four of the port groups generate at least 14% of fishery-related income from groundfish. One of these is the south Washington coast. Thus, while this region is the most dependent on fishery generated income, it is not very engaged in harvesting and processing of groundfish.

The two blocks on the second page of the table split the groundfish totals into limited entry trawl and other gear components. From this information we see that of the regions highly involved in groundfish, Astoria/Tillamook, Puget Sound, Newport, and Eureka-derive more than 40% of groundfish income from the limited entry trawl fishery. Only the Northwest Olympic Peninsula derives more than one-third of groundfish income from non-trawl sources.

3.3.6.5 Demographics, Ethnic, and Social Characteristics

Table 3.3-49 displays the most recent (2000) information on the components of total personal income in counties along the West Coast, Puget Sound, and Lower Columbia River. The counties are then ranked on the basis of several different average or per capita income measures. Examining these rankings gives us a picture of the county economies.

For example, on the basis of total per capita personal income, the urban Northern California counties are on top, with Marin county ranked number one, followed by two other Bay Area counties: San Mateo and San Francisco. Figure 3.3-10 illustrates the distribution of per capita income among regional counties. San Mateo and San Francisco also rank first and second in terms of average annual wage, a measure of the strength of these economies as centers of high wage employment, with King county Washington at number three. Marin, San Mateo, and San Francisco counties are ranked first, second, and third in terms of per capita non-labor income (dividends, interest and rent). Here again, Marin county is number one. The status of Marin county as a top bedroom community for San Francisco-bound commuters is betrayed by its ranking as number one in terms of residence adjustment, a net measure of income brought home by resident commuters minus the income carried out by non-residents. The other two top spots in this category are held by Contra Costa, California and Columbia County, Oregon.

Transfer payments include welfare and Social Security benefits received from federal, state, and local governments. As such it can be both a measure of how dependent an area is on public assistance or an indicator of how attractive an area is as a retirement destination. By this measure, Curry County, Oregon is number one, followed by Pacific and Clallam counties in Washington. Looking at dividends, interest and rent (a measure of wealth) expands this picture. By this measure, Curry and Clallam counties rank relatively high (7% and 9% respectively), but Pacific County is well down the list at number 32, indicating that Pacific is probably the poorer of the three counties.

The four poorest counties in the region, measured by per capita income, are Del Norte, California, and Pacific, Klickitat, and Wahkiakum counties in Washington.

Table 3.3-50 and figures 3.3-11 and 3.3-12 display some additional socioeconomic information about the coastal counties. The variables shown in the table represent the latest available county-level data. A pattern discernible in figure 3.3-11 shows clusters of counties with relatively high unemployment rates arrayed along the lower Washington coast, Columbia River, and southern Oregon coast. Monterrey and Del Norte were the only counties in California with unemployment rates among the highest ten. Four of the five counties with highest unemployment rates in 2001 were located in southwestern Washington.

Figure 3.3-11 also displays the national average unemployment rate and the state averages for the three coastal states. Unemployment rates for all three states were significantly above the national average. In Washington, 10 of the 15 counties displayed had higher unemployment rates than the state average. In Oregon, 7 of 11 counties displayed had higher than state-average unemployment. In California, 6 of 19 counties displayed had unemployment rates higher than the state average.

Looking at poverty rates tells another story. Here, four of the five counties with the highest poverty rate in 1998 were located in California, three of the next five highest are in Oregon. Washington had two counties among the poorest ten. Figure 3.3-12 shows a band of high poverty rates along the West Coast. Note also, the national and state average poverty rates shown in the figure. California's state average of 14.9% was considerably higher than the 12.7% national rate. Both Washington's and Oregon's poverty rates were lower than the national average.

Median income is a measure of relative household affluence and also an indicator of income distribution. It represents the income level of the household at the exact middle of the county income distribution. Median income is a better, although harder to measure, gauge of income distribution than per capita income, because the median is not skewed by the presence of very high income individuals. Also, since it is a household measure, median income incorporates additional information about the size and structure of resident households.

Pacific County on the Washington coast had the lowest median income. Three of the next four poorest counties are along the Oregon coast (Curry, Coos, and Tillamook) and one is in California (Del Norte). By per capita income, however (Table 3.3-49), Del Norte is poorest, with the four next poorest counties all in Southwest Washington (Pacific, Klickitat, Wahkiakum, and Grays Harbor). The discrepancy between median and per capita income rankings may be due to different average household size, age composition, or the presence or absence of relatively high income persons. The two are also measured for different years (1998 versus 2000), use different survey methodology, and include different items counted as "income."

Table 3.3-50 includes information on the race of county households as reported by the 2000 Census. Counties with highest concentrations of minority populations are generally in California. Oregon counties are the least racially diverse of the group. Eight of 11 Oregon counties were at least 90% white. Only Hood River County on the Columbia River has a minority population above 10% (Hispanic or Latino). Three Oregon counties have among the 10 most concentrated Native American populations in the region (Wasco, Lincoln, and Coos). Only urban Multnomah County has an African American population concentration in the top 10.

In Washington, only five of the fifteen counties were more than 90% white. Four Washington counties had Native American populations in the top ten, two had African American populations in the top ten, and one had an Asian population in the top ten.

California counties were the most racially diverse. None of the 19 California counties was more than 85% white. California counties had six of the top ten regional concentrations of African Americans, three of the top ten Native American, nine of the top ten Asian and nine of the top ten proportions of Hispanic or Latino households.

The highest proportion of African American households are found in the California counties of Solano, Alameda, and Los Angeles; and in Pierce County, Washington. Native Americans are most represented in Del Norte, Humboldt and Mendocino counties in Northern California, and Clallam and Grays Harbor in Washington. The highest concentrations of Asian households were reported in Bay Area counties of San Francisco, Alameda, San Mateo and Solano; and Orange and Los Angeles counties in Southern California. All of the five counties reporting at least 30% of households as Hispanic or Latino were in California, led by Monterey (46.8%) and Los Angeles (44.6%), and including Santa Barbara, Ventura, and Orange.

3.3.6.6 Social Structure: Networks, Values, Identity

The fishing community on the West Coast is composed of many separate communities based on fishery, gear type, targeted species, geography and, to some degree, cultural background and ethnicity. For example, the Port of Astoria has Finnish roots which are celebrated in community festivals, and Native American communities have ties to the fishery which date back thousands of years.

Commercial fishing enterprises in Washington, Oregon, and California are socially and culturally diverse. However, most tend to be family-run businesses. While most fishers are male, women are often involved in the shoreside aspects of the fishing business and provide an important support and communications network for the fishing community. Few fishing families own multiple boats, and few boats are owned by large corporations. In many communities, families can trace several generations of involvement in the fishing industry.

Recreational fishing is also an important part of many communities' identities. The recreational fishing industry includes charter boats, guides, marinas; and gear, bait, and other suppliers. Many of these businesses are also family-owned and operated. In addition to their direct impact on the local community, the recreational fishing industry supports a broad-based community of thousands of individual boat owners and shore fishers participating in ocean and inland recreational fisheries.

The commercial fishing industry generally places a high value on independence. Fishing necessarily occurs at sea, and frequently attracts people who enjoy solitude and self-direction. This sense of independence and self-reliance contrasts sharply with the increasingly stringent controls being placed on the industry.

Fishing is also known for its high level of danger; it is consistently rated among the most dangerous professions in the United States. Despite this danger, there are few safety nets for people in the industry. Crew members are not technically “employees” and are not eligible for unemployment insurance, workers’ compensation, and other benefits normally associated with workers in other demanding and dangerous occupations. Vagaries of weather, market conditions and regulations demand high levels of flexibility. Many crew members are itinerant, moving from port to port and job to job (Gilden 1999).

The challenges of pursuing and maintaining fishing-based livelihoods have caused fishers to form organizations to represent common interests. Examples include the Coos Bay Trawlers Association, the Newport Fishermen’s Wives Association, the Pacific City Dorymen’s Association, the Fishermen’s Marketing Association, the Pacific Marine Conservation Council, the West Coast Fishermen’s Alliance, the Western Fishboat Owner’s Association and the Women’s Coalition for Pacific Fisheries (Gilden 1999). These organizations help the multiple facets of the fishing community represent their interests to policy makers and the general public.

3.3.6.7 Impact on the Built Environment in Fishing Communities

While few coastal communities depend exclusively on fishing, fish harvesting, processing, and related support industries (fuel, docks, ice, gear repair, etc.) are part of a complex web of interaction with other economic activities such as sport fishing, whale watching, tourism, and other recreational activities. Commercial and recreational fishers coexist, and both contribute financially to the businesses and infrastructure that serve and support them. Communities such as Newport, Oregon celebrate their fishing industry, having turned the port waterfront into a major tourist attraction. This is also true for many other historic ports in Washington, Oregon, and California. Maintenance of port facilities for the fishing fleet provides access for other user groups, such as recreational fishers and boaters and draws tourists who are attracted to the sights and smells of a working fishing port.

The presence of a viable commercial fleet helps provide the funding and incentive to dredge harbor entrances and to maintain jetties and port facilities. These in turn assist the recreational industry and private users to operate safely and efficiently from coastal ports. Seafood processors and shoreside support businesses pay property taxes and license fees to the port cities and surrounding jurisdictions, thereby contributing to the maintenance of the local infrastructure for all area residents.

The following are examples of fishery-related effects on port infrastructure. In ports such as Brookings and Garibaldi in Oregon, reduction in fishing fleets has coincided with the silting of harbor entrances due to reduced dredging. This has restricted access for larger vessels, including trawlers, and made it more difficult for a fleet to become established in the future (Gilden 1999). In another example, the Port of Astoria recently added a new breakwater to provide additional moorage for larger vessels involved in the new sardine fishery (Oregon Coastal Zone Management Association 2002).

3.3.7 Health and Safety

3.3.7.1 Background

National Standards 10 of the Magnuson-Stevens Act calls for conservation and management measures to promote the safety of human life at sea to the extent practicable. Nevertheless, commercial fishing consistently ranks as one of the most hazardous occupations in the United States. Commercial fishing is inherently dangerous; however, repeated efforts to increase marine safety regulation and compliance have failed. While recreational fishing vessels also encounter safety risks, their risks are considerably different than those encountered by commercial vessels.

The 1999 report of the U.S. Coast Guard’s Fishing Vessel Casualty Task Force (FVCTF), *Living to Fish, Dying to Fish* (FVCTF 1999) describes attempts to legislate safety in the commercial fishing industry. It describes casualty characteristics and presents recommendations for improving safety in the fishing industry. The report notes that much opposition to more stringent safety requirements has come from the fishing industry itself, both for cultural and economic reasons.

The Commercial Fishing Industry Vessel Safety Act of 1988 was one of the first successful attempts to legislate safety in the commercial fishing industry. The Act led to a set of regulations and a voluntary inspection program for commercial fishing vessels. While safety has improved since the Act went into effect, the Coast Guard report notes that "the level of fishing safety standards is analogous to *requiring* parachutes for an airplane crew, but only *marketing* voluntary measures to *encourage* a mechanically sound aircraft and a competent pilot and crew" (p. 1). At present, certain safety gear such as EPIRBs (emergency position indicating radio beacons), radios, survival suits, fire protection equipment, life preservers, and life rafts are required on board commercial fishing vessels (requirements vary by the size and range of the vessel). Past efforts to implement safety regulations have attempted to address stability and seaworthiness, construction, licensing of skippers and crew, safety training, flooding detection, dewatering systems, prohibition of alcohol and drug use when engaged in commercial fishing operations, and related matters. These requirements have yet to be enacted. Currently, dockside safety inspections are strictly voluntary. (Different rules apply to recreational and charter boats. Regulations for charter boats vary depending on the size of the boat and where the boat is used.)

The Coast Guard reports that unsafe conditions on commercial fishing vessels are not exclusively created by mariners themselves. Systemic failures, such as regulations, pressure applied by owners, managers, and insurance companies, and larger market forces all contribute to the safety problems in the industry.

The Coast Guard report lists four solutions to the safety problem. These are *seaworthy boats, adequate survival gear, competent crews*, and *safety-conscious resource and industry management regimes*. This section provides a brief overview of the current state of these four areas and discusses other factors that affect safety. Finally, we address the special circumstances of recreational and charter vessels.

3.3.7.2 Seaworthy Boats

Poor vessel or equipment condition is a primary cause of fishing casualties. Equipment may be used beyond its intended service life, used in ways that were not originally intended, poorly designed, or improperly installed. Even in the best of times, many boat owners put off needed replacements, maintenance, and repairs. This neglect arises from personal beliefs and values, economic reasons, lack of regulation, a culture that de-emphasizes safety concerns, and other factors. The Coast Guard report notes that "many fishers have strongly opposed standards that might save their own lives" (p. 1). This tendency to put off maintenance has been exacerbated during the past several years, as fishing regulations have grown increasingly stringent, and revenues have declined. Many commercial fishers have put off maintenance, hoping for better times.

3.3.7.3 Adequate Survival Gear

As noted above, the Coast Guard requires commercial fishing vessels to have certain survival equipment, such as EPIRBs, life rafts, and survival suits. This equipment is expensive and requires regular upkeep and inspection in order to function properly. For example, EPIRBs must be tested and registered, registration must be kept current, and batteries must be replaced. Life rafts must be inspected and repacked every year (after the first two years) at a cost of approximately $600 to $750 (Markle 2000). Immersion suits cost nearly $500.[4/] They must also be inspected and tested regularly; batteries for the attached lights must be renewed periodically. Alarm systems must be tested and maintained. Many accidents have been caused by people neglecting these inspections or using equipment improperly. Finally, crew must know how to properly use and maintain these different types of safety equipment.

3.3.7.4 Competent Crews

As revenues in the fishing industry decline, vessel owners and captains report it has become more difficult 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

4/ Stearns Immersion Suit with Harness, $490.99 at MARSARS Water Rescue Systems, Inc.

discouraged by increasing regulations and by the apparent lack of a promising future. Conversely, the industry attracts people who are unable to find work elsewhere, and who lack the requisite skills and training. Some are itinerant, and do not stay long enough to be fully trained or invested in vessel operations—including safety (Gilden and Conway 2000). The Coast Guard report (FVCTF 1999) notes that inadequate training to respond to emergencies or use survival gear, lack of awareness of stability issues, and ignoring stability issues contributed to several recent marine accidents. Unskilled or untrained skippers and crew can also cause accidents by loading vessels improperly or modifying vessels, creating unsafe conditions.

At present, there are no specific licensing requirements for captains or crew of commercial fishing vessels under 200 gross tons—the vast majority of domestic fishing vessels. "John Doe" crew licenses also make it impossible to track or contact crew members, which increases the difficulty of conducting outreach and education campaigns.

Even the most skilled crew can be affected by fatigue and lack of sleep. Fisheries management measures that require captains to drive long distances or compete in "derby" fisheries can lead to levels of fatigue that compromise safety. An analysis of marine vessel casualties by the National Transportation Safety Board cites fatigue as a cause in 16% of accidents (NTSB 1999).

Lastly, because many safety measures are currently voluntary, "competence" must include a willingness to be educated and comply with these measures.

3.3.7.5 Safety-conscious Resource and Industry Management Regimes

Management decisions can have a strong impact on safety. For example, measures that increase competition or restrict people to limited seasons and catch quotas can force people to venture out in extreme weather or take other undue risks. Intense harvesting effort concentrated in limited areas can cause safety problems by increasing the chance of collisions. Management measures such as inshore closures can force boats into areas where they are unsafe or far from assistance.

3.3.7.6 Other Factors Affecting Safety

On the West Coast as elsewhere, weather and ocean conditions pose a significant safety risk to fishing operations—both commercial and recreational. Groundfish vessels mainly operate from coastal ports that have potentially hazardous bar crossings, and fishing grounds are in ocean waters primarily three miles to 50 miles offshore. Wind and sea state conditions can be dangerous and bar conditions extremely hazardous. Numerous marine advisories are issued by the National Weather Service each year. While icing, hurricanes, and other extreme weather conditions are rarely factors off the West Coast, water temperatures are low enough to quickly cause hypothermia when people who are not wearing survival suits fall overboard or have a boat sink under them.

3.3.7.7 Recreational and Charter Vessels

The rate of recreational boating fatalities has been decreasing during the past ten years. Nevertheless, 519 recreational boaters drowned in the United States in 2000, and the Coast Guard estimates that half would have survived had they been wearing life jackets. The Coast Guard also reports that nearly one-third of these fatalities involved alcohol. Because of its long coastline, large population, warmer weather, and popular recreational fisheries, California had a higher number of recreational vessel accidents in 2000 than Oregon or Washington. That year, boaters off California experienced 900 accidents and 49 fatalities. Of the accidents, 338 were caused by collisions with other vessels. Off Oregon, the statistics were 97 accidents and 14 fatalities; and in Washington, 131 accidents and 22 fatalities (FVCTF 2001).

Recreational and charter vessels face some of the same safety risks as commercial vessels. However, recreational vessels do not face the same risks associated with the use of heavy equipment, and they tend to operate in better weather and stay closer to shore. At the same time, the operators of private recreational boats have widely varying levels of ability and are often less familiar with currents, tides, hidden obstacles, and other safety risks than professional charter captains or commercial captains. Operating close to shore creates a new set of safety risks associated with groundings and obstacles.

Fewer safety regulations pertain to small recreational boats than to commercial or charter vessels. Some states apply additional regulations to recreational boats operating within the three-mile limit. Regulations for charter vessels tend to be more stringent than for either recreational or commercial vessels; generally, the more passengers a vessel can carry and the farther it goes out to sea, the more stringent the regulations become. Unlike the other vessel categories, charter operators must be tested and licensed.

3.3.7.8 New Safety Advances

The Coast Guard's "Rescue 21" system is expected to improve the safety of marine vessels. This system, which has yet to go into effect on the West Coast, will serve as a "911" system for coastal waters. By increasing detection and localization of distress calls and eliminating known VHF radio coverage gaps, it will minimize the time search and rescue teams spend looking for people in distress. This system will be implemented first in the Northeast, then nationwide. Among other things, it increases channel capacity and uses Global Positioning System (GPS) technology to help locate distressed vessels.

3.4 Distribution of Landed Catch and Bycatch of Overfished Species Among Sectors

Total catch of overfished groundfish species in the various fisheries described above is addressed in this section. Total catch comprises both landed catch and fish discarded at sea, or bycatch. Controlling total catch of overfished species is a critical component of an effective rebuilding program and a central focus in the 2003 groundfish management decision. Total catch accountability and the uncertainty inherent in current catch monitoring systems by fishery sector is described. Table 3.4-1 summarizes these total catch estimates for overfished species.

Landed catch accountability is uncertain. Species recently declared overfished, such as darkblotched rockfish and yelloweye rockfish, were managed as part of a species complex and were not required to be sorted. In such cases, species composition is estimated from a smaller sample of the landed catch; and, therefore, more uncertain. Recreational catch estimates are also bounded with a large uncertainty, especially those in the California recreational groundfish fishery where there has been a dependence on the NMFS Marine Recreational Fisheries Statistical Survey (MRFSS). Table 3.4-2 depicts landed commercial catch of overfished species by a two-month period from 1999 to 2001 by coastal regions and key West Coast ports. Table 3.4-3 depicts 1999 through 2001 recreational catch estimates, which include landings and discard.

In most cases bycatch has not been directly measured; instead, logbook and other data have been used to estimate bycatch. These data and past observations of bycatch indicate the skewed distribution of bycatch. Many efforts, regardless of sector, result in a relatively selective catch of target species with minimal bycatch. However, most of the accounted bycatch has occurred in relatively few instances. This distribution makes bycatch accountability particularly difficult to reliably estimate.

The NMFS Groundfish Observer Program was implemented in August 2001. About 10% of the limited entry trawl and fixed gear trips were observed in the first few months of the program. Observations increased to about 20% of limited entry trips in this first year and expanded to portions of the directed groundfish open access fleet.

3.4.1 Limited Entry Trawl

Of the West Coast limited entry trawl fisheries, those targeting Pacific whiting have the best accountability of overfished species bycatch (Table 3.4-4). The at-sea sectors (motherships and catcher-processors) have had a long-standing 100% observer program with direct estimation of bycatch. An EFP has been adopted annually by the Council and NMFS that allows suspension of at-sea sorting requirements in the shoreside whiting fishery to enable port sampling of the entire catch. Tribal landings are accounted by the tribes, primarily the Makah Tribe, and provided to PacFIN.

Limited entry trawl landings of overfished shelf rockfish species in the non-whiting trawl fisheries were reduced dramatically by small footrope restrictions imposed in 2000 (Tables 3.4-1 and 3.4-2). However, with the absence of direct observations to determine discarded bycatch, other methods were needed to estimate the total catch of overfished groundfish species in the West Coast limited entry trawl fishery. Hastie (2001) developed a trawl bycatch model, endorsed by the SSC and Council in November 2001 for use in 2002 management, that estimates the co-occurrence rate of five overfished groundfish species (bocaccio, canary rockfish, darkblotched rockfish, lingcod, and Pacific ocean perch) relative to the weight of key target groundfish species and complexes. The model stratified bycatch (or co-occurrence catch rates) by a two-month period, area north and south of Cape Mendocino, and gear type/target fishery (e.g., midwater yellowtail/widow rockfish, DTS, etc.) as determined from 1999 trawl logbook data, the Electronic Data Collection Program, and fishtickets. The model also predicts trawl vessel participation and effort shifts given different fishing opportunities (vessel landing limits by species and species complex). Trawl fishing opportunities in 2002 were dramatically affected by active management of overfished species OYs as estimated by the Hastie (2001) model and as indexed by landings of target species.

3.4.2 Limited Entry Fixed Gear

Two major classes of fishing gear are used in the limited entry fixed gear sector: traps and longlines. These gears are both effective in catching sablefish, the most important target species in this sector, but have different rates of observed bycatch of the overfished species. Baited longlines, whether deployed horizontally on the bottom or deployed vertically in the water column, are much more effective at capturing rockfish, and therefore, more prone to incidentally catch overfished rockfish species than traps.

Limited entry fixed gear fisheries have primarily targeted rockfish and sablefish on the shelf and slope. Groundfish landings for this sector are depicted in Tables 3.4-1 and 3.4-2. With no corresponding bycatch model for this fishery, discard in the fishery is not as well known nor understood as in the limited entry trawl fishery. Fixed gear fisheries have not exhibited a significant impact on overfished slope rockfish. Limited entry and open access fixed gears have accounted for only 3.0% and 0.2% of the average total landings of darkblotched rockfish and Pacific ocean perch, respectively, during 1981 through 2001 on the West Coast. Therefore, fixed gear opportunities targeting slope rockfish and sablefish on the slope may not pose a risk for overfished groundfish species.

The proportion of shelf rockfish species landed with fixed gear has increased in recent years. This has been especially true since the small footrope restrictions were imposed on the trawl fishery in 2000. Yelloweye rockfish landings in the last three years have been higher in this sector than in other groundfish sectors (Table 3.4-2), which is a management concern given the low harvest levels considered for rebuilding this stock. Some shelf rockfish species, such as canary rockfish and yelloweye rockfish, have been a highly valued target for this sector of the fishery. Yelloweye rockfish are particularly vulnerable to targeting due to their sedentary nature. Longline gears are particularly effective gears for targeting yelloweye rockfish in the high relief habitats they reside. In Washington, where yelloweye are most abundant, 97.5% of all rockfish landed in commercial directed line fisheries in 2001 were yelloweye rockfish. In 1999, there were 23 mt of yelloweye rockfish landed in Washington fixed gear fisheries.

3.4.3 Directed Open Access

Directed open access fisheries that target groundfish use the same fixed gear types and fish in the same areas as the limited entry fixed gear sector. Rockfish and sablefish are primary target species for this sector as well. The landings of overfished groundfish species in open access non-shrimp fisheries (Table 3.4-2) include landed catch from open access fisheries targeting groundfish and landings of incidentally-caught groundfish in incidental (non-shrimp) open access fisheries. At times, individual open access trips combine opportunities to target federally-managed groundfish and nongroundfish species. Further disaggregation of landings data between the direct open access and the incidental open access sectors is therefore somewhat arbitrary and dependent on the filtering criterion (i.e., if $50% of the landed catch in a trip is groundfish, the trip qualifies as directed open access). It is, therefore, more difficult to infer the proportion of recent landings of overfished groundfish species that were targeted versus incidentally-caught in open access fisheries.

3.4.4 Incidental Open Access

The distribution of groundfish catch and bycatch in incidental open access fisheries is far less certain than in the other sectors (Table 3.4-5). In some cases, groundfish landings may have been an important supplement to the income generated while pursuing nongroundfish targets, while, in other cases, groundfish bycatch was truly incidental. This section details what is known regarding the catch and bycatch of groundfish in these open access fisheries, given the same caveats expressed in the preceding discussion.

Dungeness Crab: Groundfish bycatch in the pot fishery is minimal although occasionally black rockfish or lingcod may be pulled up in a pot. Groundfish are caught incidentally in Dungeness crab pots off Washington, Oregon, and California, but can only be landed in Oregon and California ports. Coastwide, groundfish landed with Dungeness crabs have ranged between 5 mt in 1993 and 1998 to 17 mt in 1995. Overall, the percentage of groundfish landed with Dungeness crab is less than 1%. For example, in 2001, 6 mt of groundfish were landed out of a total of 8,274 mt of Dungeness crab, or 0.07%. Similarly, out of the over 800 vessels that participate in the Dungeness crab fishery coastwide, generally less than 100 of those vessels also land groundfish.

Gillnet Complex: PacFIN data shows that groundfish landed in the California gillnet complex as a whole have ranged from less than one mt in 1991 and 1992 to 54 mt in 1999 (out of a total of 1,223 mt landed in the gillnet complex). Participation in the gillnet complex fishery since 1993 has ranged between 99 vessels in 1993, to a high of 194 vessels in 1994, and was at 127 vessels in 2001. In 2001, 69 vessels also landed groundfish out of 127 total vessels in the gillnet complex fishery.

Pacific Halibut: Groundfish are caught in the Pacific halibut fishery coastwide. Rockfish and sablefish are commonly intercepted, as they are found in similar habitat to Pacific halibut and are easily caught with longline gear. Landings of halibut are monitored by state fishtickets and through the mandatory logbooks required in the directed commercial halibut fishery. The amount of groundfish by weight landed coastwide between 1990 and 2001 with Pacific halibut has ranged from 6 mt in 1995 to 23 mt in 1997. In 1997, a high of 210 vessels participated in the Pacific halibut fishery coastwide, with participation concentrated off the Oregon coast north of Coos Bay. Of the coastwide participants in 1997, 168 of those vessels also landed groundfish in landings of Pacific halibut.

Pink Shrimp: Vessels targeting pink shrimp also land groundfish species, including rockfish, lingcod, sablefish, thornyheads, and flatfish. Between 1990 and 2001, incidental landings of groundfish in the pink shrimp fishery have not exceeded 10% of the total pink shrimp landings coastwide. The highest percentage of landings was in 1993 at 8% (896 mt of groundfish) of the total landings with shrimp. The lowest incidental landings of groundfish were in 2000 and 2001, with groundfish only making up 2% (153 mt) and 1% (94 mt) of total pink shrimp landings, respectively. This recent reduction in incidental landings of groundfish in the pink shrimp fishery is due in part to fewer vessels in the fishery, described in the following paragraph, and also to gear modifications. Efforts are underway to reduce the incidence of groundfish bycatch, by requiring bycatch reduction devices (BRDs a.k.a. finfish excluders) and no-fishing buffer zones above the seafloor. In 2001, Washington and Oregon instituted mandatory BRDs in pink shrimp trawl nets, effective August 1, 2001, to reduce finfish take, including canary rockfish, an overfished species. Historically, about 71% of the canary rockfish landed annually by Pacific Coast shrimpers was landed in Oregon (ODFW 2002). For 2002, Washington and Oregon are not requiring BRDs unless implemented through temporary emergency rule if canary rockfish landings reach a certain level, similar to 2001. California requires BRDs for all vessels landing shrimp in California ports.

In Washington, 19 vessels participated in the pink shrimp fishery in 2001, 17 of those vessels also landed groundfish while participating in the shrimp fishery. Washington monitors landings from the pink shrimp fishery through state fishtickets. Prior to 1993, Washington monitored landings through a mandatory logbook program, as well as through fishtickets. In Oregon, only 84 vessels landed shrimp in 2001 (74 double-rig; 10 single-rig) compared to 108 in 2000, 121 in 1999 and 109 vessels in 1998 (ODFW 2002). Oregon shrimpers are required to have a state permit to land shrimp and have historically been required to make annual shrimp landings to keep their permits. In 2001, the state removed the participation requirement and the exvessel value for shrimp was low – these two factors likely kept the number of participating shrimp vessels down. Despite lower landings in recent years, Oregon generally has the largest volume by weight of landings. In 1999, Oregon landed more shrimp than California, Washington, British Columbia and Alaska combined. As part of Oregon's management of the fishery, enhanced logbooks record and monitor the fishery. In California, the pink shrimp fishery has been managed by the state since 1952. An average of 88 vessels participated per season from 1983 through 1999. A record high of 155 boats shrimped during the 1994 fishery, the first year of a moratorium on new shrimp permits (Collier and Hannah 2001).

Salmon Troll: The salmon troll fishery has an incidental catch of Pacific halibut and groundfish, including yellowtail rockfish. The historical data show that trips where no halibut are landed have a higher range of groundfish landings (11-149 mt) in comparison to trips where halibut was landed (1-19 mt). However, looking at groundfish catch frequency, either by vessel or trips reveals that groundfish are caught more often by vessels or on trips catching halibut. Table 3.4-6 shows incidental catch of overfished rockfish species by the non-Indian salmon troll fisheries in 2000-2001. Small amounts of rockfish and other groundfish are taken as incidental catch in salmon troll fisheries. Although the gillnet/tangle net fishery does not technically occur in Council-managed waters, it may have some impact on groundfish that migrate through that area during part of their life cycle. To account for yellowtail rockfish landed incidentally while not promoting targeting on the species, a federal regulation was adopted in 2001 that allowed salmon trollers to land up to one pound of yellowtail per two pounds of salmon, not to exceed 300 pounds per month (north of Cape Mendocino). A similar regulation is in place for 2002.

Sea Cucumber: In Southern California, between 0 and 15 mt of groundfish have been landed with sea cucumbers, presumably in the trawl fishery. As many as 55 vessels have participated in the sea cucumber fishery in 1991. The largest number of vessels landing groundfish with sea cucumbers was in 1994, with 20 vessels landing groundfish out of 32 vessels participating in the sea cucumber fishery. Table 3.4-7 depicts the bycatch of overfished species by depth for this fishery.

Spot Prawn: Spot prawns are targeted with both trawl and trap gear. The fishery is concentrated south of Cape Mendocino with very low participation in the north. Most of the effort occurs in the 50 fm to 150 fm depth zone where bocaccio are most often found (Table 3.4-8). Of the two gear types, trawls incidentally catch more groundfish, including the overfished groundfish species (Table 3.4-9).

3.4.5 Recreational Fisheries

Most bocaccio harvest occurred in Southern California in recent years, although in 2000, Northern California had a slightly higher harvest than Southern California (Table 3.4-3). Canary rockfish are harvested primarily in Northern California and Oregon, with minor amounts in Southern California and Washington. Cowcod are encountered almost exclusively in Southern California. Widow rockfish are caught primarily in Northern California, and occasionally in Oregon but rarely in Southern California and Washington. Yelloweye rockfish are caught throughout Washington, Oregon, and Northern California, although most of the Northern California catch occurs north of Cape Mendocino. Yelloweye are caught rarely in Southern California. Lingcod is popular throughout the West Coast , but the majority of harvest occurs in Northern California and Oregon.

3.4.6 Tribal Fisheries

The bulk of tribal groundfish landings occur during the March-April halibut and sablefish fisheries. Most continental shelf species taken in the tribal groundfish fisheries are taken during the halibut fisheries, and most slope species are similarly taken during the tribal sablefish fisheries. Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery, in which 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 sablefish tribes, beginning in March and lasting into the autumn, depending on vessel participation management measures used. Participants in the halibut and sablefish fisheries tend to use hook-and-line gear, as required by the International Pacific Halibut Commission.

In 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 mid-water trawl gear. Since 1996, a portion of the U.S. whiting OY has been allocated to the Pacific Coast treaty tribes. The tribal allocation is subtracted from the whiting OY before allocation to the nontribal sectors. Since 1999, the tribal allocation has been based on a sliding scale related to the U.S. whiting OY (Table 3.4-10). 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 mid-water trawl gear have also been targeting widow rockfish and yellowtail rockfish in recent years. Table 3.4-11 shows recent historical landings of whiting, rockfish and other groundfish species by treaty tribes.

Twelve western Washington tribes possess and exercise treaty fishing rights to halibut, including the four tribes that possess treaty fishing rights to groundfish. Specific halibut allocations for the treaty Indian tribes began in 1986. The tribes did not harvest their full allocation until 1989, when the tribal fleet had developed to the point that it could harvest the entire Area 2A TAC. In 1993, judicial confirmation of treaty halibut rights occurred and treaty entitlement was established at 50% of the harvestable surplus of halibut in the tribes' combined U&A fishing grounds. In 2000, the courts ordered an adjustment to the halibut allocation for 2000-2007, to account for reductions in the tribal halibut allocation from 1989-1993. For 2000 through 2007, the non-tribal fisheries will be transferring at least 25,000 lb per year to the tribal 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 (C&S)component. Historical tribal halibut allocations since 1992 are shown in Table 3.4-12.

Tribal commercial halibut fisheries have historically started at the same time as Alaskan and Canadian commercial halibut fisheries, generally in mid-March. The tribal halibut allocation is divided so that approximately 80–85% of allocation is taken in brief open competition derbies, in which vessels from all halibut tribes compete against each other for landings. In 2002, three of these “unrestricted” openings were held in the spring: a 48-hour opening on March 18th, a 24-hour opening on April 2nd, and a 36-hour opening on April 30th. In addition to these unrestricted openings, 15-20% of the tribal halibut allocation is reserved for “restricted” fisheries, in which participating vessels are restricted to a per trip and per day poundage limit for halibut. Two restricted opening opportunities were available in 2002, from March 20th through April 19th and from May 5th through 9th. Similar to the unrestricted openings, these restricted openings are available for vessels from all halibut tribes.

Estimated bycatch of groundfish in Makah trawl and troll fisheries are depicted in Table 3.4-13, while bycatch in tribal longline fisheries is found in Table 3.4-14.

3.4.7 Other Nongroundfish Fisheries

Coastal Pelagic Species (CPS): Because CPS are harvested in mostly pure schools relatively near the water’s surface, where fish are easily identified, the incidental catch of groundfish is thought to be minimal. However, incidental catch increases when purse seines are set in shallow water, such that the seine comes in contact with the bottom or a rocky outcropping.

In round haul gear, if larger fish are in the net, they can be released alive before pumping or brailing by lowering a section of the cork-line or by using a dip-net. The load is pumped out of the hold at the dock, where the catch is weighed and incidentally caught fish can be observed and sorted. Because pumping at sea is so common, any incidental catch of small fish would not be sorted at sea. Incidental harvest of non-prohibited larger fish are often taken home for personal use or processed.

The CPS fishery has not operated on a significant scale during recent times north of Monterey, CA; therefore, little is known about the incidental catch of groundfish that might occur in this area. However, the states of Washington and Oregon are gathering information about the effects of these northern fisheries.

Information from at-sea observations of the CDFG and conversations with CPS fishers suggest that incidental catch has not been and is not significant (Table 3.4-8). These data are likely representative of actual incidental catch, because fish are pumped from the sea into fish holds aboard the fishing vessel. Fishers do not sort catch at sea that pass through the pump; they land whatever is caught and pumped into the hold.

Between 1985 and the partial year of 1999, there were 5,306 CDFG port samples taken from the sardine and mackerel landings. From 1992 to 1999, incidental catch was reported on only 179 occasions, representing only a 3.4% occurrence in which incidental catch was noted.

Between 1990 and 2001, incidental landings of groundfish in the CPS/squid fishery were less than 1% of the total CPS/squid landings. The highest landings were in 1990, 1997, and 1998-2001 with 1 mt of groundfish landed each year. Between 1990 and 2001, incidental landings of groundfish in the CPS/finfish fishery were also less than 1% of the total CPS/finfish landings. The highest landings were in 1992 with 1 mt of groundfish landed.

Highly Migratory Species (HMS): Some of the species of groundfish that have been reported as incidental catch in HMS fisheries include Pacific whiting, rockfish, lingcod, sablefish, leopard shark, soupfin shark, and spiny dogfish. These species have been reported from observers only on the drift gillnet fishery for swordfish and shark and the large vessel purse seine fishery for tuna. Other HMS fisheries have not required observers to date and have not reported incidental groundfish catch. The proposed HMS FMP is set to only monitor three groundfish species (leopard shark, soupfin shark, and spiny dogfish).

3.5 Current Management Regime

The management regime is an important issue because it generates direct and indirect impacts. The regime is also itself affected by changes in law and policy, which can cumulatively affect the environment. This section discusses stock assessments and research fisheries, both crucial components in the process of determining sustainable fishery yields, and uncertainty, which underlies the range of alternatives evaluated in this EIS.

3.5.1 The Stock Assessment Process

Stock assessments for Pacific Coast groundfish are generally conducted by staff scientists of the California Department of Fish and Game, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Oregon State University, University of Washington and the Southwest, Northwest, and NMFS Alaska Fisheries Science Centers. These assessments describe the condition or status of a particular stock and reports on its health. This allows biologically sustainable harvest levels to be forecast; scientists can then make management recommendations to maintain or restore the stock. If a stock is determined to be overfished (less than 25% of its unfished biomass), a rebuilding analysis and a rebuilding plan are developed.

For more than 20 years, groundfish assessments have primarily been concentrated on important commercial and recreational species. These species account for most of the historical catch and have been the targets of fishery monitoring and resource survey programs that provide basic information for quantitative stock assessments. However, not all groundfish assessments have the same level of information and precision.

Quantitative and non-quantitative assessments are used for groundfish stocks. Stocks are assessed quantitatively. Scientists use life history data to build a biologically realistic model of the fish stock for these stock assessments; they then calibrate the model so that it reproduces the observed fishery and survey data as closely as possible. During the 1990s, most West Coast groundfish assessments were conducted using the stock synthesis model. Recently there has been development of similar, but more powerful, models using state-of- the-art software tools. Assessment models and results are independently reviewed by the Council's stock assessment review (STAR) panels. It is the responsibility of the STAR Panels to review draft stock assessment documents and relevant information to determine if they use the available scientific data effectively to provide an accurate assessment of the condition of the stock. In addition, the STAR Panels review the assessment documents to see that they are sufficiently complete and the research needed to improve assessments in the future is identified. The STAR process is a key element in an overall process designed to make timely use of new fishery and survey data, to analyze and understand these data as completely as possible, to provide opportunity for public comment, and to assure the assessment results are as accurate and error-free as possible.

Following review of assessment models by the STAR Panels and subsequently the Groundfish Management Team (GMT) and Scientific and Statistical Committee (SSC), the GMT uses the reviewed assessments to recommend preliminary ABCs and OYs to the Council. The SSC comments on the STAR review results and the GMT recommendations. Biomass estimates from an assessment may be for a single year or an the average of the current and several future years. In general, an ABC will be calculated by applying the appropriate harvest policy (MSY proxy) to the best estimate of current biomass. ABCs based on quantitative assessments remain in effect until revised by either a full or partial assessment.

Full assessments provide information on the abundance of the stock relative to historical and target levels, and provide information on current potential yield. Scientists conduct partial assessments when they do not have enough data for a full assessment. Even full assessments can vary widely in reliability because of the amount of data available for modeling. Council-affiliated scientists conduct several assessments each year. Individual stocks are periodically reassessed as often as every year—currently only the case for Pacific whiting—to every three or four years. However some species have been assessed only once.

Stocks with ABCs set by non-quantitative assessments typically do not have a recent, quantitative assessment, but there may be a previous assessment or some indicators of the status of the stock. Detailed biological information is not routinely available for these stocks, and ABC levels have typically been established on the basis of average historical landings. Typically, the spawning biomass, level of recruitment, or the current fishing mortality rates are unknown.

Many species have never been assessed and lack the data necessary to conduct even a qualitative assessment, such as a general indication in biomass trend. ABC values have been established for only about 26 stocks. The remaining species are incidentally landed and usually are not listed separately on fish landing receipts. Information from fishery-independent surveys are often lacking for these stocks, because of their low abundance or invulnerability to survey sampling gear. Precautionary measures continue to be taken when setting harvest levels (the OYs) for species that have no or only rudimentary assessments. Since implementation of the 2000 specifications, ABCs have been reduced by 25% to set OYs for species with less rigorous stock assessments, and by 50% to set OYs for those species with no stock assessment. At-sea observer data are expected to be available for use in the near future to upgrade the assessment capability or evaluate overfishing potential of these stocks. Interim ABC values may be established for these stocks based on qualitative information.

The accuracy and reliability of various data used in assessments—and the scientific assumptions on which they are based—need to be further evaluated to improve the quality of forecasts. Uncertainty associated with fishery logbook data, calibration of surveys, and accuracy of aging techniques also need more evaluation when considering survey reliability. Finally, a better understanding of ecosystem change and its influence on groundfish abundance will also improve stock assessments. The Council and NMFS have identified a range of projects that will help to improve stock assessments:

- develop models to better quantify uncertainty and thus better specify precautionary management measures;

- develop models to specifically for species with limited data;

- make assessment methods more standardized and conduct a formal review of these methods in order to shorten subsequent review of each species' assessment, which could allow more assessments to be reviewed each year;

- develop models to better represent spatially-structured populations, such as populations with low rates of internal mixing or populations with ontogenetic patterns spanning a range of habitats.

3.5.2 Capture of Fish in Research Fisheries

Research fisheries, or resource surveys, are an essential part of the management process. Two important issues arise in connection with these surveys. First, they provide fishery-independent data which—because it is gathered in a uniform, consistent manner—provide "benchmarks" used to track natural and anthropogenic changes in fish abundance. In some cases, a single survey or a short time series can be directly calibrated to absolute abundance. An annual survey will most closely track natural biological fluctuations and smooth out apparent fluctuations caused by environmental effects on catchability. However, a second issue stems from the fact that most current surveys involve catching fish, adding to total fishing mortality. For overfished stocks with low OY values, the research take can represent a significant proportion of the harvest specification. At the same time, the reduction in fishery catches means less data are available from this source, making it even more difficult to determine abundance, measure stock recovery, and estimate potential yields. Long-term groundfish survey efforts include:

- <u>Acoustic and midwater trawl survey</u>: A coastwide survey that is conducted triennially (1977-2001) for Pacific whiting. Recent surveys have been coordinated with the Canadian acoustic survey to assure adequate coverage in northern areas.

- <u>Shelf survey</u>: A bottom trawl survey conducted triennially in midsummer, with sufficient coastwide coverage for most target species. Areas south of Point Conception were not surveyed until recently, however. The survey covers bottom depths of 30 fm to 275 fm using two large (125 foot) chartered vessels.

- <u>Slope survey</u>: A bottom trawl survey conducted near annual in mid-autumn, covering bottom depths of 100 fm to 700 fm. Survey was started in 1998 and 1999.

- <u>Nearshore survey</u>: These are SCUBA and hook-and-line surveys for various nearshore rockfish off California and are conducted by CDFG.

- <u>Mark-recapture survey</u>: This effort targets black rockfish and lingcod by WDFW.

- <u>Shelf rockfish recruitment survey</u>: A midwater trawl survey off Central California by Southwest Fisheries Science Center (SWFSC) for age zero rockfish.

- <u>California Cooperative Oceanographic Fisheries Investigation (CalCOFI)</u>: A multi-species, multi-disciplinary oceanographic and egg and larvae survey off Southern California, which is currently conducted quarterly.

- International Pacific Halibut Commission annual survey. This survey using longline vessels is important for management of Pacific halibut. However, it catches groundfish incidentally.

Additional surveys would increase the accuracy and reliability of management specifications. Increasing the number of surveys and geographic scope would provide information about distribution, abundance, and age structure of many groundfish populations while new types of survey could provide a better index of spawning biomass. A variety of other initiatives are needed to test the accuracy of existing techniques and develop new methods. Because catches of overfished species has become a critical concern, survey methods that do not involve capture need to be developed. For example, submersible surveys, where fish are counted and basic measurements taken through photography are being developed and tested. These may be especially appropriate for depleted rockfish species that occur in discrete habitats such as reefs and rock piles.

3.5.3 Fishery Management and Enforcement

Traditional fishery monitoring techniques include air and surface craft surveillance, declaration requirements, landing inspections, and analysis of catch records and logbooks. Depth restrictions have not been used on a large scale in Council-managed fisheries, and the ability to monitor vessels' locations related to depth-based closed areas will be essential to effective management. Vessel monitoring systems (VMS) can provide this information to enforcement agencies through the use of a specialized transmitter on subject fishing vessels, which transmits position information via satellite. There are several issues related to the implementation of VMS in a fishery, including the variety of equipment types and associated costs, vessels' ability to carry VMS, VMS operating requirements, VMS vessel coverage, and collaboration of VMS with traditional enforcement techniques. As a new monitoring tool for West Coast groundfish fisheries, VMS will dramatically enhance rather than replace traditional techniques.

Current assets for patrolling offshore areas include helicopter and fixed wing aircraft deployed by the U.S. Coast Guard and state enforcement entities, one large 210 foot Coast Guard cutter, and smaller Coast Guard and state enforcement vessels. Only the aircraft and large cutter are suitable for patrolling the more distant offshore closed areas. The availability of Coast Guard assets may be challenged by other missions such as Homeland Security and search and rescue. State enforcement assets may be compromised by pessimistic budget outlooks for next year that threaten to reduce these assets as state programs are rationalized under an increasingly more conservative fiscal environment. Ensuring compliance with depth restrictions requires consideration for substantially increasing an at-sea enforcement presence coupled with a VMS that remotely tracks vessels using satellites and transponders.
State enforced declaration requirements have been utilized to increase the efficiency of at-sea patrols and improve enforcement, particularly in areas closed to certain gear types or fishing strategies. Under declaration programs, legal incursions into closed areas must be reported to state enforcement authorities prior to fishing. This requirement is generally reserved for vessels that would otherwise appear to be fishing illegally when viewed from an at-sea patrol craft.

Shoreside enforcement activities complement at-sea monitoring and declaration requirements by inspecting recreational and commercial vessels for compliance with landing limits, gear restrictions, and seasonal fishery closures. State agencies are increasingly using dockside sampling as a means of assessing groundfish catch in recreational fisheries, which when combined with state and federal enforcement patrols at boat launches and marinas, provides a means of ensuring compliance with bag limits and fishery closures. Commercial landings are routinely investigated upon landing or delivering to buying stations or processing plants and can be tracked through fish ticket and logbook records.

In response to enforcement complexities of the depth-based closures fo 2002, the Council requested that the Enforcement Consultants (EC) form a work group to investigate the feasability of phasing in a VMS for West Coast groundfish fisheries. The EC recommended VMS equipment requirements, identified approximate fleet sizes for fishing sectors likely to be considered for VMS units, and estimated the cost associated with purchase, installation, and operation of VMS units. Following this inceptive investigation, the Council formed the Ad Hoc VMS Committee comprised of fishing industry representatives and EC participants to further investigate VMS and other enforcement issues relative to depth-based management. NMFS, in consultation with the Council and the Ad Hoc VMS Committee, has prepared a proposed rule and an associated Environmental Assessment/ Regulatory Impact Statement/ Initial Regulatory Flexibility Analysis (RIR/IRFA) for a pilot VMS program for 2003. The RIR/IRFA provides a description of the range of fishery monitoring alternatives considered, including their associated costs, as well as an analysis of their impacts. Publication of the final rule in the *Federal Register* is anticipated in the summer of 2003.

The burden of covering the costs associated with VMS is a significant issue and federal funds have not been identified for these expenditures. The Council has recommended that VMS units be installed on the limited entry trawl and limited entry fixed gear fleets (over 400 vessels) and that NMFS fully fund all VMS requirements if funding becomes available. Currently, the estimated costs of a VMS transmitting unit ranges from $1,800 to $5,800 with transmission costs of $1.00 to $5.00 per day. In the absence of federal funding the costs may be bourne entirely by the vessel owners. NMFS is revising its type-approval process and will be testing emerging VMS technologies in time to notify the public of a list of approved VMS equipment before implementation of the final rule. The price of some of these new technologies is expected to be generally lower that those quoted above.

3.5.4 Federal, State and Tribal Roles and Responsibilities in Management

3.5.4.1 State/Federal Jurisdiction under the Magnuson-Stevens Act

Under the Magnuson-Stevens Act, NMFS manages the groundfish fishery in the Exclusive Economic Zone, which starts at the seaward boundary of the states (3 nm from shore) and extends 200 miles offshore. The states retain jurisdiction to manage fisheries in State waters (within 3 nm of shore). A state can also regulate vessels registered under the laws of that state outside the boundaries of that state if the state's laws and regulations are consistent with the FMP and applicable federal law.

In practice, the states and federal government manage the groundfish fishery consistently and cooperatively. For the groundfish fishery, the states, the responsible federal agencies, and the Pacific Fishery Management Council coordinate closely. Each state has a representative of its fishery agency as a voting member on the Council. NMFS has a voting member on the Council, and the U.S. Coast Guard, U.S. Fish and Wildlife Service, and the Pacific States Marine Fisheries Commission have non-voting members on the Council. The states and NMFS have representatives on the Council management and scientific committees that help develop the management measures. In short, there is very close coordination between the states and NMFS.

Management measures—including catch limits, bag limits, and size limits—apply to vessels operating in the EEZ (50 CFR 660.301). However, these limits, which apply to vessels that fish in the EEZ, also include fish caught between 0 and 3 miles from shore (50 CFR 660.323(a)). Therefore, if a vessel fishes in both state and federal waters, any fish caught count toward the limits in the federal groundfish regulations, no matter whether the fish were caught in state or federal waters. In addition, because the regulations have been developed cooperatively through the Council process, the States of Washington, Oregon, and California adopt regulations under their own authority that are the same as the federal regulations. For area closures, the federal regulations implement closed areas in federal waters, and state regulations implement closed areas in state waters.

3.3.4.2 Treaty Indian Fishing Rights

Treaties between the United States and numerous Pacific Northwest Indian tribes reserve to these tribes the right of taking fish at usual and accustomed grounds and stations ("u & a grounds") in common with all citizens of the United States. See U.S. v. Washington, 384 F. Supp. 312, 349-350 (W.D. Wash. 1974).

NMFS recognizes four tribes as having u & a grounds in the marine areas managed by the Pacific Coast Groundfish FMP: the Makah, Hoh, and Quileute tribes, and the Quinault Indian Nation. The Makah Tribe is a party to the Treaty of Neah Bay, Jan. 31, 1855, 12 Stat. 939. See 384 F. Supp. at 349, 363. The Hoh and Quileute tribes and the Quinault Indian Nation are successors in interest to tribes that signed the Treaty with the Quinault, et al. (Treaty of Olympia), July 1, 1855, 12 Stat. 971. See 384 F. Supp. at 349, 359 (Hoh), 371 (Quileute), 374 (Quinault). The tribes' u&a grounds do not vary by species of fish. U.S. v. Washington, 157 F. 3d 630, 645 (9th Cir. 1998).

NMFS recognizes the areas set forth in the regulations cited below as marine u&a grounds of the four Washington coastal tribes. The Makah u&a grounds were adjudicated in U.S. v. Washington, 626 F.Supp. 1405, 1466 (W.D. Wash. 1985), aff'd 730 F.2d 1314 (9th Cir. 1984); see also Makah Indian Tribe v. Verity, 910 F.2d 555, 556 (9th Cir. 1990); Midwater Trawlers Co-op. v. Department of Commerce, 282 F.3d 710, 718 (9th Cir. 2002). The u&a grounds of the Quileute, Hoh, and Quinault tribes have been recognized administratively by NMFS. See, e.g., 67 Fed. Reg. 30616, 30624 (May 7, 2002) (u&a grounds for salmon); 50 CFR 660.324(c) (u&a grounds for groundfish); 50 CFR 300.64(l) (u&a grounds for halibut). The u&a grounds recognized by NMFS may be revised as ordered by a federal court.

The treaty fishing right is generally described as the opportunity to take a fair share of the fish, which is interpreted as up to 50% of the harvestable surplus of fish that pass through the tribes' u&a grounds. Washington v. Washington State Commercial Passenger Fishing Vessel Association, 443 U.S. 658, 685-687 (1979) (salmon); U.S. v. Washington, 459 F. Supp. 1020, 1065 (1978) (herring); Makah v. Brown, No. C85-160R, and U.S. v. Washington, Civil No. 9213 - Phase I, Subproceeding No. 92-1 (W.D. Wash., Order on Five Motions Relating to Treaty Halibut Fishing, at 6, Dec. 29, 1993) (halibut); U.S. v. Washington, 873 F. Supp. 1422, 1445 and n. 30 (W.D. Wash. 1994), aff'd in part and rev'd in part, 157 F. 3d 630, 651-652 (9th Cir. 1998), cert. denied, 119 S.Ct. 1376 (1999) (shellfish); U.S. v. Washington, Subproceeding 96-2 (Order Granting Makah's Motion for Summary Judgment, etc. at 4, November 5, 1996) (Pacific whiting). The court applied the conservation necessity principle to federal determinations of harvestable surplus in Makah v. Brown, No. C85-160R/ United States v. Washington, Civil No. 9213 - Phase I, Subproceeding No. 92-1, Order on Five Motions Relating to Treaty Halibut Fishing, at 6-7, (W.D. Wash. Dec. 29, 1993); Midwater Trawlers Co-op. v. Department of Commerce, 282 F.3d 710, 718-719 (9th Cir. 2002).

The treaty right was originally adjudicated with respect to salmon and steelhead. However, it is now recognized as applying to all species of fish and shellfish within the tribes' u&a grounds. U.S. v. Washington, 873 F.Supp. 1422, 1430, aff'd 157 F. 3d 630, 644-645 (9th Cir. 1998), cert. denied, 119 S.Ct. 1376; Midwater Trawlers Co-op. v. Department of Commerce, 282 F.3d 710, 717 (9th Cir. 2002) ["The term 'fish' as used in the Stevens Treaties encompassed all species of fish, without exclusion and without requiring specific proof. (citations omitted)"]

In 1994, the U.S. government formally recognized that the four Washington Coastal Tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish, and concluded that, in general terms, the quantification of those rights is 50% of the harvestable surplus of groundfish available in the tribes' u&a grounds. In 1996, NMFS promulgated a “framework rule” on treaty Indian fishing rights to groundfish. This rule is codified at 50 CFR 660.324. The rule establishes procedures for implementing treaty rights, and provides that rights will be implemented either through an allocation of fish that will be managed by the tribes, or through federal regulations that apply specifically to tribal fisheries. Under 50 CFR 660.332(a), tribal allocations are subtracted from the species OY before limited entry and open access allocations are derived.

For 2003, the tribal fisheries for sablefish, black rockfish, and Pacific whiting are separate fisheries, and are regulated by the tribes so as not to exceed their allocations. The tribal allocation for black rockfish is the same in 2003 as in 2002 (30,000 lb harvest guideline). Also similar to 2002, the tribal sablefish allocation is 10 percent of the total catch OY (650 mt), less 3% for estimated discard mortality, or 631 mt.

In 1999 through 2002, the tribal allocation of Pacific whiting has been based on a methodology originally proposed by the Makah Tribe in 1998. The methodology is an abundance-based sliding scale that determines the tribal allocation based on the level of the overall U.S. OY, up to a maximum 17.5% tribal harvest ceiling at OY levels below 145,000 mt. The tribes have proposed using the same methodology in 2003. In 2003, applying the sliding scale methodology to a 148,200 mt overall OY results in a 25,000 mt tribal whiting allocation, which will be taken by the Makah Tribe. No other tribes have proposed to harvest whiting in 2003.

The sliding scale methodology used to determine the treaty Indian share of Pacific whiting is the subject of ongoing litigation. In United States v. Washington, Subproceeding 96-2, the Court held that the methodology is consistent with the Magnuson-Stevens Act, and is the best available scientific method to determine the appropriate allocation of whiting to the tribes. United States v. Washington, 143 F.Supp.2d 1218 (W.D. Wash. 2001). This ruling was reaffirmed in July 2002. Midwater Trawlers Cooperative v. Daley, C96-1808R (W.D. Wash.) (Order Granting Defendants’ Motion to Supplement Record, July 17, 2002). Additional briefing will occur in this case. However, at this time NMFS remains under a court order in Subproceeding 96-2 to continue use of the methodology unless the Secretary finds just cause for its alteration or abandonment, the parties agree to a permissible alternative, or further order issues from the court. Therefore NMFS is obliged to continue to use the methodology unless one of the events identified by the court occurs. Since NMFS finds no reason to change the methodology, it has been used to determine the 2003 tribal whiting allocation.

For some species on which the tribes have a modest harvest, no specific allocation has been determined. Rather than try to reserve specific allocations for the tribes, NMFS is establishing trip limits recommended by the tribes and the Council to accommodate modest tribal fisheries. For lingcod, all tribal fisheries are restricted to 300 lb (136 kg) per day and 900 lb (408 kg) per week cumulative limits. Tribal fisheries are expected to take about 5.2 mt of lingcod in 2003. For rockfish species, the 2003 tribal longline and trawl fisheries will operate under trip and cumulative limits. Tribal fisheries will operate under a 300-lb (136-kg) per trip limit each for canary rockfish, thornyheads, and the minor rockfish species groups (nearshore, shelf, and slope), and under a 100-lb (45-kg) trip limit for yelloweye rockfish. A 300-lb (136 kg) canary rockfish trip limit is expected to result in landings of 2.3 mt in 2003. A 300-lb (136-kg) thornyheads trip limit is expected to result in landings of 2.7 mt in 2003. Other rockfish limits are expected to result in the following landings levels: widow rockfish, 45 mt; yelloweye rockfish, 3.1 mt; yellowtail rockfish, 400 mt; minor nearshore rockfish, 2 mt; minor shelf rockfish excluding yelloweye, 4.5 mt; minor slope rockfish, 4 mt. Trace amounts (<1 mt) of POP and darkblotched rockfish may also be landed in tribal commercial fisheries.

3.5.5 Uncertainty and Risk in the Management Process

Fishery managers are constantly confronted with uncertainty, and the environmental consequences of decision making is often a product of this uncertainty. Resource characteristics make this more of an issue in fisheries than in most other resource systems, because populations are widely dispersed in an inaccessible environment. In fact, the range of harvest level alternatives evaluated in this EIS is largely a product of uncertainty; given perfect knowledge (and perfect agreement about social objectives) it would be possible to precisely specify the optimal harvest level.[5/] Walters (1986) classifies uncertainty in three broad categories; Mace and Sissenwine (2002) identify an additional two management-related sources of uncertainty. These five sources of uncertainty are:

- Natural variation in the environment, including that caused by other, non-fishing human activities. Natural variability in recruitment is probably the most germane factor for estimating sustainable yields.

- Observation errors, including measurement error—an inaccurate temperature reading for example—and sampling error, or the difference between the distribution of values in a set of measurements and the actual frequency and range of values in the population or phenomenon being measured.

- Model misspecification, or the accuracy of abstract representations of reality (models) in terms of causal relationships and system dynamics.

- Translation of scientific advice into management measures. Scientists may express uncertainty by bracketing a value with a range or confidence interval. Managers may be tempted to choose a value at the high end of the range if there is no more specific information about the risk (versus short-term benefit) of such an action.

- Imperfect implementation of management measures. The most common implementation error stems from inaccurate monitoring of the fishery. If fishing mortality is not accurately measured on a reasonably "real time" basis total catch may exceed the harvest specification

5/ Traditionally, MSY has been viewed as an OY or target harvest level; but for populations below MSY, harvest levels must be adjusted downward to allow rebuilding to the MSY biomass. Further, although fishery managers view MSY dynamically by specifying fishing mortality rates (versus constant catch), population productivity (recruitment) can vary due to environmental factors such as regime shifts. Over the long term these environmental factors need to be accounted for or the population size can move away from the MSY level. Even if the biological system were perfectly specified, society may value resources in complex ways, for example, by attaching non-consumptive value to some proportion of the resource. Finally, the precautionary approach and National Standards Guidelines treat MSY as a limit rather than a target. In summary, annual specification is ongoing, and in a world without uncertainty these variables would have to be correctly identified each year for future yields to achieve MSY.

Groundfish management (like many other management regimes) suffers from all of these sources of uncertainty.

Greater uncertainty about the outcome of a particular action or event generally increases the level of risk, depending on how many possible outcomes would be undesirable. Risk analysis evaluates the likelihood that a given action will produce an undesirable outcome, often using statistical methods to specify the probability of certain outcomes. The rebuilding analyses that underlie the range of harvest specifications for overfished species use these methods to compute the probability of a population rebuilding to B_{MSY} within the specified time period if a given level of harvest is allowed. This is a form of risk analysis; the residual probability value expresses the risk of the population not reaching B_{MSY}; but the rebuilding analyses only evaluate recruitment variability, one component of the many sources of uncertainty about future stock performance. These analyses do, however, present managers with a more explicit measure of risk on which to base their decisions.

Resources users' and the public's skepticism of the validity of science, identified as an important issue in scoping (see section 1.5), highlights the significance of uncertainty and risk. The following sources of uncertainty can be identified in relation to specifiying 2003 management measures:

- Changes in the environmental regime (natural variability). As noted in section 3.1.1, meso-scale climate variability influences stock productivity.

- The effect of human activity on population productivity. Although fishing and non-fishing impacts to habitat are demonstrably damaging, it is not possible to quantify the effect on stock productivity or precisely specify the relationship between habitat impacts and productivity. The effect of changes in trophic structure is also uncertain.

- Observation error comes into play in all cases where fishery-dependent and independent data are gathered. Measurement error is common to much fishery-dependent data; bycatch estimates represent one crucial source of error of this type. Although measurement error is more easily reduced in survey work, sampling error is almost always present. For example, random stratified assignment of fishery observes allows partial coverage to be representative of what occurs in a fishery as a whole, but some, albeit quantifiable, level of uncertainty exists.

- Model error is unavoidable and not always transparent. For this reason the STAR process described above, involves several stages of review by a range of experts and interested parties. This may reduce risk (even if sources of uncertainty are not formally addressed) through a shared understanding about the state of nature being modeled and described.

- Mistranslation and misapplication in the management process are ongoing issues. Mistranslation—the choice of "over-optimistic" harvest levels, for example—are reduced somewhat through the procedures such as the rebuilding analyses now used to determine harvest specifications for those species. In contrast to a point estimate bounded by a confidence interval, a rebuilding analysis can specify the risk (in terms of the probability of the stock rebuilding with a given time period) for any value within a range. Misapplication is still a major problem, one that overlaps with observation error. Timely and accurate estimates of recreational catches are currently a major challenge to effective inseason management. Since bocaccio were declared overfished, for example, actual catches have exceeded harvest specifications, largely for this reason.

Uncertainty and risk are also translatable into socioeconomic impacts, an issue not explored by Mace and Sissenwine. Very broadly, mis-specification of harvest levels involves the assumption of either short-term or long-term risk. Short-term risk accords with under-harvest, if harvests are set below a level that is both sustainable in the long term and below some social optimum (representing a mix of consumptive market and non-consumptive, non-market values). Long-term risk is usually expressed as the potential of over-harvest compromising future returns from the fishery; it involves the tradeoff of short-term benefit (harvests now) against long-term gain (potentially higher harvests in the future). To a large degree the management process implicitly plays off these two types of risk. However, current analytical capability precludes effective quantification of the tradeoff.

4.0 IMPACTS OF THE ALTERNATIVES

Chapter 4 is organized to parallel the previous chapter, with sections on habitat and ecosystem, affected species and stocks, socioeconomic impacts, and effects on the management system. The description of the affected environment in the previous chapter described baseline conditions—the state of the environment before the proposed action is implemented—and provides the information needed to evaluate the impacts of the alternatives presented in this chapter. National Environmental Policy Act (NEPA) requires seven types of effects to be evaluated: direct and indirect, cumulative, short and long term, and irreversible and irretrievable effects. Direct and indirect effects are described in sections 4.1 through 4.4. Cumulative effects are summarized in section 4.6, while section 4.7 reviews irreversible and irretrievable impacts.

4.1 Overview of Direct and Indirect Impacts to Essential Fish Habitat

Section 11.10.3.1 of the Groundfish fishery management plan (FMP) describes adverse impacts of fishing gear to essential fish habitat (EFH), including ecosystem effects, in general terms. Ecosystem effects are, almost by definition, indirect. Overfishing has reduced some fish stocks to levels that are a small fraction of estimated unfished biomass and may affect trophic relationships: these species are less available both as prey and predators. Direct effects to habitat result from the deployment of fishing gear that damages benthic habitat. Habitat modification can also have indirect ecological effects because different species may be better adapted to the altered habitat, displacing other species. Bottom trawl footrope restrictions implemented by the Council make it difficult for fishers to access rock piles and other areas of complex topography (due to the risk of gear damage). This helps protect important, complex habitat and creates defacto refugia for species preferring that habitat type. Biodiversity impacts are directly and indirectly related to overfishing. Overfished species may become locally extinct in a part of their former range, and there is some risk of actual species extinction. It is unlikely such extinctions would be a direct result of overfishing, in the sense that all organisms were removed by fishing. However, the population could be reduced to such a low level that unfavorable environmental conditions or biological and behavioral constraints (inhibiting successful reproduction for example) could subsequently result in localized or species extinction. Given the current state of knowledge and available data, it is not possible to quantitatively evaluate the ecosystem, habitat, and biodiversity effects of the alternatives. Instead, the alternatives are evaluated qualitatively below.

The effects of fishery management practices on the physical environment typically include such things as fishing gear effects on the ocean floor, changes in water quality associated with vessel traffic, and fish processing discards as a result of fishing practices. There are no data to suggest that characteristics of the California Current System or topography of the coast change with fishery management or fishing practices. However, there is information to indicate fishery management and fishing practices may have an effect on EFH.

In general, potential bottom trawl fishing-related impacts to groundfish habitat take the form of lost or discarded fishing gear and direct disturbance of the seafloor from contact by trawl nets. While the effects of fishing on groundfish habitat have not been directly investigated, there is some research exploring how gear affects habitat. Auster and Langton (1999) reviewed a variety of studies reporting habitat effects due to fishing for a wide range of habitats and gear types. Commonalities of all studies included immediate effects on species composition and diversity and a reduction of habitat complexity.

Bottom trawling gear is known to modify seafloor habitats by altering benthic habitat complexity and by removing or damaging infauna and sessile organisms (Freese *et al.* 1999; Friedlander *et al.* 1999). In a study on the shelf and slope off California, high-resolution sidescan-sonar images of the Eureka area revealed deep gouges on the seafloor believed to be caused by trawl doors (Friedlander *et al.* 1999). The effects of bottom trawling on a "hard bottom" (pebble, cobble, and boulder) seafloor was also investigated in the Gulf of Alaska, and results indicated a significant number of boulders were displaced and emergent epifauna were removed or damaged after a single pass with trawl gear. Casual observations during the Freese *et al.* (1999) study revealed that Sebastes species use cobble-boulder and epifaunal invertebrates for cover. When boulders are displaced they can still provide cover, but when piles of boulders are displaced it reduces the number and complexity of crevices (Freese *et al.* 1999).

Limited qualitative observations of fish traps, longlines, and gillnets dragged across the seafloor during set and retrieval showed results similar to mobile gear, such that some types of organisms living on the seabed were dislodged. Quantitative studies of acute and chronic effects of fixed gear on habitat have not been conducted (Auster and Langton 1999).

In addition to fishing activities, humans have many direct and indirect effects on groundfish habitat. While non-fishing human impacts have not been directly assessed on groundfish habitat, a study of flatfish in Puget Sound, Washington indicated that anthropogenic stressors included chemical contaminant exposure and alteration of nearshore nursery habitats (Johnson *et al*. 1998). The New England Fishery Management Council compiled a list of human-induced threats to fish habitat that may be used as a guide to factors affecting groundfish species off the West Coast. Oil, heavy metals, acid, chlorine, radioactive waste, herbicides and pesticides, sediments, greenhouse gases, and ozone loss are thought to be chemical factors that affect fish habitat. Biological threats can include the introduction of non-indigenous species, stimulation of nuisance and toxic algae, and the spread of disease. Human activities that may physically threaten fish habitat are dredging and disposal, mineral harvesting, vessel activity, shoreline alteration, and debris (Wilbur and Pentony 1999).

In the last few decades, marine debris has also been recognized as posing a risk to marine organisms via entanglement and ingestion. Seafloor debris was surveyed from Point Conception, California to the United States/Mexico international border at depths of 10 m to 200 m and anthropogenic debris occurred on approximately 14% of the mainland shelf. Of the debris sampled, discarded fishing gear had the largest spatial coverage, followed by plastic, metal, and other debris (e.g., shoe soles and automobile parts) (Moore and Allen 1999). Less is known about the quantity of marine debris off Washington and Oregon, but it may be at levels that could negatively affect marine organisms.

4.1.1 Direct, Indirect and Cumulative Impacts of the Alternatives to Ecosystem, Habitat, and Biodiversity

The preceding section describes a range of direct and indirect effects resulting from fishing activity. Section 4.6.2 describes a range of external factors that when combined with the effects of the proposed actions may produce cumulative effects. Cumulative effects result primarily in changes in the productivity of ecosystem components, which itself may be a result in fishery-induced changes in ecosystem structure (see section 4.6.2.2). These factors include:

<u>Climate variability.</u> Climate cycles affect population productivity. Since predictions about future productivity are based on past relationships, between stock size and recruitment for example, if underlying conditions change, these predictions may be inaccurate. Thus, if climate is not or cannot be accounted for when modeling population dynamics, scientists may under or over predict population growth and sustainable fishery removals.

<u>Ecosystem structure.</u> Structural change becomes an effect itself (if resulting from fishery removals) that could interact cumulatively with the effects of the alternatives. Ultimately, it is the presence and differing abundances of species that constitutes ecosystem structure. The abundance of a given species is in turn the result of physiographic conditions (water temperature, relief, depth, etc.), processes external to an arbitrarily bounded system (e.g., fishing mortality) and interactions between system components (trophic relationships). Structure can change as a result of internal feedback. For example, scientists have posited “cultivation/depensation effects” that may lead to recruitment failure even though one would expect compensation to declines in biomass (MacCall 2002a; Walters and Kitchell 2001). (Compensatory response assumes that growth and survival are density dependent.)

<u>Non-fishing impacts to habitat.</u> These change physiographic conditions, which may produce changes in ecosystem structure. (Section 11.10.4 of the Groundfish FMP describes these effects.) Activities such as dredging, oil and gas exploitation, wastewater discharge, aquaculture and coastal development generally affect inshore habitats. With some notable exceptions (such as the live fish fishery in Southern California) most limited entry and directed open access fisheries do not occur in the inshore areas directly affected by these activities. However, according to EFH descriptions in the Groundfish FMP, early life stages of some

target species—such as Pacific cod, whiting, bocaccio and English sole—use estuarine habitat, so these stocks could be affected if nearshore non-fishing activities reduce productivity by damaging habitat.

Past and future fishing activity and related management actions. There is no evidence that the direct and indirect effects of fishing in January and February 2003, as constrained by management measures in the alternatives, are significant, recognizing limited knowledge of these effects. However, past fishing regulated under the Groundfish FMP contributes to habitat impacts. As important, management measures implemented by the emergency rule are related to a full-year management program that will have greater impacts. Again, recognizing the limited state of our knowledge, there is no evidence that these effects are significant.

While these effects may be described, the current state of scientific knowledge does not allow us to predict the ecological and habitat effects of a suite of management measures, at least in any quantitative fashion. It should be noted that NMFS is preparing an EIS to comprehensively evaluate groundfish habitat and the effects of groundfish fishing on that habitat, in response to litigation (*American Oceans Campaign v. Daley et al.*, Civil Action No 99-982(GK)). This EIS is gathering more information about the effects of fishing i order to evaluate alternatives to minimize fishing effects on EFH to the extent practicable, as required by the Magnuson-Stevens Act. However, in the absence of a comprehensive assessment that will enhance the ability to quantify the effects of different types and amounts of fishing, the relative effects are presumed to correlate with total fishing effort and its distribution under the alternatives, which must also be evaluated qualitatively since currently we do not model projected fishing effort across all fisheries. This makes it difficult to meaningfully distinguish between the alternatives with respect to effects on the ecosystem because, although we know that the alternatives would have differential effects on ecosystem and habitat, we cannot specify the nature or magnitude of those effects with any precision.

All of the action alternatives would result in reduced fishing effort in comparison to baseline conditions because of lower trip limits. Depth-based restrictions, if used, would eliminate bottom trawl impacts to habitat in large areas of the continental shelf (depending on the alternative). Footrope restrictions, already implemented but extended to all areas shoreward of the closed areas under the *Council-preferred Alternative*, also reduce habitat impacts. Thus, although the alternatives will have some effect on effect on ecosystems and habitat (including EFH), these effects will be reduced from historic levels. As noted above, there is insufficient information to quantitatively predict the effects of the Pacific Coast groundfish fishery on ecosystems and habitats because indirect and cumulative effects are poorly understood. As more information is gathered about the effects of fishing and non-fishing human activities on ecosystem and habitat, additional management measures may be taken to mitigate effects. Instead, effects are evaluated in terms of fishing effort, which is assumed to correlate with projected landings. Tables 2.1-9 through 2.1-11 and 2.1-15 include projected landings in the limited entry trawl fishery (based on the Hastie bycatch model). These projections does not include fixed gear landings, and thus cannot be used as a proxy for fixed gear effort. But it is assumed that the effect of the management measures on constraining effort in these two sectors is reasonably correlated. Similar landings estimates were not made for the No Action Alternative, but projections taken from the 2002 Annual Specifications EA (PFMC 2001b) may be used as a proxy. In doing so, it is important to note that actual landings will be less than these values since in-season management measures in 2002 severely constrained fisheries because of overfished species bycatch.)

Projected landings under the *No Action Alternative* are close to the *Council-preferred Alternative*, which is close to the high end of the range considered (bounded by the *High OY Alternative*). Habitat and ecosystem impacts are thus approximately equivalent. But this alternative does not include depth-based restrictions. It is difficult to predict the relative effect because corresponding impacts are more likely to be extensive (dispersed over a wide area) rather than intensive (confined to a smaller area) in the absence of depth-based restrictions. As noted above, in 2002 in-season management constrained fishing later in the year.

The *Low OY Alternative* will have the least impact on ecosystem and habitat because it has the lowest projected catch and most extensive closed areas. Inshore areas would be closed to most commercial fishing (except limited entry trawl north of 40° 10' N latitude where trawlers could operate inside 50 fathoms. However, in Washington they are excluded from state waters, eliminating much of this area.)

Trip limits under the *High OY Alternative* are generally higher and depth-based restrictions are not as extensive as under the *Low OY* and *Council-preferred* alternatives. Thus, this alternative is likely to have the greatest relative effect on ecosystem and habitat because it would allow the highest level of fishing effort. It would, however, implement depth-based restrictions but not the depth-based footrope requirement. (The existing footrope restriction, which prohibits landing shelf rockfish if using a large footrope, would still apply.)

The *Allocation Committee Alternative* with no depth restrictions has lower trip limits and would result in the lowest projected catch of target species, although it would result in the highest bycatch of overfished species. Assuming projected catches correlate with fishing effort, this suggests that this alternative will have the least ecosystem and habitat impacts. However, since it does not employ new depth restrictions on the continental shelf, trawl effort could be more widely dispersed than under the *Low OY Alternative*. This alternative would confine limited entry fixed gear and open access fisheries inside existing nearshore management lines. But these gear types generally damage bottom habitat less than bottom trawl gear. In summary, ecosystem and habitat impacts may be greater than under the *Low OY Alternative* but less than the other alternatives.

The *Allocation Committee* Alternative with depth restrictions and the *Council-preferred Alternative* are likely to have similar effects on ecosystem and habitat, and these effects would be intermediate to the *Low OY* and *High OY* alternatives, although the trawl catch projections suggest that they would be closer to the *High OY Alternative* in its ecosystem and habitat effects. However, the depth restrictions are more extensive than the *High OY Alternative* for limited entry trawl both north and south of Cape Mendocino. Comparing the *Allocation Committee* and *Council-preferred* alternatives to each other, under the Allocation Committee Alternative the depth restrictions are not as extensive: the outside boundary is relaxed to 150 fathoms during certain periods while it remains at 250 fathoms under the *Council-preferred Alternative*. On the other hand, the *Council-preferred Alternative* includes the exemptions to the California Rockfish Conservation Area identified in section 2.2.5. This would allow some trawl fisheries to operate with small footropes inside the CRCA. The small footrope requirement prevents trawling in rocky areas, a particularly important and sensitive environment (because of the physiographic complexity and epibenthos). Assuming that trawl impacts in mud and sand areas are moderate, these exemptions may counterbalance the deeper outer boundary of the closed area, when comparing these two alternatives.

4.2 Impacts to the Biological Environment - Managed Species

Fishing mortality directly affects stocks by removing some proportion of the population on a periodic basis. The framework that has been developed by fishery biologists and managers, based on the maximum sustainable yield (MSY) concept, accounts for all sources of mortality, albeit often imperfectly due to limits on our knowledge. Population modeling is dynamic, because reproduction, growth, and survival must all be considered. In this sense, a comprehensive assessment of the direct, indirect, and cumulative effects of the proposed action on a given species' stock size is "built into" the models used to estimate how many fish can be harvested sustainably. National Standard Guidelines and the Groundfish FMP provide a framework for evaluating harvest specification alternatives (OY levels) and the management measures intended to achieve a given harvest level. Harvest levels not in accord with this framework—because they allow overfishing or fishing at a rate that prevents stocks from rebuilding to or maintaining MSY biomass—may be considered to have a significant impact on managed stocks. Harvest level alternatives represent a range of values that may fall within this framework; variation is due to various sources of uncertainty, representing different levels of risk. The alternatives must be evaluated in terms of their likelihood of achieving a given harvest level. They may result in a harvest above a sustainable rate as determined by the management framework, and therefore, would have significant biological impacts, or result in harvests below a given OY level, resulting in socioeconomic impacts because of foregone income and fishing opportunities. (Harvests above OY are unlikely because management measures can be changed throughout the year in order to slow harvest rates. However, harvests below OY for a given species have occurred in past years because of the difficulty in managing multi-species fisheries.) These socioeconomic impacts are discussed in section 4.3.

4.2.1 Groundfish Resources

4.2.1.1 Overfished Stocks

Harvest levels for overfished groundfish species considered and analyzed in this EIS for 2003 West Coast fisheries comport with rebuilding constraints specified in the Magnuson-Stevens Act, Groundfish FMP, National Standards Guidelines (NSGs), and other legal mandates. Among these mandates are consideration of rebuilding strategies that have at least a 50% probability of rebuilding (achieving a spawning abundance of $B_{40\%}$ in West Coast groundfish management) within the maximum allowable time (T_{MAX}). The NSGs specify that rebuilding must occur within 10 years even if all sources of fishing-related mortality need to be eliminated (F=0). If rebuilding is estimated to take longer than 10 years at F=0, then the maximum allowable rebuilding time specified in the NSGs is the minimum possible rebuilding time (T_{MIN} = rebuilding at F=0) plus one mean generation time. One mean generation time is the average length of time it takes for a spawning female to replace herself in the population and is an index of relative productivity. All of these rebuilding specifications are determined in rebuilding analyses generated from peer reviewed stock assessments and a rebuilding program developed by Punt (Punt 2002). The standards, procedures, methodological approaches, and other terms of reference for conducting stock assessments and rebuilding analyses are formally reviewed, endorsed, and recommended by the Council's SSC. These documents, once formally endorsed by the Scientific and Statistical Committee (SSC) and adopted by the Council, are considered the best available science for rebuilding overfished groundfish species and prescribing harvest levels and management measures for the West Coast groundfish fishery. Table 4.2-1 shows the 2003 harvest specifications under the harvest alternatives analyzed in this EIS for overfished West Coast groundfish stocks.

<u>Bocaccio</u>

Management constraints imposed for bocaccio only consider very low harvest levels in 2003; significantly lower than those imposed for 2002 management. In fact the *Low OY Alternative* is 0 mt. The original *High OY Alternative* of 5.8 mt specified by the Council at its June 2002 meeting was as per a modeled result consistent with any new rebuilding analysis for bocaccio as recommended by the SSC. Specifically, the SSC Guidelines for Rebuilding Analyses recommended a non-overlapping time series of historical recruits and spawner estimates for bocaccio (and any other groundfish stock where recruitment is assumed to be primarily influenced by spawner density-dependence) be used to estimate unfished spawning biomass (B_0) and predict future recruitment. Under the SSC advice, an earlier recruitment time series should be used to calculate $B_{0,}$ because early recruitment is assumed to best reflect pre-fishery levels. Additionally, according to the SSC's recommendation for conducting rebuilding analyses, a more recent and non-overlapping time series of recruits per spawner (R/S) should be used to predict future recruitment since the effect of the current low spawning biomass would be more heavily weighted. This modeled result was subsequently estimated to be 0 mt for 2003.

The original high bocaccio OY of 5.8 mt may, therefore, be unsupportable. This OY was based on the first draft bocaccio rebuilding analysis conducted by MacCall and He (MacCall and He 2002a), which was adopted by the Council at its June 2002 meeting. The SSC-endorsed groundfish rebuilding program (Punt 2002) used to conduct the 2002 bocaccio rebuilding analysis was subsequently modified to extend the rebuilding time horizon to allow rebuilding realizations for yelloweye rockfish. Since this modification, bocaccio rebuilding trajectories that allow some harvest in 2003, and are estimated to have at least a 50% probability of timely rebuilding cannot be replicated. Also, if the aforementioned SSC advice to segregate the R/S time series to estimate B_0 and future recruitment of bocaccio is considered the best available science, no harvest or fishing mortality rate greater than zero is supported under the National Standards Guidelines. Subsequent re-analysis of bocaccio rebuilding since the June 2002 meeting did not fully conform to the SSC guidelines in that, future recruitment was predicted using the full time series of R/S, which would theoretically predict a higher productivity. The rationale was there is no temporal or biomass trend in the R/S time series. Furthermore, if the high 1963 R/S value is not used in the time series to predict future recruitment, bocaccio abundance does not tend to increase even at F=0. The estimated 2003 bocaccio OY in this revised rebuilding analysis is 0 mt (MacCall and He 2002b). It is unclear, given our current understanding of bocaccio productivity, what actions other than eliminating fishing-related mortality would mitigate bocaccio rebuilding. The issue of the “high” range of alternative bocaccio harvests in 2003 between 0 mt and 5.8 mt is practically a moot point anyway. The current ability of management systems to estimate or manage for a total fishing-related mortality within this range may be inadequate to differentiate between these considered harvest limits.

A critical uncertainty in bocaccio rebuilding is whether future recruitment of bocaccio is more driven by environmental factors or spawning stock size. MacCall and He (MacCall and He 2002a; MacCall and He 2002b) assumed stock recruitment is driven by stock size or, in scientific parlance, exhibits density-dependence. If environmental factors drive future recruitment to a greater degree than is currently assumed, the outlook for bocaccio might be more optimistic. However, a significantly large proportion of past recruitments have been estimated to be below the replacement line (the theoretical point in a stock-recruitment relationship where spawning populations produce enough new recruits on average to replace their numbers and maintain an equilibrium spawning biomass) (Figure 4.2-1). This is strong evidence that bocaccio population productivity is very low and rebuilding will likely be a slow, protracted process, even under a very conservative management regime.

Estimated natural mortality (M) for bocaccio is also uncertain. MacCall (2002b) assumed M = 0.2, which was assumed in the previous assessment done by MacCall *et al.* (MacCall *et al.* 1999). Past bocaccio assessments assumed a range of natural mortality rates from M = 0.15 to 0.25 (Bence and Hightower 1990; Bence and Rogers 1992; MacCall *et al.* 1999; Ralston *et al.* 1996b). Ralston *et al.* (1996b) estimated a fixed natural mortality rate of M = 0.15 by profiling natural mortality under the estimated stock size and likelihood fit of the baseline model. The likelihood surface across the range of M = 0.15 to 0.2 was relatively flat. The assumed natural mortality rate, in this case, was M = 0.15 in light of evidence of increased longevity for the species. MacCall (2002b) did a sensitivity analysis of assumed natural mortality rates across the range of M = 0.15 to 0.25. The analysis indicated a similar current biomass relative to B_0 across the range (4.0% at M = 0.15, 4.3% at M = 0.20, and 5.2% at M = 0.25). Use of M = 0.15 yields an average R/S that implies sustainability at a higher fishing rate, while M = 0.25 yields a sustainable fishing rate lower than the current proxy of $F_{50\%}$. Assuming M = 0.15, rebuilding times would be shorter (67 years at F=0) and the estimated 2003 OY would be approximately 4.4 mt (MacCall pers. comm.). The STAR Panel and SSC agreed with the use of M = 0.2 in the new assessment and rebuilding analysis.

There have been widespread anecdotal reports of a larger abundance of juvenile bocaccio than inferred by MacCall (2002). There are two considerations: the strengths of the 1999 and 2002 year classes. Lacking any other evidence, we assumed these are equal in strength. A reasonable range of possibilities goes from the low end, where the strength of the 1999 year class estimated in the 2002 assessment is correct (the 1X case), to the high end, where the 1999 year class is twice as large as was estimated (the 2X case). In the 2X case, the 1999 year class is still a little smaller than the 1992 year class. The 1X case examines the consequences of the 2002 assessment results being as is, and assuming the 2002 year class is the same size as the 1999 year class. The result is an OY of 0.4 tons, and a maximum probability of rebuilding by T_{MAX} of 50.2%. T_{MIN} is 94 years. The 2X case assumes the 1999 year class is twice as large as was estimated and the 2002 year class is equally large. The result is an OY of 19 tons, and a maximum probability of rebuilding by T_{MAX} of 56.4%. T_{MIN} is 81 years.

With such a low potential productivity and the vulnerability of the stock to further declines, how much fishing mortality can bocaccio sustain at current levels of abundance? MacCall and He (MacCall and He 2002b) modeled the probability of no further declines in bocaccio abundance at different levels of fishing mortality (Table 4.2-2, Figure 4.2-2). They determined a fishing mortality rate of F=0.094 had a 50% probability of causing no further decline in the next 100 years. This fishing mortality rate would result in a 2003 harvest level of 79 mt. There would be a 90% probability of no further decline in the next 100 years if all sources of fishing mortality were eliminated (F = 0).

All of these bocaccio rebuilding considerations and uncertainties were discussed by the Groundfish Management Team (GMT) and the Groundfish Subcommittee of the SSC in August 2002. There was general agreement that MacCall and He (2002b) modeled bocaccio rebuilding appropriately, and the revisions were reasonable. Officials from NMFS were present at that meeting and a subsequent meeting of the Council's Ad Hoc Allocation Committee. They discussed the appropriateness of allowing a minimal fishing mortality of bocaccio in 2003 to avoid serious and widespread disruption of fisheries off California that target healthy marine species and have been shown to have a minimal impact on bocaccio. According to NOAA officials, the NSGs never contemplated a situation where rebuilding would pre-empt all sources of potential fishing mortality. The fact the stock cannot be rebuilt within T_{MAX} was also not contemplated. Therefore, the judgement is the NSGs are inadequate in this case. NMFS, therefore, went to the Magnuson-Stevens Act for guidance. The biology of the stock and the needs of fishing communities argues against a zero fishing mortality scenario. What criteria should be used to determine a level of incidental fishing mortality? NMFS feels the appropriate criteria are consistency with the Magnuson-Stevens Act, a high probability of not driving the stock to extinction or into further decline, not jeopardize future rebuilding, and not drive the stock to be listed under the Endangered Species Act (ESA). The bocaccio sustainability analysis (Table 4.2-2) will be the guide for this decision. The guidance is to adopt a 2003 OY as close to 0 mt as possible and no greater than 20 mt. The uncertainty in accounting for bocaccio bycatch needs to be taken into account. Whatever management regime is recommended by the Council, the Council, NMFS, and the states need to have adequate observer coverage. Incidental catch needs to account for all sources of mortality including research catch. NMFS is not invoking a Mixed Stock Exception.

Based on the above considerations, the Ad Hoc Allocation Committee specified a *High OY Alternative* of #20 mt for bocaccio for 2003. They agreed the management target should be as close to 0 mt as practicable while allowing fishing opportunities with a negligible bocaccio impact. MacCall and He (2002b) estimate this fishing mortality rate would have a greater than 80% probability of causing no further decline in the next 100 years. The Council concurred with this recommendation and formally adopted this harvest level as part of its *Council-Preferred Alternative*.

The California Rockfish Conservation Area (CRCA) described in section 2.2.5 was developed and recommended as a means to keep total fishing mortality of bocaccio below the 20 mt limit (and under prescribed limits for the other overfished species found in this area, notably cowcod, canary rockfish, and yelloweye rockfish) under the *Council-Preferred Alternative*. It restricts fishing gears that have demonstrated a significant bycatch of bocaccio from the 20-150 fm depth zone south of Cape Mendocino where this stock occurs. There are exceptions to these gear restrictions which are described elsewhere in this document. However, it is worth noting that some opportunity for small footrope trawls is provided under the *Council-Preferred Alternative* to provide some opportunity to harvest shelf flatfish such as Pacific sanddabs and non-groundfish species such as California halibut. This gear specification (trawl footropes <8 in. in diameter; no chafing gear on the net) is designed to keep trawls out of the high relief rocky habitats where bocaccio (and most of the other overfished rockfish species) are found. The GMT estimates that the cumulative catch of bocaccio under the *Council-Preferred Alternative* in 2003 is 10.3 mt (Table 4.4-1). This catch includes all the gear exemptions outlined in the CRCA as well as 1.6 mt of bocaccio reserved for a possible Exempted Fishing Permit (EFP) south of Cape Mendocino. Complete observer coverage for all exempted fisheries in the CRCA would be a good way to validate the actual bocaccio catch within the CRCA; however, such an action would deplete the pool of observers in federal and state observer programs which would compromise the overall objective of estimating bycatch of all overfished and prohibited species coastwide. The Council and CDFG recommend and expect implementation of regulations mandating that all exempt trawl fisheries in the CRCA be subject to the Federal Observer Program. Therefore, bocaccio bycatch is anticipated to be adequately estimated to validate assumptions and estimates made regarding these fisheries.

Canary Rockfish

The alternative harvest levels considered for canary rockfish are based on alternative probabilities of rebuilding within T_{MAX} (Table 4.2-1) (Methot and Piner 2002a). The catch sharing scenarios depicted for each harvest alternative in Table 2.1-1 are not allocations or recommendations thereof, but the rebuilding model result of the effect of the recreational fishery taking a greater proportion of younger fish and having a greater "per-ton " impact on rebuilding. The *Low OY Alternative* harvest alternative is based on a rebuilding trajectory with an 80% probability of rebuilding within T_{MAX}, while the *Medium OY Alternative* and *High OY Alternative* are on rebuilding trajectories consistent with 60% and 50% probabilities, respectively.

Rebuilding canary rockfish will significantly constrain harvests on the West Coast, especially north of Cape Mendocino since the bocaccio stock is the binding constraint on the southern shelf. Harvest levels considered for 2003 are about half those used in annual management since canary rockfish rebuilding measures were first adopted in 2001. Although canary rockfish are a rocky reef shelf species, they are readily caught in midwater trawl fisheries at times, such as those trawl fisheries targeting yellowtail rockfish and pink shrimp. The small footrope restrictions imposed for groundfish trawls landing shelf rockfish, and considerations for hard-grate finfish excluders in shrimp trawls in recent years were largely influenced by the need to reduce canary rockfish bycatch. Low sublimits in West Coast marine recreational fisheries and no retention regulations (or low landing limits) in commercial fisheries were also imposed to reduce canary rockfish targeting and bycatch. Reducing canary fishing mortality in 2003 to about half will require a much more conservative management regime. Bocaccio rebuilding measures considered for 2003 and beyond will likely benefit canary rockfish rebuilding in the southern end of their range. However, further constraints to shelf fisheries north of Cape Mendocino are likely needed.

Methot and Piner (2002b) describe the uncertainties inherent in the canary rockfish assessment. Foremost, estimating past recruitment and predicting future recruitment provide the basis for any understanding of the productive potential of the stock and the ability to sustain harvest. The strong pattern of declining recruitment at low spawning stock levels was noted in previous assessments (Crone *et al.* 1999; Williams *et al.* 1999) and is now quantified by fitting a spawner-recruitment curve. This curve allows calculation of MSY, the fishing mortality rate that would produce MSY (F_{MSY}), and the equilibrium level of spawning stock biomass associated with MSY (B_{MSY}). The curve also provides a basis for calculation of the level of unfished recruitment (R_0) and projection of recruitment levels into the future.

The critical factor influencing the rate of rebuilding is the degree to which recruitments will be above the replacement level, thus able to rebuild the stock and potentially support a small harvest during rebuilding. Since the level of recruitment is not much above the replacement level (Figure 4.2-3), rebuilding will be extremely slow. The expected level of recruitment is determined by the steepness parameter of the Beverton-Holt formula. Methot and Piner (2002a) provide results for three levels of steepness: the steepness level initially estimated within the model (0.289, lower dashed line in Figure 4.2-3), the best-estimate of steepness obtained from a focused examination of the recruitment-spawner information (0.33, solid line), and a higher steepness level (0.36, upper dashed line), which provides a contrast to the 0.289 level. If steepness is 0.289, rather than 0.33, then T_{MIN} is extended by 20 years. Steepness levels near 0.7 are normal, and Dorn's (1995) review of steepness for rockfish found an average value near 0.6 when he included rockfishes off Alaska and off the West Coast. If future steepness for canary rockfish increases to 0.5, rebuilding will accelerate, but will still have a T_{MIN} that is 30 years away. Methot and Piner (Methot and Piner 2002a) attest a steepness of 0.33 is the best estimate of the level of recruitment to be expected as the stock begins to rebuild.

This low level of steepness is conditional upon all the downward trend in recruitment being caused by the decline in spawner abundance. Other fish species often have steepness levels near 0.7 (Myers *et al.* 1999) and Dorn's (2000) meta-analysis of rockfish found a level of approximately 0.67. If some of this recruitment downtrend for canary rockfish has been because of long-term shifts in the ocean climate, then it is possible a future shift in the ocean climate will cause an upward shift in recruitment, and future estimates of the spawner-recruitment steepness will be higher and representative of a longer-term environmental average. As an illustration of such a shift, a spawner-recruitment curve with steepness of 0.5 is shown on Figure 4.2-3 Although there are signs of a shift in the ocean climate towards a more productive regime in 1999 and evidence of stronger sablefish, whiting, and salmon survival in 1999, there is yet no evidence of such a shift for canary rockfish.

The assessment area extends northward to the U.S./Canada border, but the trawl survey which extends northward to about 49° N latitude shows that canary rockfish abundance is often high near the border. Canadian catch has been near 200 mt in recent years, so the combined impact of the U.S. and Canadian fisheries could be greater than the levels forecast here as necessary for rebuilding. A combined U.S. and Canadian stock assessment is advised to improve the estimate of total fishery impact.

<u>Cowcod</u>

The range of considered alternative harvest levels consistent with the need to rebuild cowcod is unchanged from the harvest specified for 2002 since there is no new scientific data available relevant to the current status of cowcod. It is uncertain whether this *No Action Alternative* strategy of prohibiting bottom fishing activities in two Cowcod Conservation Areas in the Southern California Bight estimated to be the most important habitats for cowcod and no retention regulations coastwide are adequately precautionary. The actual bycatch of cowcod in current fisheries is also uncertain since major sectors of the fishery (i.e., the private boat recreational fishery) have not been directly observed. However, despite these uncertainties, it is anticipated that efforts to minimize bocaccio fishing-related mortality south of Cape Mendocino will provide significant protection for cowcod, which have a similar latitudinal and depth distribution and reside in similar habitats as bocaccio. A new stock assessment and rebuilding analysis for cowcod is expected in 2003. This is the most outdated of the needed periodic assessments for overfished West Coast groundfish stocks.

Darkblotched Rockfish

The range of alternative harvest levels and associated exploitation rates considered for darkblotched rockfish in 2003 are consistent with estimated probabilities of rebuilding by T_{MAX} (Table 4.2-1). Darkblotched rockfish harvest under the *Low OY Alternative* is 100 mt and has a 100% probability of rebuilding by T_{MAX}. This is the most risk-averse harvest level considered for darkblotched rockfish in 2003. In June the Council also requested a 130 mt alternative be analyzed. This harvest level, dubbed the *2001 OY Alternative* in this Environmental Impact Statement (EIS), has a 98% probability of rebuilding within T_{MAX} and equals the darkblotched rockfish harvest specification for 2001. Prior to the rebuilding analysis developed by Methot and Rogers (2001), the best available science indicated that darkblotched rockfish could be rebuilt within 10 years. This was the corresponding 2001 harvest level with an estimated 50% probability of timely rebuilding. Methot and Rogers (2001) updated the darkblotched rockfish rebuilding analysis according to the SSC recommendation in June 2001 that "the analysis should be based on an assessment update that included the 2000 NMFS slope trawl survey data and recruitments during the more recent era should be the basis for the rebuilding rate." This result indicated darkblotched rockfish could not be rebuilt within 10 years. In this circumstance, according to the NSGs, the Council and NMFS would have the ability to extend rebuilding to as long as T_{MAX} (with a probability \$50%) to lessen the socioeconomic impacts of reduced harvest. The Ad Hoc Allocation Committee recommended consideration of a 172 mt harvest of darkblotched rockfish in 2003 (*Allocation Committee Alternative*). The *Allocation Committee Alternative* has an 80% probability of rebuilding within T_{MAX}. This is also the harvest level consistent with T_{MID}, the rebuilding period halfway between T_{MIN} and T_{MAX}, which is a suggested harvest specification under the NSGs. It is more conservative than the 70% probability trajectory that was part of the Council interim rebuilding strategy adopted last year and defined under the *Medium OY Alternative*. The *High OY Alternative* for 2003 management is 205 mt, which is on the 50% probability rebuilding trajectory. This is the highest harvest allowed for darkblotched rockfish under rebuilding given our current understanding of the stock's status and the limits recommended under the NSGs.

Controlling total fishing-related mortality for darkblotched rockfish necessitates constraining the total catch (including bycatch) in limited entry trawl fisheries on the West Coast. The Council recommended consideration of depth-based constraints in the limited entry trawl fishery for 2003 at its June 2002 meeting. Tables 4.2-3a and 4.2-3b depict the bycatch rates estimated for target trawl fishing opportunities by area (north and south of the Cape Mendocino management line) by two-month period and depth zone as estimated by logbooks. These rates correspond to the percentage by weight of darkblotched rockfish relative to weight of target species' catch. The proposed use of this model dictates the amount of opportunity that might be available for the trawl fleet to target healthy groundfish species such as deepwater flatfish, sablefish, and thornyheads within the 150 fm to 250 fm depth zone where darkblotched rockfish are most densely distributed. The range of alternative harvest levels defines the degree of bycatch that would be acceptable to effectively harvest target groundfish species that also frequent this depth zone. The target species most likely to frequent the 150 fm to 250 fm depth zone are Dover sole, petrale sole in the fall and winter, sablefish, and shortspine thornyhead. Longspine thornyhead, arrowtooth flounder, and minor slope rockfish are also frequently caught in these areas. The most risk-averse strategy and the one most likely to be effective at controlling harvest at the lower end of the range of considered harvest levels (*Low OY Alternative*) is to limit trawl opportunities inside the 150 fm line and outside the 250 fm line. Sablefish and many of the target flatfish species are accessible inside 150 fm; however, such opportunities could risk a bycatch of overfished shelf rockfish species such as bocaccio south of Cape Mendocino, yelloweye rockfish north of Point Conception, and canary rockfish coastwide. Mandating small footropes less than eight inches diameter and prohibiting chafing gear on trawls has been shown to dramatically reduce the take of these species since it effectively keeps trawls out of the rocky reef habitats where these species reside. Under the *Low OY Alternative* for these shelf rockfish, any trawling inside 150 fm, even with small footropes, may risk too high a bycatch of canary rockfish and yelloweye rockfish in the north. Such opportunities probably cannot be considered south of Cape Mendocino, where any bocaccio bycatch inhibits rebuilding.

Potential fishing opportunities in deeper waters outside 250 fm exist for the DTS (Dover sole, thornyheads, and sablefish) species. Higher landing limits may be a reasonable incentive to fish in these areas where overfished groundfish species are not found. These opportunities may not be available for the entire limited entry fleet, because only the larger trawlers (predominantly greater than 50 feet in length) are likely able to safely carry the extra wire and gear necessary to fish in the deep. Longer transit times to open fishing areas also poses higher safety risks (see section 4.3.7). As in all depth-based restrictions, compliance would be best accomplished with the use of a Vessel Monitoring System (VMS) system. Safety concerns could be somewhat mitigated by the distress alarm functions in some VMS systems (see section 4.4.1).

The latitudinal management line for darkblotched rockfish and the minor slope rockfish species has been the Cape Mendocino management line at 40°10' N latitude. In the first four months of 2002 significantly higher-than-normal landings of darkblotched rockfish occurred south of Cape Mendocino. At first it was thought the higher limits set for southern minor slope rockfish may have influenced illegal landings of catches made in the north in southern ports. However, scrutiny of fish landing tickets, trawl logbooks, and NMFS survey data by the GMT suggest it is likely these catches came from the northern Monterey International North Pacific Fishery Commission (INPFC) area south of Cape Mendocino. Trawl representatives on the GAP confirmed a high interception of darkblotched rockfish occurred just south of the Cape Mendocino line by trawlers who landed in Fort Bragg this year. The bycatch implications of darkblotched rockfish catch south of Cape Mendocino threaten disrupted trawl opportunities in 2002 due to unexpected early attainment of the 2002 darkblotched rockfish OY. Since these were ancillary impacts to those modeled and contemplated at the beginning of 2002 in the Hastie (Hastie 2001) bycatch model, where it was assumed all darkblotched rockfish would be encountered north of Cape Mendocino, they were even more onerous to the trawl fishery. To avoid such impacts in 2003, the GMT has recommended, and the Council has adopted for consideration, moving the slope rockfish management line further south to Point Reyes at 38° N latitude Trawl landing limits for slope species north of this line would be significantly decreased (especially under *Low OY Alternative* and *2001 OY*) relative to southern limits to reduce fishing-related mortality of darkblotched rockfish.

Lingcod

Lingcod harvest alternatives vary by rebuilding probabilities (Table 4.2-1). The *Low OY Alternative* of 555 mt is based on an 80% rebuilding trajectory, while the *Allocation Committee Alternative* (651 mt) and *High OY Alternative* (725 mt) are based on 60% and 50% rebuilding probabilities, respectively. These harvest levels are coastwide specifications, but are constructed by adding the harvests estimated from area-specific harvest rates (north and south of the Eureka/Columbia INPFC area line) determined by Jagielo and Hastie (Jagielo and Hastie 2001).

Lingcod are on a fast rebuilding trajectory due to their fast growth rate and high reproductive potential. Jagielo and Hastie (2001) estimated lingcod would rebuild by 2009 under all the alternatives analyzed herein. Preliminary evidence suggests lingcod are rebuilding coastwide faster than predicted and may reach $B_{40\%}$ two to three years early (Jagielo pers. comm.). A new assessment in the next two years should confirm rebuilding progress.

Fishery restrictions anticipated for 2003 are likely to reduce lingcod exploitation and enhance rebuilding progress. The GMT predicts the 2003 harvest of lingcod, even under the *Low OY Alternative*, will not be attained due these anticipated restrictions.

Pacific Ocean Perch

As in most of the overfished groundfish species with alternative harvest levels analyzed in this EIS, Pacific ocean perch (POP) harvest alternatives vary by estimated rebuilding probabilities. The *Low OY Alternative* (311 mt) conforms to an 80% probability of rebuilding by T_{MAX}, while the *Allocation OY Alternative* (377 mt) and *High OY Alternative* (496 mt) are harvests on the 70% and 50% rebuilding trajectories, respectively. The *Allocation Committee Alternative* is consistent with the Council interim rebuilding strategy adopted for POP in 2001 and is also the alternative recommended by the Ad Hoc Allocation Committee for 2003.

Exploitation of POP is likely to be significantly reduced from past years due to darkblotched rockfish protective measures contemplated for 2003. The depth-based restrictions for trawl opportunities north of Cape Mendocino recommended by the GMT to manage darkblotched rockfish harvest and control total fishing mortality are likely to reduce effort in the same habitats where POP reside. It is highly probable that all the analyzed OYs for POP in 2003 will not be attained, including the *Low OY Alternative* harvest level. The GMT has been concerned that POP trip limits in the past have provided incentives to target this stock. However, among the 2002 management constraints imposed on the trawl fishery to reduce darkblotched rockfish bycatch, not the least of which was a trawl closure in September, trip limits for POP were reduced. This is a common management measure/inseason adjustment; co-occurring species' trip and landing limits are often reduced to reduce impact on species of concern. Such precautionary actions effectively reduce targeting, since there is no incentive to pursue species with low limits. All precautionary actions designed to reduce darkblotched rockfish impacts are likely to reduce impacts on co-occurring POP; and therefore, hasten rebuilding.

<u>Pacific Whiting</u>

The 2003 harvest alternatives considered for Pacific whiting do not vary by estimated probabilities of rebuilding by T_{MAX} since a formal rebuilding analysis has not been approved for the stock. A draft analysis was presented to the SSC and Council in June but was rejected. The SSC determined that, while the rebuilding analysis followed the guidelines established by the SSC, results were complicated owing to the highly variable nature of whiting recruitment and the short life span of Pacific whiting. This leads to a short rebuild period even if catches remain high, although, given recruitment variability, the probability of the resource dropping below the overfishing threshold following recovery is high. The predicted rapid recovery of the Pacific whiting spawning output in the rebuilding analysis is due to the presence in the population already of the above-average 1999 year class. The SSC recognized that application of the 40-10 adjustment was adequate to achieve recovery to $B_{40\%}$ within 10 years; projections made by Helser *et al.* (Helser *et al.* 2002) indicated rebuilding would take seven to nine years in this case. The SSC recommended that any 40-10 adjusted OY values be based on the results of the assessment conducted in 2002 rather than the rebuilding software, because the 2002 assessment model includes multiple fisheries and time-varying weight at age. The 2002 Whiting STAR Panel concluded that "given concerns with the current formulation of the stock reconstruction model and the dependence of yield options beyond 2002 on continued recruitment of the 1999 year-class and recruitment from year-classes not actually observed, the Panel recommends against adopting 2003 projections until another assessment is conducted." The SSC supported this recommendation.

However, given the implications of anticipated major fishery restructuring in 2003 to rebuild overfished shelf rockfish, the GMT was uncomfortable modeling fishery effects without considering Pacific whiting harvest alternatives. Concerns about the impacts on other groundfish fisheries were considered by the GMT. Participants in the shore-based whiting fleet have accounted for roughly 50% of the annual harvest of species in the DTS species complex, as well as at least 20% of the non-Dover sole flatfish species. Many whiting vessels target flatfish and DTS species after the whiting season. It is expected the length of the whiting season would be reduced proportionately with the OY. Therefore, a drastically-reduced OY would likely result in a shorter whiting season and increased fishing pressure on already constrained non-whiting fisheries, resulting in higher-than-expected landings, inseason reductions in trip limits, and possibly early closures. Therefore, the GMT recommended consideration of 2003 whiting harvest alternatives before a new assessment is completed and reviewed this winter.

The *Low OY Alternative* is the 2002 specification and is based on the default $F_{40\%}$ harvest rate applied to abundance at the start of 2002 with the 40-10 adjustment. This alternative assumes the medium recruitment scenario for the 1999 year class presented by Helser *et al.* (Helser *et al.* 2002). The *Allocation Committee Alternative* uses a more conservative $F_{45\%}$ harvest rate with the 40-10 adjustment applied to the biomass projected to the start of 2003. The *High OY Alternative* uses the same criteria for *Low OY Alternative* ($F_{40\%}$ harvest rate with the 40-10 adjustment), but assumes projected abundance at the start of 2003.

Protections imposed on midwater trawl fisheries to protect widow rockfish and overfished shelf rockfish will reduce the bycatch of whiting. For instance, shrimp trawls, which have a demonstrated bycatch of whiting, widow rockfish, and other groundfish species, will be required to use hard-grate finfish excluders in 2003. This should dramatically reduce whiting bycatch. Limited opportunities, relative to recent years, to target other midwater groundfish species such as yellowtail and widow rockfish, will also reduce whiting bycatch. This stock should recover rapidly under all three harvest alternatives considered for 2003. The new assessment scheduled for this winter is anticipated to confirm the relative strength of the 1999 year class and resolve uncertainties discussed by Helser *et al.* (2002).

The allocation of the whiting resource between the U.S. and Canada is not resolved. The stock assessment was a collaborative effort between the two nations. However, the results of the new stock assessment were not available in time to hold formal negotiations with Canada before the March Council meeting when the 2002 OY was considered. Consequently, the Council assumed continuation of the 80% share the U.S. has used in recent years to set harvest levels. Canada, meanwhile, assumed a 30% share of the coastwide OY and rolled over the unused portion of their 2001 share into the 2002 OY. Disparate management strategies for this transboundary stock risk future OYs and economic benefits in this high-value fishery. The Council recommended future whiting negotiations between the U.S. and Canada, which are scheduled to begin in October 2002.

Widow Rockfish

The alternative harvest levels considered for widow rockfish are ranged based on their respective probabilities to rebuild within T_{MAX} (Table 4.2-1). The *Low OY*, *Medium OY*, and *High OY* alternatives are on 80%, 60%, and 50% rebuilding trajectories, respectively.

Widow rockfish are a principle midwater species targeted by trawlers also pursuing yellowtail rockfish. Washington tribal fisheries also target widow rockfish. Midwater trawl opportunities were seriously constrained in 2002 due to the bycatch implications for canary rockfish. To date, a midwater fishery has not been scheduled to avoid summer interceptions of canary rockfish; the Hastie (2001) bycatch model estimates high canary rockfish bycatch rates during the summer. However, one may be planned during the winter period this year if there is enough canary rockfish OY left. These considerations lessen the chance of attaining even the *Low OY Alternative* in 2003, despite the bycatch of widow rockfish in other fisheries such as the whiting and shrimp fisheries.

Bycatch in these fisheries has been observed. Whiting fisheries have realized an average bycatch of 381 mt of widow rockfish annually, 1998 through 2001. Widow rockfish bycatch is often infrequent, but can be significant due to the aberrant behavior (for a rockfish species) of aggregating at night and dawn and dispersing during the day. When a trawl tow occurs on a widow rockfish aggregation, a large amount of bycatch can occur. One tow in the 2002 shoreside whiting fishery took an estimated 80 mt of widow rockfish. However, such large tows of widow rockfish in this fishery are infrequent. Shorter whiting seasons during rebuilding will lessen the chance of widow rockfish bycatch in that fishery. Hard grate finfish excluders expected to be imposed for shrimp trawls in 2003 will reduce the bycatch of widow rockfish in that fishery.

Yelloweye Rockfish

The *Low OY Alternative* for yelloweye rockfish is based on a preliminary rebuilding analysis (Wallace 2002) that was reviewed by the Council at the June Council meeting; they recommended this be updated. The *High OY Alternative* and *Allocation Committee Alternative* are based on a new rebuilding analysis (Methot and Piner 2002b) the SSC reviewed at the September Council meeting. Therefore, harvest specifications are not comparable between alternatives since they are based on different scientific assumptions, stock assessments, and rebuilding analyses. The scientific underpinnings of the appropriate yelloweye rockfish rebuilding specifications were discussed by the SSC at the September Council meeting.

Yelloweye rockfish have been caught in recent years much more frequently as a target species due to their high value and quality fillets. Incidental catches are considered less likely due to their propensity to live in very high relief rocky habitats. Yelloweye rockfish catch has, therefore, come mostly from directed line fisheries like limited entry and open access longline fisheries as well as recreational fisheries targeting shelf rockfish, specifically yelloweye rockfish in many instances, and Pacific halibut. While these fisheries may be the dominant sectors catching yelloweye rockfish, there are groundfish and nongroundfish fisheries with an incidental catch of yelloweye rockfish. In 2002 the Council and NMFS prohibited yelloweye rockfish retention (except for a 300-pound two-month cumulative landing limit in the limited entry trawl fishery to determine unavoidable bycatch) to remove incentives for directed harvest. However, under *Low OY*, all fisheries with a potential incidental yelloweye rockfish impact need to be considered. Under the *Allocation Committee Alternative* and *High OY Alternative* many of these fisheries with only a negligible impact may be held harmless or require only minor restructuring. Those fisheries with a historical directed take of yelloweye rockfish may still be too risky under any circumstance under considered rebuilding harvest levels. The non-retention regulations adopted for 2002 management may be adequate protection for yelloweye rockfish under the *Allocation Committee Alternative* and *High OY Alternative*, depending on the bycatch implications of varying depth restrictions. Small footrope regulations for any limited entry trawl opportunities on the shelf should be risk-averse in this circumstance.

The management measures considered for protecting bocaccio south of Cape Mendocino and canary rockfish coastwide will likely benefit yelloweye rockfish rebuilding. A large focus of the considered strategy is to shift directed line effort off the West Coast continental shelf, which should reduce any yelloweye rockfish bycatch considerably. Over 99% of the yelloweye rockfish caught in the International Pacific Halibut Commission (IPHC) halibut longline survey were caught between 50 fm and 100 fm (Table 4.2-4). Therefore, depth restrictions imposed on commercial line fisheries within this depth zone should adequately protect yelloweye rockfish.

All three of the coastal state agencies on the West Coast plan on establishing depth restrictions on recreational groundfish fisheries. The California Department of Fish and Game (CDFG) is planning to impose a 20 fm to 150 fm restriction on recreational groundfish fisheries south of Cape Mendocino, while Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW) intend to restrict their recreational fisheries inside of 27 fm and 25 fm, respectively, if the yelloweye rockfish harvest guideline is projected to be exceeded inseason. These plans depend on adequate monitoring of recreational fisheries to estimate bycatch inseason. The ODFW is considering allowing a one yelloweye rockfish sublimit in the recreational daily bag limit of groundfish. They intend to monitor the recreational catch of yelloweye rockfish with their port sampling program. The WDFW is planning on prohibiting yelloweye rockfish retention in 2003 as they did in 2002. Their management philosophy is that yelloweye rockfish are so desirable, the species would be targeted in the recreational fishery if a small retention limit were allowed. The WDFW is planning to continue their observations of the halibut charter fishery to estimate yelloweye rockfish and canary rockfish bycatch in that fishery. Such efforts reduce the risk associated with assuming management measures are adequately precautionary.

Summary of the Direct, Indirect and Cumulative Impacts of the Alternatives to Overfished Species

The concept of different types of impacts—direct, indirect, and cumulative—described in NEPA regulations can be correlated with the fishery management framework, which must consider the total effect to dynamic fish populations over a long time period. The direct effect of the proposed action is equivalent to the total fishing mortality that occurs during the year as a consequence of management measures. Indirect effects include changes in future stock productivity that result from changes in spawning biomass due to fishing mortality. Past, present and future fishing mortality also contribute to cumulative impacts to a given fish stock. Cumulative effects must also be evaluated in terms of external factors that when combined with the proposed action produce some greater effect. (See section 4.6 for a description of these external factors.) However, all of these external factors act on the fish population and must be accounted for, at least in sum, when modeling population dynamics. For example, factors influencing the ecosystem (including habitat impacts and fishing-induced changes to population structure) are a component of natural mortality, or alternatively affect recruitment. Admittedly, these types of model parameters are not derived by summing all the components—the cumulative effects—contributing to a parameter value such as natural mortality. More often they are inferred from population structure, which can be used to estimate year-to-year total mortality rates, and an estimate of fishing mortality, which is then deducted from year-specific total mortality estimates. Evaluating the different types of effects identified in NEPA regulations separately is not very useful when evaluating impacts of management measures to fish populations. The direct effect of the action, if defined as total fishing mortality in a given year, is almost meaningless unless it is evaluated in the broader context of ongoing fishing mortality in past, current and future years. The management framework and rebuilding analyses for overfished species are based on long-term stock rebuilding targets; current year OYs are based both on estimates of how past fishing mortality has affected the population and an assumption that the current harvest policy will be used over the course of the rebuilding period. In this sense a rebuilding analysis is a cumulative effects analysis of "past, present, and reasonably foreseeable future actions."

The alternatives are compared in terms of their efficacy in constraining total fishing mortality on overfished stocks and the probability of rebuilding stocks. National Standard Guidelines and the Groundfish FMP provide a framework for evaluating harvest specification alternatives (OY levels) and the management measures intended to achieve a given harvest level. Harvest levels not in accord with this framework—because they allow overfishing or fishing at a rate that prevents stocks from rebuilding to or maintaining MSY biomass—may be considered to have a significant impact on managed stocks. Harvest level alternatives represent a range of values that may fall within this framework; variation is due to various sources of uncertainty, representing different levels of risk. The alternatives must be evaluated in terms of their likelihood of achieving a given harvest level. They may result in a harvest above a sustainable rate as determined by the management framework, and therefore, would have significant biological impacts, or result in harvests below a given OY level, resulting in socioeconomic impacts because of foregone income and fishing opportunities. (Harvests above OY are unlikely because management measures can be changed throughout the year in order to slow harvest rates. However, harvests below OY for a given species have occurred past years because of the difficulty in managing multi-species fisheries.) These socioeconomic impacts are discussed in section 4.3.

The *No Action Alternative* puts the least constraints on bycatch of overfished species for two reasons. First, groundfish fisheries are now largely managed for certain key constraining overfished species. The harvest limits placed on these species prevent the fisheries from approaching OYs for other overfished and healthy stocks. The higher OYs for canary rockfish and bocaccio under this alternative would relax key constraints both north and south of Cape Mendocino (an important biogeographic and management boundary for groundfish stocks). Second, this alternative does not employ depth-based closed areas that are an important strategy under the other alternatives to keep fisheries out of areas with high abundance of overfished species. The annual bocaccio OY of 100 mt would cause a significant cumulative impact in that it there is a greater than 50% probability that the stock would decline from its present size over the next 100 years (see Table 4.2-2). The canary rockfish OY (under the 50:50 allocation) would also result in a rebuilding probability below 50%, which is the lower threshold set pursuant to National Standard Guidelines. For other overfished species the probabilities are above 50%. (Although not estimated and presented in Table 4.2-1, these probabilities can be approximated by looking at the values of the action alternatives that bracket the No Action OYs for each overfished species.) Management measures set at the beginning of the year may not constrain fishing sufficiently, as was the case in 2002. Although this would not necessarily have a cumulative effect in terms of rebuilding, *if* inseason management prevented an overshoot of the OY, much more stringent measures would have to applied later in the year, an important indirect effect.

The *Low OY Alternative* is structured around the most risk-averse rebuilding parameters in comparison to other alternatives. This alternative would employ the most extensive closed areas for commercial fisheries (see Table 2.1-2), particularly to keep total fishing mortality on bocaccio at 0 mt. Table 2-1.9 provides bycatch estimates for key overfished stocks in the limited entry trawl fishery. Equivalent estimates are not possible for other sectors, but for the purposes of comparison to other alternatives it may be assumed that total fishing mortality across all fishery sectors would correlate with limited entry trawl, which represents a large proportion of total groundfish landings. It can be seen that limited entry trawl bycatch of key overfished species is lower under this alternative than the other action alternatives. Table 4.2-1, showing rebuilding parameters, give an indication of cumulative effects to the stock if this strategy is pursued over the long term in terms of the likelihood of rebuilding. This translates into rebuilding probabilities of 80% or 100%, depending on the species, with the exception of bocaccio. (Although declared overfished in 2002, a rebuilding analysis was not approved for Pacific whiting, because of anomalous results. See the discussion above. As noted, rapid recovery is expected for this stock under all the alternatives.) The most recent rebuilding analysis for bocaccio (MacCall and He 2002b) revealed that it cannot rebuild within the framework envisioned in National Standard Guidelines. This is a result of over-optimistic projections of recruitment used in setting OYs during the first years after the stock was declared overfished in 2000 and actual catches that exceeded these OYs. (Difficult to manage recreational catches explain some of this overshoot.) As result, the analysis shows that even in the absence of fishing P_{MAX} is 49%, just under the threshold. Thus, any fishing mortality will result in a still-lower rebuilding probability.

Although OYs for many overfished species are actually higher under the *High OY Alternative* than under No Action (based on a constant exploitation rate and stock increase), depth-based management restrictions make it likely that actual catch of overfished species would be lower than under No Action. This harvest mortality represents the direct impact of the alternative. (Again, projections are available for the limited entry trawl fishery, see Table 2.1-5.) The cumulative effect in terms of rebuilding is higher than other alternatives for most of the overfished species. It is risk-neutral in the sense that rebuilding probabilities are set at the 50% threshold for most species. As noted above, bocaccio is a special case in which a sustainability analysis is used to determine the OY under this alternative and the remaining alternatives discussed below. This analysis estimates the probability that there will not be any further decline in stock size over the next 100 years (as opposed to actual recovery to the target stock size) for a given level of fishing mortality. Based on this analysis, an OY is proposed that caps total catch at 20 mt but dictates measures to bring actual catch as close to 0 mt as possible. The 20 mt cap represents a greater than 80% probability of no decline in stock size and slightly more than 33% probability of rebuilding by T_{MAX}.

The two Allocation Committee alternatives have the same OYs for overfished species but are expected to produce different levels of bycatch based on the whether or not depth-based closed areas are used. Looking at the OYs by themselves, which are also the same as the *Council-preferred Alternative* for overfished species, gives an indication of the cumulative or long-term effect of constraining harvests to the given OYs. Evaluated in terms of the rebuilding probabilities (excepting bocaccio), these range from 52% for cowcod, which is the same for all of the alternatives, to 92% for yelloweye rockfish. (Cowcod are managed using existing Cowcod Conservation Areas to prohibit fishing where this species most likely occurs. See the discussion above) Most of the probabilities are in the 60%-70% range. The same 20 mt cap for bocaccio, as under the *High OY Alternative*, is proposed in both of these alternatives. Despite the same OYs among the two Allocation Committee alternatives, depth-based management reveals an important difference in terms of impacts. Without depth-based management trip limits have to be lowered (resulting a much greater decline in exvessel revenue and community income, see section 4.3) yet the bycatch of overfished species is likely to be higher. Again, the limited entry trawl estimates can be examined as a proxy in this regard.

The *Council-preferred alternative* is based on the same rebuilding parameters as the Allocation Committee alternatives. However, bycatch projections for the limited trawl fishery in Table 2.1-15 show lower bycatch in comparison to the *Allocation Committee Alternative* with depth restrictions. This alternative employs more conservative depth restrictions in comparison to the Allocation Committee Alternative. Perhaps most important, the outer boundary of the closed area is deeper at most times and places. As another example, this alternative is more restrictive in terms of where small footrope trawls may operate. Table 4.4-1 presents estimates of bycatch of overfished species across all fisheries. This table was developed by the GMT, based on data provided by state management agencies. This provides the best estimate of the direct impact of the *Council-preferred Alternative* on overfished species. These values can be compared to the OYs in Table 2.1-1, which shows that projected total mortality is at or below the OYs for all of these species, in some cases by a substantial amount (e.g., widow rockfish) due to the need to manage for constraining overfished species such as bocaccio, canary rockfish and darkblotched rockfish. Since the rebuilding probabilities correlate with a harvest rate that translates to the OY, these decreases from OY add some level of precaution. Of course, as pointed out above, stock rebuilding must be evaluated in cumulative fashion, based on fishing mortality over the long term, although differences in fishing mortality early in rebuilding have a bigger influence on the long-term trajectory.

4.2.1.2 "Precautionary Zone" Stocks

Dover Sole

There are no alternative harvests considered for Dover sole since no new assessment was done this year. The 2002 OY of 7,440 mt is specified for management in 2003. Dover sole is an important target for the limited entry trawl fishery, which targets the species in shallow water on the shelf as well as the deeper waters of the slope. While larger trawlers may be able to access Dover sole in deeper water with depth-based restrictions, smaller boats may not be able to fish these depths. Many smaller trawlers may be constrained from getting their Dover sole, especially south of Cape Mendocino where opportunities may be limited. Small footrope restrictions in shallow-water fisheries may be adequately precautionary north of Cape Mendocino under anything but the *Low OY Alternative* for yelloweye rockfish, but trawlers in the south may need to consider further gear modifications to gain access to Dover sole. ODFW has been testing experimental flatfish trawls designed to effectively target flatfishes like Dover sole while avoiding rockfish. These trawls have a cutback headrope and a smaller vertical mouth. When they are fishing on the bottom, the natural escape tendency for flatfishes is to dive to the bottom while rockfish tend to escape by swimming up from the footrope. This flatfish trawl configuration shows promise as an effective means to target flatfish in zones where rockfish bycatch is a concern. Use of an experimental fishing permit to test these trawls should be considered to allow smaller trawlers access to flatfish species such as Dover sole in 2003.

Sablefish

The harvest alternatives considered for sablefish are based on a new assessment done in 2002. The *Low OY Alternative* (4,477 mt north of Conception; 233 mt in the Conception INPFC area) is based on a requested model result by the GMT. They were interested in calculating a harvest rate and OY that projected no decline in abundance after 10 years when recent recruits no longer contribute to the spawning biomass. This modeled result assumed average future recruitment and an $F_{60\%}$ harvest rate.

The *Allocation Committee Alternative* (5,000 mt north of Conception; 251 mt in the Conception INPFC area) is based on a desire to avoid a volatile management future. They also noted the industry is concerned when the fishery harvests smaller fish; a conservative harvest level would allow greater survival to a larger size bringing future harvest benefits.

The *High OY Alternative* (8,187 mt north of Conception; 346 mt in the Conception INPFC area) assumes an environmental regime shift state of nature (i.e., environmental conditions determine recruitment) and is calculated using an $F_{40\%}$ harvest rate with the 40-10 adjustment. A competing hypothesis that was not used to structure this alternative is based on the proxy $F_{45\%}$ harvest rate with the 40-10 adjustment under the assumption that density-dependence is the primary factor determining recruitment (i.e., recruitment levels are based on relative spawning biomass). This produces somewhat lower OYs of 7,359 mt north of Conception and 233 mt in the Conception INPFC area. The more optimistic assessment this year (Schirripa 2002) may give credence to the environmental regime shift hypothesis in determining sablefish recruitment. An assessment in the near future should help determine which state of nature is the best assumption for sablefish recruitment.

Sablefish are an important commercial species targeted in directed line and trawl fisheries. The seasonal targeting of sablefish on the shelf will likely be reduced given the management measures considered to protect overfished shelf rockfish. However, sablefish are effectively targeted in deeper water by both gears. Without depth-based restrictions, the *High OY Alternative* probably could not be attained. Darkblotched rockfish protective measures may also force effort to waters deeper than 250 fm during some periods of the year. This could preclude smaller trawlers (< 60 feet in length) from accessing appreciable amounts of sablefish. Larger boats are required to safely and effectively trawl with the increased wire and spools necessary to trawl in deeper waters.

Smaller sablefish also tend to get caught on the shelf. In an effort to allow access to sablefish in 2002 after the bocaccio OY was attained, a minimum size limit of 22 inches was specified. The theory was the fishery would have to move off the shelf to get larger sablefish and thereby avoid bocaccio. However, fixed gear fishers south of Point Conception, where sablefish are smaller, were seriously constrained by the minimum size limit. A regulatory correction was finally adopted to allow them to fish, but fishing opportunity was lost. There should, therefore, be consideration for a smaller or no size limit on sablefish south of Point Conception in 2003. Depth-based restrictions contemplated for bocaccio protection in that area should be adequately precautionary.

Shortspine Thornyhead

There are no alternative harvests considered for shortspine thornyhead since no new assessment was done this year. The 2002 OY of 955 mt is specified for management in 2003. It is not likely the OY will be attained in 2003 given the depth-based constraints anticipated to protect overfished shelf and slope rockfish.

4.2.1.3 Stocks at or Above Target Levels

Arrowtooth Flounder

Arrowtooth flounder are an abundant species and important trawl target. Most fishing for arrowtooth occurs on the shelf where canary rockfish bycatch in the past has disrupted the trawl fishery for this species. The WDFW conducted an Exempt Fishing Permit (EFP) fishery in 2001 and 2002 and has plans to continue this EFP in 2003 with the objective of exploring strategies to make this a more selective fishery. Results from this EFP hold some promise that this stock can again be fully accessed without being as constrained by shelf rockfish bycatch. Experimental flatfish trawls that were tested in Oregon in 2002 and are expected to undergo further testing in a 2003 ODFW-sponsored EFP may also provide more trawl access to abundant shelf flatfish species such as arrowtooth flounder.

Bank Rockfish

Bank rockfish have been an important commercial target on the shelf and shelf/slope break. They were primarily taken in trawls and setnets. Fishing constraints imposed by rebuilding needs for overfished groundfish stocks have limited access to this species. Since this species is primarily found in the south, it is likely that exploitation will decrease as fisheries are significantly constrained by actions implemented to rebuild bocaccio and other species in the depth and latitude range of bank rockfish.

Black Rockfish

The portion of the black rockfish population north of Cape Flattery in Northern Oregon and Washington is healthy (about $B_{50\%}$) according to the last assessment (Wallace *et al.* 2000). This species is an important component of nearshore and shelf recreational and commercial fisheries. The actions contemplated in this EIS to protect bocaccio and other overfished species are anticipated to increase effort and potential exploitation on black rockfish next year. Nearshore precautionary strategies to avert overfishing for black rockfish and other nearshore species are discussed in section 4.5.2. A new assessment of the species in California and Oregon is planned for 2003.

Blackgill Rockfish

Blackgill rockfish is an important commercial slope species and is the target of southern fixed gear slope fisheries. While slope rockfish limits have been reduced to protect darkblotched rockfish, more liberal limits in the south have raised "point of concern" considerations for this species. Management has, therefore, focused on this point of concern to keep from overfishing this species. Reduced impacts on blackgill are anticipated north of Point Reyes with the new darkblotched rockfish management line contemplated for the limited entry trawl fishery in 2003. Blackgill have also been confused with darkblotched rockfish in the past leading to questions regarding species composition of some landings in the south. The Northwest Fisheries Science Center is reviewing landings and biological data to determine whether any past stock discrimination techniques can be used to reduce this confusion.

Chilipepper Rockfish

Chilipepper rockfish are an important shelf rockfish species in the south, especially in commercial trawl and fixed gear fisheries. This species co-occurs with bocaccio; harvest will, therefore, be constrained for this species under actions contemplated to reduce fishing mortality of bocaccio. There is some indications that chilipepper and bocaccio undergo some competitive interactions as evidenced by historical cycles of abundance. It appears that in years when bocaccio are more productive and abundant, chilipepper populations decline and vice versa. This potential relationship should be further explored as actions to rebuild bocaccio are investigated in the future.

Longspine Thornyhead

Longspine thornyhead are an abundant deep-water species and important trawl target as part of the DTS complex. The OY for longspine thornyhead has not been attained in recent years as the trawl fishery has been constrained by limits imposed on slope rockfish and shortspine thornyhead. The depth-based restrictions considered under the 2003 alternatives may allow increased access to and larger landing limits for longspine thornyhead since a large proportion of the stock is outside the darkblotched rockfish depth zone

Petrale Sole

Petrale sole are an important trawl target species, especially during winter months when spawning aggregations are targeted in deep water between 150 fm and 250 fm. The 2003 trawl management alternatives are designed to reduce impacts on darkblotched rockfish while allowing some access to abundant petrale sole. The preferred alternative is conservative with respect to protecting darkblotched rockfish by maintaining a 250 fm depth restriction of the trawl fishery year-round. However, the *Council-preferred Alternative* does prescribe a modified 250 fm line during periods 1 and 6 (November through February) to incorporate some petrale sole fishing areas. Large winter landings of petrale sole have led to market constraints in the past when markets and buyers were saturated by petrale sole.

Shortbelly Rockfish

Shortbelly rockfish are an abundant rockfish caught incidentally in trawl fisheries, but are not targeted due to a relatively low market value. Exploitation on this species is expected to be reduced under the 2003 alternatives analyzed in this EIS by the need to protect bocaccio and other overfished species.

Splitnose Rockfish

Splitnose rockfish largely co-occur with darkblotched rockfish on the slope. As limits have been adjusted for slope rockfish to reduce darkblotched rockfish impacts, they have also been reduced for splitnose. It is anticipated that splitnose harvest opportunities will be reduced due to the darkblotched rockfish protective measures contemplated in 2003 management alternatives.

Yellowtail Rockfish

Yellowtail rockfish are an important target of midwater trawl fisheries and is a common species incidentally caught in trawl whiting fisheries. Canary rockfish bycatch has been a concern in trawl fisheries targeting yellowtail rockfish which has limited access to the species. They also co-occur with widow rockfish which is another species under rebuilding. The Council contemplates some winter midwater trawl opportunities next year when canary rockfish bycatch is minimal. Yellowtail rockfish have also been incidentally caught in shrimp trawls. This bycatch is anticipated to be reduced with mandatory use of finfish excluders in shrimp trawls coastwide in 2003.

Other Groundfish Stocks

Other groundfish include abundant shelf flatfish species such as English sole, sand sole and other species. Efforts to access these species 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. Such an effort is planned in proposed EFPs sponsored by CDFG and ODFW.

Spiny dogfish, a federally-managed groundfish species, has become a fixed gear target in the north. Access to this species will be constrained under the *Council-preferred Alternative* with the imposition of a 100 fm depth restriction for fixed gears. The WDFW is proposing a 2003 EFP to test potentially risk-averse strategies for targeting dogfish with longlines to provide access to the species and allow fixed gear fishers to exploit this specialized market.

4.2.1.4 Cumulative Effects on Other Managed Groundfish Species

Stocks at precautionary levels and healthy stocks are subject to essentially the same types of cumulative effects as those applying to overfished species. Past fishing, along with other sources of mortality and stock productivity, determine current abundance. Stocks in the "precautionary zone" in terms of biomass were subject to past overfishing, in that stock size was reduced below the target level estimated to produce MSY. Under the current management framework harvest specifications are reduced so that surplus production from these stocks is available for stock size increase. Most other stocks are assumed to be at or above the target MSY biomass, but have not been assessed. (Harvest specifications are set based on past landings.) Since these stocks are unassessed, there is a risk they have been or are currently being overfished (a harvest rate sufficient to put the stock in an overfished condition). Again, in comparing alternatives, cumulative effects correlate with the harvest level associated with each alternative.

4.2.2 Nongroundfish Species and Fisheries

4.2.2.1 Salmon

Groundfish catch is not a significant component in salmon troll fisheries, although some incidental groundfish catch is landed (Table 3.4-5). Alternatives that require changes to salmon troll gear configurations and area closures will, however, have a significant effect on commercial salmon fisheries. Groundfish catch data were collected in a study of troll gear encounter rates for coho and chinook salmon (Lawson 1990). In this study spreads were spaced at 4 fm intervals with the bottom spread placed 2 fm above the cannonball. Gear was fished close to the bottom in a minimum of 45 fm of water to accommodate 10 spreads. Groundfish catch rates were low, with an average of 0.9 rockfish and 0.7 flatfish per boat-day. Most groundfish were caught on the lowest two spreads (Figure 4.2-4). Coho salmon were caught higher on the gear than chinook (Figure 4.2-5). In general, raising the gear off the bottom should reduce the catch of groundfish and chinook while increasing the catch of coho. However, Lawson's (1990) gear study was not designed to measure this effect. More specific analysis of the data require making some assumptions, most importantly, that fish do not respond to the gear by moving up and down in the water column. For coho and chinook there is evidence this assumption may not be true; coho tend to move down to the top spread, and chinook tending to move up to the bottom spread. No information exists about similar behavior in groundfish; however, if groundfish tended to move up to the bottom spread, raising the bottom spread would reduce catch rates less than might otherwise be anticipated. A second assumption is that salmon trollers are positioning their gear near the bottom. This was true during the Lawson (1990) study, but in some years (e.g., 2002) the distribution of salmon in the water column is such that midwater fishing may be more effective. In this case, groundfish encounters should be minimal, and the proposed regulations would have no effect. Assuming no movement of fish up and down the gear and fishing near the bottom, moving the bottom spread up to 4 fm from the cannonball would be equivalent to eliminating the bottom spread in Lawson (1990). With four spreads (the current configuration in Oregon south of Cape Falcon), this would reduce the total groundfish catch rate by 74%, the Pacific halibut catch rate by 92%, and the chinook catch by 26%. The coho catch rate would increase by 22% (Table 4.2-5). The Pacific halibut catch in the salmon troll fishery is considered incidental in the Council's 2002 Pacific Halibut Catch Sharing Plan for Area 2A. In 2001, the Area 2A non-Indian commercial salmon troll fishery was allocated 34,046 pounds of Pacific halibut.

The Central and Southern Oregon commercial troll fisheries are currently modeled with lower coho encounter rates when a four-spread restriction is in place based on the results of the Lawson (1990) study and corresponding gear profiles of the fleet. By moving the gear up in the water column and increasing the coho encounter rate, opportunity to harvest healthy chinook stocks would be constrained to provide a similar level of protection (e.g., allowable exploitation rate) to depressed natural coho stocks. In deeper water, the effect on coho encounter rates of moving the gear up from the cannonball would be partially mitigated since the gear would be fished deeper to target chinook, and in very deep water where the cannonball is not close to the bottom, the gear could be lowered to locate the lower spread at the desired depth. In areas less than 50 fm, salmon fisheries are generally conducted very close to shore, in less than 10 fm over sandy bottoms, where rockfish are rare. The most effective technique involves fishing very near the bottom. Raising the lower spread would essentially eliminate salmon fishing in this area, where almost no groundfish are encountered.

Alternatives that prohibit fishing outside 25 fm in Washington Marine Catch Areas 3 and 4 would eliminate almost all of the productive commercial salmon fishing waters in those areas, and the fleet would be displaced to other areas or other fisheries. Approximately 31% (97,000 pounds) of the non-Indian commercial chinook landings from north of Cape Falcon occurred in those areas in 2001, and the recent five-year average is 38% PFMC 2001; Review of 2001 Ocean Salmon Fisheries Tables IV-7 and IV-8).

4.2.2.2 Other Nongroundfish Species and Fisheries

The Pacific halibut fishery would be affected by depth restrictions. The proposed actions to rebuild canary rockfish and yelloweye rockfish north of the Cape Mendocino management line at 40°10' N latitude are anticipated to severely limit fishing effort on the continental shelf inside of the 150 fm line. Opportunities to harvest Pacific halibut may depend on determining areas inside 150 fm where canary rockfish and yelloweye rockfish are not encountered. The Council and the WDFW proposed this general strategy at the June 2002 Council meeting. Such areas may be inferred from IPHC halibut survey data, WDFW observations of their recreational charter halibut fishery, port sampling data, NMFS shelf trawl surveys, trawl logbooks, and fishtickets. The WDFW is anticipated to identify 1 nm^2 (or larger) halibut hotspot areas north of Point Chehalis, Washington where Pacific halibut can be harvested without a bycatch of overfished shelf rockfish (Table 4.2-6). This risk-averse strategy will be particularly effective insofar as, the data used to inform the decision of open fishing areas accurately depicts areas where these rockfish do not reside. The strong habitat affiliations and apparent lack of significant movements by canary rockfish and yelloweye rockfish may reduce the uncertainty of these data. Observations of 2003 Pacific halibut fisheries, such as the 2002 WDFW effort to place observers on recreational charters, will be important to verify these fishing opportunities effectively avoid these rockfish species. Pacific halibut fishing opportunities on the shelf will also depend on the effectiveness of enforcing compliance with area restrictions (see section 4.4).

One likely outcome of the proposed action(s) is a decrease in the harvest of Pacific halibut in Catch Area 2A. It is unknown how this may affect any allocation of Pacific halibut in Area 2A in 2003. The IPHC will meet in January 2003 to decide 2003 Pacific halibut management and allocations.

Coastal Pelagic Species are taken incidentally in the groundfish fishery. Incidental take is well documented in the at-sea and shore-based whiting fishery. Preliminary data for 2001 indicates that approximately 80 mt of squid was incidentally taken in the at-sea whiting fishery through October. There is little information on the incidental take of CPS by the other segments of the fishery; however, given that CPS are not associated with the ocean bottom, the interaction is expected to be minimal. Similarly, highly migratory species (HMS) are largely pelagic, open-ocean species infrequently caught in groundfish-directed fisheries. However, the *Low OY Alternative* imposes substantial limitations on a wide range of nongroundfish fisheries, including CPS fisheries and some HMS fisheries, reducing nongroundfish catches.

Dungeness crab, which are typically harvested using traps (crab pots), ring nets, by hand (scuba divers) or dip nets, are incidentally taken or harmed unintentionally by groundfish gears. Very little bycatch of rockfish and other overfished West Coast groundfish species has been noted in pot and trap fisheries, including those targeting Dungeness crab. It is not anticipated that this fishery would need to be constrained or modified to rebuild any of the overfished West Coast groundfish species of concern.

Other nongroundfish species would not be significantly affected by changes in fisheries resulting from the alternatives.

4.2.3 Protected Species

The effects of this proposed action and the differences between alternatives on endangered and/or threatened marine mammals, seabirds, sea turtles, and salmon will be discussed below.

4.2.3.1 Marine Mammals

There is limited information documenting the interactions of groundfish fisheries and marine mammals, but marine mammals are probably affected by many aspects of groundfish fisheries. The incidental take of marine mammals, defined as any serious injury or mortality resulting from commercial fishing operations, is reported to NMFS by vessel operators. In the West Coast groundfish fisheries, incidental take is infrequent and primarily occurs in trawl fisheries (Forney *et al.* 2000). Additional effects of groundfish fisheries on marine mammals are more difficult to quantify due to a lack of behavioral and ecological information about marine mammals. However, marine mammals may be affected by increased noise in the oceans, change in prey availability, habitat changes due to fishing gear, vessel traffic in and around important habitat (i.e., areas used for foraging, breeding, raising offspring, or hauling-out), at-sea garbage dumping, and diesel or oil discharged into the water associated with commercial fisheries.

Of the marine mammal species incidentally caught in West Coast trawl fisheries, the Steller sea lion is listed as threatened under the ESA, the northern elephant seal may be within its optimum sustainable production (OSP) range, and there is insufficient data to determine the status of the harbor seal, California sea lion, Dall's porpoise, and Pacific white-sided dolphin relative to their OSPs. None of these species are classified as strategic stocks under the Marine Mammal Protection Act (MMPA).

Based on NMFS annual list of fisheries, the incidental take of marine mammals in the West Coast groundfish fisheries does not significantly affect marine mammal stocks. Marine mammals species found off the West Coast are either year-round residents in the area or are traveling through the area to breeding/feeding grounds. The alternatives for the 2003 West Coast groundfish specifications and management measures are not anticipated to have a significant effect on either resident, transient, or ESA-listed marine mammal species. It is expected the *Low OY Alternative* will have the least impact on marine mammals as it will likely result in the least fishing effort. Because trip limits under the *Allocation Committee Alternative* and the *Council-preferred Alternative* are expected to be similar, these alternatives will likely result in comparable intensities of fishing effort and effects on marine mammals. It is expected the *High OY Alternative* and *No Action Alternative* would have the greatest effect on marine mammals, because it provides for the highest trip limits which may result in the highest intensity of fishing effort. As the West Coast Groundfish Observer Program collects more information about the effects of the West Coast groundfish fishery on marine mammals, additional management measures may be taken to mitigate the effects if necessary.

4.2.3.2 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 on the West Coast, seabirds are occasionally taken incidentally by trawl and pot gear, but they are most often taken by longline gear. Around longline vessels, seabirds forage for offal and bait that has fallen off hooks at or near the water's surface, and are attracted to baited hooks near the water's surface, during the setting of gear. If a bird becomes hooked while feeding on bait or offal, it can be dragged underwater and drowned. Of the incidental catch of seabirds by longline groundfish fisheries in Alaska, northern fulmars represented about 66% of the total estimated catch of all bird species, gulls contributed 18%, Laysan albatross 5%, and black-footed albatross about 4% (Stehn *et al.* 2001). Longline gear and fishing strategies in Alaska are similar to some, but not all, of those used in Washington, Oregon, and California (WOC) longline fisheries.

Besides entanglement in fishing gear, seabirds may be indirectly affected by commercial fisheries in various ways. Change in prey availability may be linked to directed fishing and the discarding of fish and offal. Vessel traffic may affect seabirds when it occurs in and around important foraging and breeding habitat and increases the likelihood of bird storms. In addition, seabirds may be exposed to at-sea garbage dumping and the diesel and oil discharged into the water associated with commercial fisheries.

Alternatives for the 2003 West Coast groundfish specifications and management measures are not anticipated to have a significant effect on any seabird species, nor any ESA-listed seabird species. It is expected the *Low OY Alternative* will have the least impact on seabirds as it will likely result in the least fishing effort. Because trip limits under the *Allocation Committee Alternative* and *Council-preferred Alternative* are expected to be similar, these alternatives will likely result in comparable intensities of fishing effort and effects on seabirds. It is expected the *High OY Alternative* and *No Action Alternative* will have the greatest effect on seabirds, because it provides for the highest trip limits which may result in the highest intensity of fishing effort. As the West Coast Groundfish Observer Program collects more information on the effects of the West Coast groundfish fishery on seabirds, additional management measures may be taken to mitigate the effects if necessary.

4.2.3.3 Sea Turtles

There is limited information about interactions between sea turtles and West Coast commercial fisheries. Sea turtles are known to be taken incidentally by the California-based pelagic longline fleet and the California halibut gillnet fishery. Because of gear and fishing strategies differences between those fisheries and the groundfish fisheries, the expected take of sea turtles by groundfish gear is minimal. In addition to being incidentally taken in fishing gear, turtles are vulnerable to collisions with vessels and can be killed or injured when struck, especially if struck with an engaged propeller. Entanglement in abandoned fishing gear can also cause death or injury to sea turtles by drowning or loss of a limb. The discard of garbage at sea can be harmful for sea turtles, because the ingestion of such garbage may choke or poison them. Sea turtles have ingested plastic bags, beverage six-pack rings, Styrofoam, and other items commonly found aboard fishing vessels. The accidental discharge of diesel and oil from fishing vessels may also put sea turtles at risk, as they are sensitive to chemical contaminates in the water.

Alternatives for the 2003 West Coast groundfish specifications and management measures are not anticipated to have a significant effect on any sea turtle species, nor any ESA-listed sea turtle species. It is expected the *Low OY Alternative* will have the least impact on sea turtles as it will likely result in the least fishing effort. Because trip limits under the *Allocation Committee* and *Council-preferred* alternatives are expected to be similar, these alternatives will likely result in comparable intensities of fishing effort and effects on sea turtles. It is expected the *High OY Alternative* and *No Action Alternative* will have the greatest effect on sea turtles, because it provides for the highest trip limits which may result in the highest intensity of fishing effort. As the West Coast Groundfish Observer Program collects more information about the effects of the West Coast groundfish fishery on sea turtles, additional management measures may be taken to mitigate the effects if necessary.

4.2.3.4 Salmon

NMFS issued Biological Opinions under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley, California coastal), coho salmon (Central California coastal, southern Oregon/Northern California coastal, Oregon coastal), chum salmon (Hood Canal, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, Central California coast, California Central Valley, south-Central California, Northern California, and Southern California).

4.2.3.5 Summary of the Direct, Indirect, and Cumulative Effects of the Alternatives on Protected Species

Given the limited data available on interactions with and resulting effects on protected species, impacts are evaluated in the same way as they were for ecosystem and habitat (Section 4.1). It is assumed the effects are correlated with fishing effort, with projected landings from the limited entry trawl fishery used as a proxy. Again, it is assumed that the relative level of fixed gear effort under each of the alternatives is reasonably correlated with trawl effort.

The *No Action*, *High OY* and *Council-preferred* alternatives are likely to similar effects on protected species, based on the projected landings proxy. However, the No Action Alternative does not include the depth-based restrictions that are part of the *Low OY*, *High OY* and *Council-preferred* alternatives. Fishing activities would thus occur over a wider area than under these alternatives, increasing the likelihood of interactions with protected species.

The *Low OY Alternative* or the *Allocation Committee Alternative* without depth restriction are likely to have the least effect on protected species. Although the no depth restriction alternative would result in the lowest presumed fishing effort, remaining effort—aside from fixed gear—could be deployed more widely, increasing the possibility of encounters with protected species. Conversely, fixed gear vessels would be confined to areas within 20 or 27 fathoms. Given that longline gear–seabird interactions are a concern in other regions, this concentration of effort could have unforeseeable effects on bird species more common in coastal waters. The *Low OY Alternative* results in the lowest amount of presumed fishing effort, implying the least impacts. It also would force vessels offshore (outside 250 or 150 fathoms). If some fishers avoided fishing offshore in the winter months due to bad weather, this might reduce interactions still further during the emergency rule period of January and February 2003.

Cumulative impacts to protected species result from the combination of past, present and future direct and indirect impacts of management measures combined with the effects of other activities. A variety of human activities affect protected species and contribute to their listing under relevant laws. These effects include habitat loss and the direct effects of marine activities not related to fishing, such as vessel traffic and at-sea dumping and discharges. As with ecosystem and habitat impacts, cumulative effects cannot be distinguished among the alternatives except in relation to the intensity of direct and indirect impacts. Thus the relative cumulative impacts have the same relative intensity as the direct and indirect impacts discussed above.

4.3 Impacts to the Socioeconomic Environment

4.3.1 Overview and Baseline for Analysis

The distribution, low spawning biomass, and particularly low productivity of bocaccio will pose the most significant constraint to fisheries south of Cape Mendocino inside 150 fm in 2003. The range of harvest levels considered and analyzed in this EIS include an alternative that provides no allowable harvest of bocaccio.

Fisheries and coastal communities north of Cape Mendocino to the U.S./Canada border will be similarly affected by constraints imposed to rebuild canary rockfish and yelloweye rockfish. As in the south, fisheries inside 150 fm will be most constrained by the actions considered and analyzed in this EIS.

Groundfish trawl opportunities will need to be further constrained in 2003 in order to rebuild darkblotched rockfish.

For the purpose of the socioeconomic analysis, the 2001 fishery will be used as the baseline for comparison. The 2002 fishery is not being used as a baseline, because the fishing year is not complete, and information on fleet performance for 2002 fishery is even less complete. The analyses provided here required detailed information on the distribution of landings among vessels, processors and communities. For 2002, midseason projection of harvest information at the level of detail needed for the analysis would be unnecessarily speculative given the availability of 2001 information. We are less concerned about error in the aggregated projections for the 2002 fishery. Therefore, the 2001 fishery will be used as the baseline for evaluating relative effects projected for the 2003 fishery alternatives and a few aggregated projections for the 2002 fishery are provided to give the reader a comparison of the overall level of activity in 2002 as compared to the overall level in 2001 and the alternatives being considered for 2003.

For the 2001 commercial fishery, a proxy fishing year of November 2000 through October 2001 is used as the baseline, because it is more reflective of traditional patterns in the fishery than the calendar year 2001 fishery. In November and December of 2001 the fishery was under severe limits that are not typical of the usual fishing cycle. For the recreational fisheries, the 2001 fishery will serve as the baseline against which all alternatives are compared, including the *No Action Alternative*.

In evaluating the appropriateness of the shift away from harvest levels allowed for the baseline fisheries, it should be recognized that based on the information we now have the harvest levels and economic benefits of the 2000-2001 fishing year would not be sustainable so long as it is national policy that all stocks must be managed to maintain MSY biomass levels, at a minimum.

4.3.2 Commercial Harvesters

Part of the assessment of each of the affected sectors will include an appraisal of net economic benefits (i.e., a cost-benefit analysis). Net economic benefits from the commercial fishery are computed by subtracting costs of harvest (fuel, repairs, labor, etc.) from the gross revenues (exvessel value). All costs should be properly valued as what is termed the opportunity costs. The opportunity cost is the value of the good or service in its next best use. As an extreme example, if there are no employment opportunities available in an economy, the opportunity cost of labor would be zero; (i.e., no wages are forgone, because there is no other use for the labor, if it is not used in the fishery). In such a situation, all of the payments to labor would be considered benefits rather than a cost that is subtracted from gross revenue. Alternatively, when unemployment is low and labor is easily employed elsewhere at comparable wages if there is no opportunity in the fishery, then the full amount of the wages paid, plus any other costs associated with employing the labor must be subtracted from gross revenue in determining net benefits from the fishery. There is substantially more data available on revenue in fisheries than there is on the amounts and costs of goods and services used in the harvest of fish. Therefore, much of the quantitative information and discussion will focus on the revenue end of the cost-benefit equation.

The next three sections of the chapter provide information needed for an analysis of net economic benefits associated with the commercial harvest sector of the groundfish fishery (sections 4.3.2.1, 4.3.2.2, and 4.3.2.3). A summary of net economic impacts is provided at the end of Chapter 2. The summary is based on the above assessment of impacts of the alternatives on gross revenues, costs, and capital investment. The comparisons provided in these first three sections represent overall levels of change in commercial fishing activities for the West Coast and information is provided relative to a baseline and to the *No Action Alternative*. These changes will have greater or lesser impacts on groups and communities within the fishery, depending on their degree of involvement and dependence on the fishery. Subsequent sections in the section on commercial harvesters provide information on the effects on groups identified based on degree of involvement, dependence, and size the vessel operated.

4.3.2.1 Gross Exvessel Revenue

<u>*No Action Alternative* Gross Revenue</u>

<u>Groundfish</u>: - In January, 2000 the West Coast groundfish fishery was declared a disaster. Exvessel revenue in the 2000 commercial fishery ($75.2 million, adjusted for inflation to 2002 dollars) was 30% below exvessel revenue observed in the fishery for the ten-year period from 1987 through 1997 ($108.9 million) (Table 3.3-6). In, 2001, exvessel revenue declined to $58.7 million (including whiting but excluding tribal fisheries), another 22%, as compared to the year 2000 (all values adjusted for inflation). **(NOTE: the 2001 exvessel revenue value reported in this paragraph is $3 million less than that reported in Chapter 3. The difference is due to a last minute change in the algorithm used by Pacific Coast Fisheries Information Network (PacFIN) to estimate exvessel values for the at-sea whiting fishery. The effect of the change in the algorithm on the estimates for the 2000 fishery appears minor)**. Based on the pattern of landings in the 2001 fishery, the landings reported to date for 2002 in the PacFIN database (through July for Washington and California and through August in Oregon) and a presumption of a 10% slowdown in landings due to more recently imposed restrictions, exvessel value for the 2002 fishery is projected to be $55.4 million.

<u>All Species</u>: - For the purpose of this analysis, it is assumed that under the *No Action Alternative* all species except groundfish would have similar production levels to those observed in 2002, and the 2002 fisheries are similar to the 2001 fisheries. In 2001, the total revenue for all landings on West Coast landing receipts and at-sea deliveries was $230 million, 36% below the 1981 through 2000 20-year average, adjusted for inflation. Assuming a constant level and value of harvest for all fisheries except the groundfish fishery, the 2002 *No Action Alternative* fishery would be projected to have an exvessel value of $215.8 million.

Baseline Gross Revenue

The following levels of gross exvessel revenue characterize the November 2000 through October 2001 baseline:

No Action Alternative (2002)	Exvessel Revenue ($ millions)
All Groundfish	
Total	$47.2
Total excluding catcher-processor caught whiting	$44.7
Total excluding all whiting delivered at-sea	$41.5
Total excluding all whiting	$37.2
All Species	
Total	$215.8
Total excluding catcher-processor caught whiting	$213.4
Total excluding all whiting delivered at-sea	$210.1
Total excluding all whiting	$205.7

Alternatives Gross Revenue

Expected exvessel value was modeled differently for trawl and nontrawl vessels. For trawl vessels, we used intermediate results from a model the GMT uses to estimate the effects of regulations on the harvest by individual trawl vessels based on their historic participation patterns. The GMT model uses historic behavior patterns of trawl vessels and produces an assessment for how particular regulations will affect each trawl vessel. The results from this model are for species groups and bimonthly period. The GMT model results were applied to monthly PacFIN vessel summary files, distributing changes in vessels landings among periods, processors and communities in patterns proportional to those observed during the base period. For nontrawl vessels, a simpler approach was taken. Each species was associated with a harvest area based on depth (depth strata). For some species, the harvest depth strata with which the species were associated varied by time of year. While the encounter of a particular species is not entirely controlled by harvest depth, there is a strong correlation. The depths modeled were slope, shelf, deep nearshore, and shallow nearshore. It was assumed that if a depth strata was closed for a period of time and trip limits were in place to allow retention of any incidental harvest of species associated with the closed strata (to take into account catch occurring at less typical depths), that 20% of the catch of the species associated with the depth strata during the base period would still be harvested (i.e. 20% would be harvested incidentally at other depths).

For the nearshore fisheries it was assumed that effort and harvest would increase during open periods, and any nearshore caps established to control catch would be fully harvested. For Southern California there were a number of options (scenarios) considered for the nearshore caps. For the purpose of this analysis, representative scenarios were associated with each of the Council alternatives, as indicated in the following table. In order to better depict the economic effects of the cap, the recommended *Council-preferred Alternative* was modeled with and without the nearshore caps.

Council Alternative:	Low OY	High OY	No Depth	Alloc Comm	Council-preferred	
Southern Cal Scenario:	No Harvest	2	4	1b	Adopted	No Cap
Commercial:			(metric tons)			
Shallow Nearshore Rockfish	0	52.4	17.5	38.8	38.8	-
California Scorpionfish	0	42.4	14.5	21	48	-
Deeper Nearshore Rockfish	0	131	43.8	30.4	21	-
Total Commercial:	0	225.8	75.8	90.2	107.8	-
Recreational:	0	225.9	376.3	361.5	432.9	-
Overall OY	0	451.7	452.1	451.7	540.7	

For the whiting and sablefish fisheries, it was assumed OYs would be fully harvested. The determination of exvessel revenue implicitly assumes that average monthly prices for 2003 will be same as those observed during the base period.

For nongroundfish species it was generally assumed the effects of gear and depth restrictions would primarily be on the cost of harvesting for any nongroundfish fishery for which restrictions are applied to protect groundfish (i.e. harvest activities would be relocated into areas where CPUE is lower and cost per unit harvest higher). These effects are discussed in section 4.3.2.2. Effects on harvest of species other than groundfish were projected for the *Low OY Alternative* under which no harvest of bocaccio would be allowed and the allocation committee options with status quo depth management. For this alternative, it was assumed that any nongroundfish fishery with reasonably measurable amounts of bocaccio would be closed in order to achieve the zero OY. Based on discussions of the Ad Hoc Allocation Committee and Council it was presumed the following nongroundfish fisheries would be shut down under the *Low OY Alternative* in the area south of Cape Mendocino:

- Fisheries for California halibut and sheephead.
- The drift gillnet fishery complex.
- Trawling for pink shrimp, spot prawns, and ridgeback prawns.
- CPS squid and wetfish fisheries.
-

Exvessel values for these and other nongroundfish fisheries south of Cape Mendocino are provided in Tables 3.3-3a.

It was assumed that gear modifications and area closures would limit impacts in the salmon fishery sufficiently to allow the continuation of that fishery, and the HMS fisheries could be continued in areas outside the areas likely to affect bocaccio. Other fisheries were assumed to have negligible impacts on bocaccio. .

Table 4.3-1 summarizes the gross revenues expected under each of the alternatives given the above assumptions. Comparisons are made to the base period and to the *No Action Alternative*. For the *Council-preferred Alternative*, exvessel groundfish revenue is expected to decline 21% compared to the base period or 15% compared to the projection for th 2002 fishery. The nearshore caps proposed by the Council impose at least a $0.9 million reduction in exvessel revenue as compared to the *Council-preferred Alternative* without caps. However, the *Council-preferred Alternative* without caps probably understates total revenue, because it assumes base period effort levels in the nearshore fishery. With closure of the shelf fishery, if no caps were imposed there would likely be an increase in nearshore harvest to well above those levels observed during the base period. The effect of new depth management provisions is illustrated by a comparing the Ad Hoc Allocation Committee alternatives with and without depth management. Without depth management, holding the fishery to the *Allocation Committee Alternative* would be expected to result in groundfish exvessel revenues of about $38.6 million, 36% below the base period groundfish fishery and 30% below the projected exvessel revenue for the 2002 fishery. With depth management to control impacts on overfished species such as bocaccio, yelloweye rockfish and darkblotched rockfish, the expected exvessel revenue in the commercial groundfish fishery under the Ad Hoc Allocation Committee OYs would be $45.0 million, a difference of $6.4 million in exvessel revenue. Under the *Low OY Alternative* no bocaccio harvest would be allowed, with the consequence that a number of fisheries along the southern coast would be shut down. (See the earlier discussion in this section.) Under the *Low OY Alternative*, exvessel revenue would have declined by $60 million or 26% of the total exvessel revenue for West Coast ocean area fisheries (excluding tribal fisheries), as compared to the baseline. The values in this table pertaining to the nongroundfish fishery should be adjusted downward by about $1.7 million in all alternatives to the *No Action Alternative*, except the *Low OY Alternative*, to account for the likely state closure of the spot prawn trawl fishery. Some of the prawn harvest forgone in the trawl fishery may be taken in the trap fishery, which operates at similar depths but tends to be more evenly distributed between the area north and south of Point Conception.

4.3.2.2 Operation Expenses

Harvest reductions associated with reduced effort are generally accompanied by reduced costs such that the effect on net benefits from the reduction discussed in the previous section is less than the gross reductions described. Where harvest reduction occurs without a reduction in effort, through imposed inefficiencies, the gross value of the reduction may be more reflective of the change in net benefits. If reductions in the impacts of harvest are achieved through the imposition of inefficiencies, such as gear restrictions, the effect on net benefits may be reflected more by the additional operating costs, rather than a reduction in revenue from target species.

Trip limits/cumulative limits: Reduction in harvest by the imposition of trip limits will reduce gross revenue from the species to which the limit applies. If the species is a minor part of the complex that is being fished (harvest that is incidental to the main target species) and the limits for other species are not reduced, the trip limit will result in similar amounts of effort at a similar harvest cost but less revenue. If the harvest limit is for a species that comprises a significant component of the incentive for a particular fishing strategy, there may be a reduction in effort such that the reduction in net benefits is the reduction in revenue less the reduction in harvest costs. The revenue reduction is not just the revenue associated with the trip limit species, but also includes the revenue that would have been earned from the harvest of all other species that would have been caught and retained as part of the target complex as well as any incidental catch that would have been retained for use. Because of the need to reduce mortality for overfished species, the alternatives in this document would reduce trip limits for healthy target species in order to limit bycatch mortality. Therefore, there would be some associated reduction in costs associated with the reduced effort and harvest levels. These reductions would roughly correlate with, but be less than, the projected reductions in revenue.

Cumulative limits are a kind of output control that do not tell fishers when, where, or how to take their fish. Restrictions that meet conservation objectives by dictating the manner of fishing generally impose inefficiencies that increase costs.

Depth restrictions proposed as part of all the alternatives, except the *No Action Alternative*, would prevent fishers from harvesting healthier stocks in areas where the incidental harvest of overfished groundfish species is likely to be high. Therefore, if the healthier stocks are to be harvested, the harvest must occur outside the optimal catch areas, where the catch per unit of effort (CPUE) for effort targeted on healthier species is likely to be lower, and consequently, cost per unit catch higher. In order to more fully control harvest of overfished shelf species, the harvest of all shelf groundfish species would be placed under limits that would effectively restrict their retention to harvest taken incidentally while targeting on nearshore and shelf species. Under the *Low OY Alternative*, there would also be restrictions imposed on nongroundfish fisheries over the shelf and nearshore areas south of Cape Mendocino, pushing these fisheries into areas where CPUE may be lower. Other options include a California Rockfish Conservation Area (CRCA) closure for south of Cape Mendocino waters between about 50 fm and 150 fm (down to Point Reyes) or 50 fm and 250 fm (south of Point Reyes) (section 2.2.5). The following are fisheries south of Cape Mendocino that may be affected by depth restrictions.

California Halibut: - The gillnet fishery operates south of 38° N latitude. Most of the production for the gillnet fishery for California halibut occurs in the 20 fm to 50 fm range with a fairly substantial portion of the catch occurring between 0 fm and 20 fm in some years (e.g., 1997 and 1999, Table 3.3-8). Very little is caught outside 150 fm. Forcing this fishery outside of 150 fm is likely to act as a closure on the fishery. The fishery may be able to proceed at higher costs and/or lower CPUE if it is allowed inside 20 fm. Depending on the distribution of the species during 2003 fisheries, total catch may decline. Data are not available on the depths at which the trawl fishery occurs. However, the effect of the depth restriction is likely to be the equivalent to a closure for this fishery as well.

<u>CPS Fishery</u>: - Logbook information from market squid vessels indicates that in the north the majority of the sets and harvest occurs in more than 10 fm but less than 20 fm (Table 3.3-13). In the south the fishery appears to occur in somewhat deeper areas with the majority of the sets occurring in greater than 20 fm of water. A closure inside of 150 fm would likely end this fishery. If the fishery is restricted to waters inside 20 fm it may be able to proceed but at higher cost and/or lower CPUE, depending on the distribution of target species in 2003. The proposed CRCA would not restrict the use of round haul gear.

<u>Gillnet Complex</u>: - Most of the production in the gillnet complex occurs inside 50 fm. A closure of all waters inside 150 fm would likely end this fishery. The CRCA would close waters from 20 fm to 150 fm south of Point Reyes for set gill and trammel nets with mesh sizes less than 6 inches (the gear is not allowed in the groundfish fishery north of 38° N latitude) and from 20 fm to 250 fm between Cape Mendocino and Point Reyes. A relatively small portion of the gillnet fishery occurs inside 20 fm.

<u>Pink shrimp</u>: - Very little pink shrimp fishing occurs outside 150 fm and it occurs only in some years (Table 3.3-9). When the fishery does occur in those depths, the CPUE is comparable to when the fishery occurs in shallower waters. All alternatives other than the *Low OY Alternative* would allow the fishery to proceed with the use of finfish excluders.

<u>Sea Cucumber</u>: - Most of the sea cucumber trawl fishery occurs between 20 fm and 50 fm (Table 3.3-7). In most years the CPUE drops off rapidly inside 20 fm and outside 50 fm (hence cost per unit catch increases). Alternatives other than the *Low OY Alternative* and the *Allocation Committee Alternative* with no depth restrictions would allow this fishery to proceed but require the use of small footropes.

<u>Spot Prawn</u>: - The spot prawn trawl fishery occurs mainly between 50 fm and 150 fm (Table 3.3-10). The proposed CRCA would allow the use of any trawl gear with a small footrope in waters shallower than 50 fm or 60 fm north of Point Conception and shallower than 100 fm south of Point Conception. About 90% of the spot prawn trawl fishery occurs north of Point Conception, as measured by value during the November 2000 through October 2001 base period. In years when there was some effort in waters shallower than 50 fm, the CPUE was very low. Between 15% and 25% of the effort in this fishery generally occurs in waters outside 150 fm. South of Point Reyes the CRCA extends only to 150 fm, so in this area the fishery might be able to proceed at deeper depths (greater than 150 fm) and south of Point Conception the fishery could operate out to 100 fm (under proposed federal rules). However, California has indicated that it is likely to prohibit the use of spot prawn trawl gear beginning in 2003. Some of the prawns forgone in the trawl fishery may be taken in the trap fishery, which operates at similar depths but tends to be more evenly distributed between the area north and south of Point Conception. There will not be any new federal or state regulations imposed on the trap fishery for spot prawns (Table 3.3-11).

<u>Ridgeback Prawn</u>: - Most of the ridgeback prawn trawl fishery occurs in areas outside 50 fm (Table 3.3-10). About 70% of this fishery (by value) occurs north of Point Conception. While this fishery would be allowed to continue using a small footrope in waters shallower than 50 fm between Point Conception and Cape Mendocino, catch and CPUE in shallower waters is usually lower than at depths greater than 50 fm (an example exception is 1996). In contrast to the spot prawn trawl fishery, very little effort in this fishery occurs outside 150 fm. South of Point Conception, ridgeback prawn trawlers will be able to continue to fish out to 100 fm, though fish excluder devices will be required.

To the degree that vessels might possibly target the species covered in the preceding list by moving their effort in areas that remain open, it is likely that costs would be higher and/or CPUEs lower than in normal fishing areas, raising cost per unit of catch.

While not a part of this regulatory package, it is very likely that in the near future a regulation will be imposed requiring vessels to carry Vessel Monitoring System (VMS) equipment that allow the location of a vessel to be determined by satellite. The VMS equipment is an anticipated element of the enforcement program for depth management. Such equipment will involve a capital cost, payed either by the government or the fisher. The capital cost of such equipment is discussed in the following section (section 4.3.2.3). Operating equipment will also entail a variable costs in the form of charges imposed by telecommunications companies. Such costs will likely increase with the length of the trip so that reductions in CPUE caused by gear and depth restrictions will increase the cost per unit catch associated with charges for operation of the VMS equipment. The daily service charges might range from $1 to $5 per day, depending on the type of system installed. At present it is anticipated that for the purpose of enforcing depth restrictions pertaining to the groundfish fishery, the requirement that VMS equipment be installed on a vessel will pertain only to those vessels participating in some segments of the directed groundfish fishery.

Proposed gear restrictions are likely to reduce gear efficiency, increasing cost per unit of harvest. Examples of such restrictions are requiring finfish excluders in the shrimp and prawn trawl fisheries and the imposition of small footrope requirements in situations where a fisher might otherwise have preferred to use a large footrope.

Depth management will not likely have an effect on transit time and cost for slope species except to the extent that the management lines based on waypoints are further out from shore than the actual depth contours, and to the extent that fishers might have been able to target slope species in somewhat shallower areas closer to their port. When all groundfish target fishing is taken as a whole, average cost per unit of harvest is likely to increase to the degree that harvest effort on the slope is substituted for harvest effort on the shelf. However, with declining harvest opportunity, total operation costs will likely decline, though less rapidly than total revenue.

4.3.2.3 Capital Investment

In general, the level of capital investment in fisheries reflects the revenue opportunities present over the longer term. There is a certain amount of mobility of vessels between fisheries and geographic locations either while under the same ownership or as owners leave and enter the fishery. Once a vessel is built and operational in the fishery, the costs of bringing the vessel online are sunk costs, that is, the vessel will likely remain in fisheries and active so long as revenues are sufficient to cover variable costs (including opportunity costs). If the fishery does not provide enough revenue for its owner to cover payments owed on the vessel, it is likely the vessels will be resold in the fishery at a price low enough so, the buyer will be able to make a reasonable profit at the reduced level of financial investment in the vessel. Because of this capital mobility, evaluation of impacts on capital should be carried out in the context of the broader West Coast fisheries. As fishery revenue declines, absent new innovations that increase efficiency, and given the tendency of regulators to impose inefficiency as a means of fishery management, it is likely the fishery's ability to service debt declines.

Exvessel revenue has declined by 67% since 1981 while the number of vessels landing more than $1,000 in exvessel revenue has declined by 56% (Tables 3.3-4a and 3.3-5b). Most of the decline in participation has occurred in the salmon and HMS fisheries. At the same time, the number of buyers has remained relatively constant. This point will be discussed further in the section on buyers. There was a rapid decline in exvessel revenue in the early 1980s followed by about 10 years of relatively stable exvessel revenue and another declining trend that started beginning in 1996. As of 2001, exvessel revenue from West Coast fisheries had dropped 36% since 1996. The restrictions that would have been imposed under the *Low OY Alternative* would have reduced exvessel revenue by another 26%, putting further pressure on the fisheries' ability to maintain its current level of capital investment. Under the *Council-preferred Alternative*, the revenue of West Coast fisheries is projected to fall about $13 million or by about 5% compared to the base period (Table 4.3-1). State closure of the spot prawn trawl fishery may impose another $1.7 million reduction, depending on the degree to which the spot prawn trawl fishery can pickup production lost from the trawl fishery.

The proposed vessel monitoring system, which is likely to follow on the development of depth management, will likely be accompanied by a capital cost of between $2,000 and $6,000 per vessel plus the costs of installation and adapting powers supplies to the requirements of the VMS equipment.

4.3.2.4 Distributional Effects Among Commercial Harvesters

Previous sections discussed changes in revenue under the alternatives in the context of the entire fishery. In this section we examine the effects on groups within the fishery.

Dependence

Under the *Council-preferred Alternative*, open access fishers with over 65% reliance on groundfish are expected to experience the greatest percent reduction in their total fishing revenue (Table 4.3-2). This group is followed by groundfish trawlers highly dependent on groundfish and longline and fishpot vessels dependent on groundfish for between 35% and 95% of their revenue. Fixed gear vessels most dependent on groundfish are likely heavily involved in the sablefish fishery for which an increase in harvest is expected for 2003. Dependence is measured here based on West Coast revenues. Some of the vessels that appear to be highly dependent may be less dependent than indicated if revenues from other areas, such as Alaska, were taken into account. State law currently prohibits the acquisition of confidential data on Alaska fisheries that would be necessary for a more complete dependency analysis.

In terms of the reduction in absolute revenue, trawlers that are 95% or more dependent on groundfish are expected to bear about one-third of the reduction in exvessel revenue. Out of the 247 trawl vessels that were active during the base period, 99 fall into this category of high dependency (Table 3.3-23a).

Considering just revenue from groundfish fishing, the percent reduction in groundfish revenue is expected to be greatest for the trawlers that are least dependent on the fishery (Table 4.3-2). Some of the vessels with between 5% and 35% reliance on groundfish are expected to have some opportunity to increase over previous year's harvest based on their relative inactivity in recent years compared to their historic levels of harvest.

Production Level

There were 112 trawlers with over $200,000 of West Coast fishing revenue during the base period (Table 3.3-23a). Of this amount, 78% was from the groundfish fishery (comparing Table 4.3-2a to 4.3-2b). These vessels earned 52% of all revenue from groundfish and will bear 59% of the burden of the reduction in revenue under the *Council-preferred Alternative*, as compared to the base period. Open access vessels as a group landed 11% of the groundfish revenue during the base period and are projected to bear 20% of the burden of the reduction.

Involvement

Of the 397 vessels responsible for making 50% of the landings on the West Coast (by value during the base period), 221 (56%) participated in the groundfish fishery (Table 3.3-7). These 221 participants in the groundfish fishery landed 24% of the value of all West Coast harvest. Of these 221 vessels, 93 (2% of the West Coast fishing fleet) were responsible for 50% of the groundfish landings by value. Effects on the exvessel revenue of groups of vessels by their level of involvement in the fishery are displayed in Tables 4.3.-4a through f. For the *Council-preferred Alternative* (Table 4.3-4e) the 93 top-producing vessels in the all West Coast fisheries and the West Coast groundfish fishery are projected to experience a 20% decline in their total revenue from all species ($6.9 million). This represents 40% of the total projected reduction in exvessel revenue, which will be borne by 5% of the groundfish fleet. The higher percent reduction shown on the diagonals of the blocks of numbers in the tables show that those vessels most involved in West Coast fisheries and groundfish fish fishery will experience the greatest proportional reductions in their total fishing revenue. One exception to this would be the *Low OY Alternative*. Under this alternative, fisheries in which there is a chance of encountering overfished groundfish species would be severely restricted, though there would be only a low probability of groundfish species encounters. Vessels landing no groundfish during the base period would be expected to experience a 49% reduction in gross revenues as a result of such restrictions (Table 4.3-4a).

Vessel Size

The *Council-preferred Alternative* would have its greatest impact, in terms of percent reduction in revenue, on trawl vessels less than 30 feet in length and greater than 70 feet in length, and for all other gear groups for vessels between 50 feet in length and 60 feet in length (Table 4.3-5a and b). In terms of the absolute value of the reduction in revenue, the brunt of the reduction on a per vessel basis would be borne by trawlers in excess of 70 feet in length, fishpot and longline vessels between 60 feet in length and 70 feet in length, open access vessels dependent on groundfish for more than 5% of there revenue and less than 50 feet in length, and open access vessels dependent on groundfish for less than 5% of their revenue over 50 feet in length (Table 4.3-6a and b).

Effects on Other Fisheries

Firms will likely seek to makeup revenue lost from the groundfish fishery by increasing their participation in other fisheries. Overall, it is expected that vessels losing revenue from the groundfish fishery may seek to make up $11.5 million dollars in revenue from other fisheries.

Seasonality of Harvest

During the base period harvest in the Columbia INPFC area fluctuated more than in any other area along the coast (Table 4.3-7 and 4.3-8). Table 4.3-8 shows the harvest in each month relative to the harvest in the first month in the year. Under most of the alternatives, harvest in the summer months would be dampened more than harvest in winter months. Table 4.3-9 displays groundfish harvest as a percent of total harvest by month. In October in the Vancouver INPFC area and in November in the Eureka INPFC area, groundfish accounts for 80% to 90% of the value of all landings during the month. Buyers for northern fisheries tend to be least dependent on groundfish in December and January. In the Vancouver INPFC area the crab fishery opened late during the base period and so the dependence on groundfish remained higher than for other northern areas of the coast.

4.3.3 Buyers and Processors

The projected decline in exvessel revenue reflects a decrease in the purchase of a key input that will be externally imposed on buyers and processors. Under the *Council-preferred Alternative*, product purchases are expected to decline by about $13 million (Table 4.3-10). Output is expected to decline in a proportion roughly commensurate with the reduced input; however, the effect on net revenue will depend on changes in cost associated with reduced output and any changes in the market prices for the purchasing of raw fish product or the resale of the product. Wholesale prices and processing/wholesaling costs are not available to assess the effects of the harvest reductions on gross or net revenue. In response to the reduced availability of raw product, buyers and processors may seek to increase revenue by bidding or finding other ways to acquire a larger portion of the available raw product (in the groundfish or other fisheries), reducing costs, or finding ways to add value to the products they sell.

Harvest data available for this analysis are from West Coast fish landing receipts (fish tickets). These receipts record buyer license numbers, but do not distinguish buyers from processors. Therefore, the analysis is restricted to examining buyers and processors in aggregate. There are some buyers that buy from more than one port and have facilities in each port and others that do not have landing or processing facilities in each port through which they buy. While these complexities exist, for the purposes of this analysis, a simplifying assumption has been made that each unique combination of buyer code and PacFIN port area represents a different buying unit (a different firm). In terms of percent change in total value of purchases of raw product, smaller buyers/processors are expected to experience a slightly greater percent reduction in total value of purchases for all species than larger buyers/processors (Table 4.3-10). This may be, because smaller purchasers are somewhat less diversified than larger purchasers.

The buyer/processor segment of the fishery is quite concentrated, with approximately 5% of the buyers responsible for 80% of the purchases. The 39 buyers most involved in the fishery are expected to experience decreases in product purchases of between 7% and 10% of their total purchases under the preferred alternative (Table 4.3-11). The 405 processors with only minor involvement in the fishery are expected to experience reductions of only about 2%, presumably, because of heavier involvement in other fisheries. Under the *Low OY Alternative*, nongroundfish fisheries would be severely restricted. Consequently, nongroundfish buyers would experience a 17% reduction in the value of their fish purchases, a reduction comparable to that expected for those most involved in the groundfish fishery.

4.3.4 Recreational Fishery

The regulations and regulatory alternatives being considered for 2003 present the recreational fishing industry with the challenge of responding to time/area closures. Time area closures affect net economic value by altering the quality of trips taken or causing anglers to switch to second-choice activities. Depending on the location of the second-choice activities, coastal communities that otherwise benefit from recreational fishing activity may experience a reduction in related economic activity.

Charter Vessels: - Recreational charter vessels are probably more dependent on their home port than commercial vessels, though recreational charter vessels are known to exhibit some mobility between ports. It is the marketing aspects of the charter operations that tend to be dependent on the location. Thus the charter agents and vessels that serve as their own booking agents are less able to respond to local area closures by movement to a different port than vessels that rely on charter offices to recruit clientele. Charter vessel operators and crew which do attempt to move operations to a port in an open area will face obstacles in recruiting clientele or developing new relationships with booking agents. The operator and crew may experience social effects associated with distance from family and social networks.

Recreational Fishers: - There are three groups of recreational fishers that will be considered here (1) those that travel to an area primarily, because of the opportunity to fish for groundfish, (2) those that travel to an area to take part in a suite of activities which includes groundfish fishing, and (3) those that live in an area and take part in the recreational groundfish fishery.

Recreational fishers from outside a fishing area are probably the most mobile part of the harvest effort. However, for those who travel to a particular area to go groundfish fishing, the decision to transfer their trip to a different area or time in response to a time/area or depth closures likely implies a change to a lower value experience. The fisher deciding to travel to an area at a particular time to go fishing has a variety of choices available. Presumably, the first-choice time and location offers the best value to the fisher. Thus, the move of the trip to another area and/or time, in most cases, is likely to be a move to a lower value experience.

Those for whom recreational groundfish fishing is only one of the activities for which they travel to an area may exhibit somewhat less mobility. The elimination of their opportunity to fish may not change their travel plans, but may reduce the value of their experience forcing them into second choice activities. However, for some of these anglers, the elimination of the groundfish fishing activity will be the marginal change that changes their preferred location ("I can't go groundfish fishing at Port A, but Port B offers many things almost as nice as Port A, and at Port B I can go groundfish fishing too") or time of travel ("It's not the best time to take my vacation, but if I delay for a month I'll still be able to go to my favorite groundfish fishing area at Port A and do all the other things I like to do there as well").

Those that live in an area may respond to a time/area closure by, (1) not going groundfish fishing at all and spending their time and money in the same community on an alternative activity; (2) going groundfish fishing at a different, less optimal, time; or (3) traveling to a different area to go fishing or take part in an alternative recreational activity. All cases reflect a loss of value to the individual associated with a shift to second choice activities.

While time/area closures generally reflect a loss to the individual angler forced to change from his or her optimal fishing plans, such closures are generally imposed to provide more extended fishing opportunity coastwide. This increase in fishing opportunity allows for more angler trips and, depending on complementary regulations, a greater ocean catch. From a national or coastwide point of view, the losses to the individual anglers in terms of quality of trips taken may be made up by an increase in the total number of anglers able to participate in the ocean fishery.

4.3.4.1 Effects of Recreational Management Measures

Figures 4.3-1 through 4.3-3 show Washington, Oregon, and California management measure alternatives compared to seasonal effort 2001 angler effort and the 2001 season by state.

For Washington, the alternatives would mainly focus on the manipulation of bag limits with the possibility of closures in areas outside 25 fm if canary rockfish or yelloweye rockfish guidelines are reached. In the past, managers have observed little change in recreational effort correlated with changes in bag limits. Clearly the downward adjustment of bag limits does affect the quality of the recreational experience and over time a reduced-quality experience may lead to lower levels of angler participation. Over the near term, the level of trips is expected to remain relatively unchanged and hence the impact of trip expenditures on income in local communities will likely remain relatively constant. The net value of the trips to the angler (the value to be considered for the cost-benefit analysis) will decline by an undetermined amount even if there is no decline in the number of angler trips due to the reduced quality of the recreational experience.

The *Low OY Alternative* is an exception to the expectation that number of trips will remain relatively unchanged over the short term (Table 4.3-12). Under the *Low OY Alternative* the recreational groundfish and halibut fisheries would be closed outside 25 fm. In 2001, halibut targeted trips comprised 5% and 7% of the charter and private recreational angler trips respective. A closure outside 25 fm would likely eliminate these halibut trips. It is likely that other groundfish trips (as well as some of the halibut trips) would shift to nearshore areas (within the 25 fm line) partially offsetting any reduction. In Washington, the average income impacts are estimated at $91 per trip for charter tips and $37 per trip for private trips. These impacts include direct, indirect, and induced income generated as a result of trip expenditures. The estimates do not include significant amounts that may be spent in coastal and inland communities on major pieces of gear and vessels. Additionally, there are some individuals, particularly retirees, for whom fishing opportunities are a major reason for their decision on where to take up residence. Over time, the reduction in angler trips is likely to have an effect on capital purchases necessary to support the recreational fishery and, if opportunity for fishing is substantially reduced, some individuals who would otherwise have chosen to live in coastal areas may choose to live elsewhere. Thus the social and economic effects of recreational harvest opportunities likely extend beyond the per trip expenditures.

The situation in Oregon and Northern California will be similar to that described in Washington in terms of differences between the alternatives (Figure 4.3-2). The main reduction would occur with the *Low OY Alternative*, which has depth restrictions, making it difficult to target halibut. In Oregon, approximately 6% of the recreational trips (charter and private) targeted Pacific halibut in 2001. While some halibut anglers would transfer their effort into the nearshore area, there would also be some lost opportunity for groundfish trips taken in deeper waters. The projected reduction in angler effort (6%) under the *Low OY Alternative* and associated reduction in income impacts associated with trip expenditures are provided in Table 4.3-12. As discussed in the previous paragraph, trip expenditures reflect only a portion of the economic effects of changes in angler effort.

For Central and Southern California, significant restrictions would be imposed under the *Low OY Alternative* with the closure of all groundfish recreational fisheries inside 150 fm. For the purpose of starting to estimate the size of the impact of such a closure, it was assumed that all groundfish trips would have to be eliminated. Groundfish trips generally take place in shelf and nearshore areas where adult and juvenile bocaccio area caught. Recreational fisheries targeting other species might be affected if there was a probability that they would impact bocaccio. For fisheries such as salmon it was assumed that managers would find ways to adjust salmon regulations to minimize or eliminate impacts. If such regulations could not be devised, reductions in nongroundfish target fisheries would result in greater negative impacts than estimated here. For the other alternatives, waters from 0 fm to 20 fm would remain open. Data developed by the CDFG indicates 10% to 15% of the trips occur in waters deeper than 20 fm. It is likely that some of this displaced effort will relocate into shallower waters and that some will cease. Absent other information on the likely behavioral response, the assumption was made that 50% of the effort would transfer from closed areas into open areas in shallow water. Based on these assumptions, estimates were made of the changes in angler effort, and associated changes in personal income impacts in coastal communities. For estimating a net economic value estimate for the cost benefit analysis, the perceived value of the recreational experience is of main concern. For those anglers forced to change their desired fishing patterns there will be a decrease in economic value from the trip.

4.3.5 Tribal Fisheries

There are several groundfish species taken in tribal fisheries for which the tribes have no formal allocations. Rather than try to reserve specific allocations of these species, the tribes annually recommend trip limits to the Council for the species that accommodate modest tribal fisheries. Tribal trip limits for groundfish species without tribal allocations are usually intended to constrain direct catch and incidental retention of overfished species in the tribal groundfish fisheries. Table 4.3-13 displays tribal proposed harvests for the 2003 fishery. This proposal would generally allow the continuation of harvest at levels comparable to 2002.

Tribal allocations of sablefish and whiting are the same as for 2001 and specified by negotiated agreements, with 10% of the U.S. harvest guideline of sablefish allocated to the tribes, and a whiting allocation consistent with the court-approved proposal in *United States v. Washington*, subproceeding 96-2.

4.3.6 Cumulative Effects on Groundfish Fisheries

All of the alternatives except for the *No Action Alternative* and *High OY Alternatives* would have a substantial or significant cumulative effect. Future management actions, combined with current and future annual management measures are likely to have a long-term beneficial effect if stocks return to levels capable of producing higher sustainable harvests. Fleet capacity in the most directly affected sectors, such as limited entry trawl, is likely to continue falling. Under the more restrictive management measures, including the *Low OY Alternative* and *Council-preferred OY Alternatives*, more vessels are likely to discontinue fishing or shift into other sectors, if possible. This will achieve some short-term capacity reduction. But capacity will remain latent unless measures such as permit staking, permit and/or vessel buyback programs, or other programs capable of permanent capacity reduction are implemented. Less restrictive measures such as the *No Action Alternative* or *High OY Alternatives* might allow more vessels to be economically viable in 2003, but it is not possible to predict how management measures would change in future years. As a general principal, overfishing of already overfished stocks would require still more restrictive management measures in future years, including a higher likelihood that stocks would be listed under the ESA, possibly resulting in more restrictive management measures than under rebuilding plans.

4.3.7 Impact on Communities

4.3.7.1 Exvessel Revenue under the Alternatives

Table 4.3-14 shows the estimated distribution of exvessel revenue among port areas under the baseline and five management alternatives. Table 4.3-15 displays exvessel revenue as the percentage change from baseline for each income category and port area. Baseline total exvessel revenue is $236 million. Sixty-one million dollars of this is from groundfish landings. Under the *Low OY Alternative*, total revenue declines by 26% to $175 million, and groundfish revenue declines 38% to $38 million. The next largest reduction is seen under the *Allocation Committee Alternative (no depth restrictions)*. In this case total revenue falls by 12%, and total groundfish revenue declines by 35%.

Overall the *Council-preferred Alternative* is the next most favorable after the *High OY Alternative*. Under the *Council-preferred Alternative*, exvessel revenue would fall by an estimated 7% compared with 2% under the *High OY Alternative*.

4.3.7.2 Personal Income Impacts under the Alternatives

Tables 4.3-16 and 4.3-17 and figures 4.3-4 and 4.3-5 display the estimated impacts on community personal income resulting under the five different groundfish management alternatives. These are total income impacts (direct, indirect, and induced effects), composed of the wages and salaries paid to primary producers, processors, and suppliers, and the additional income generated when those wages and salaries are spent in the local economy. Estimates were generated using the Fisheries Economic Assessment Model

(FEAM) (Jensen 1996). FEAM uses historical landings data, information on industry cost and margin structure (vessels and processors), and income multipliers generated by IMPLAN (MIG 2000) to produce estimates of "regionalized" local income impact after deducting for leakage of payments to non-residents and to non-local suppliers, wholesalers, and manufacturers. Note that income multipliers measure the income received by participants in the local economy, not gross sales or "turnover". Also note that these multipliers assume changes in capital stock resulting from investment decisions are annualized, so the impact of purchasing or replacing capital assets (vessels, gear, buildings, plant, etc.) are amortized as a series of annual payments rather than treated as a lump sum purchase.

Table 4.3-16 shows the income in thousands of current U.S. dollars that would be generated from commercial fishery activities under the baseline scenario and the five management alternatives (*Low OY, High OY, Allocation Committee (no depth restrictions), Allocation Committee (with depth restrictions), and the Council-preferred Alternative*). Table 4.3-17 displays these dollar impacts as the percentage change from the baseline for each income category and port area.

From Table 4.3-16, coastwide total baseline commercial fisheries income is $635 million. One Hundred Fifty-Seven million dollars of this was generated by groundfish fisheries, of which $130 million was attributable to limited entry trawl and $26 million contributed by all other groundfish gear. Under the most drastic scenario, the *Low OY Alternative*, the total falls to $361 million, a reduction of 43% (Table 4.3-17). Groundfish fisheries are less hard hit under the *Low OY Alternative* falling overall by 37%, 34% for limited entry trawl, and 51% for all other groundfish gear.

Under the *High OY Alternative*, reductions are least severe. Overall fisheries-related income falls from the baseline $635 million to $619 million, a reduction of only 2%. However, groundfish takes a harder hit, falling by 10% overall and by 12% for the limited entry trawl fishery. Non-trawl groundfish is reduced overall by only 1%.

Under the *Allocation Committee Alternative (no depth restrictions)*, overall fisheries-related income falls from the baseline $635 million to $568 million, a reduction of 11%. Groundfish takes a harder proportional hit, falling by 33% overall, by 32% for the limited entry trawl fishery, and 42% for non-trawl groundfish gear.

Including depth-based management under the *Allocation Committee Alternative (with depth restrictions)* results in a significant improvement over the same OY package without depth restrictions. Total income under this alternative is $595 million, a reduction of 6% from the baseline level, but $27 million higher than without depth restrictions. Groundfish is reduced by one quarter from the baseline, with non-trawl income falling by more than one-third (-34%).

Under the *Council-preferred Alternative*, overall fisheries-related income falls by 6% from the baseline to $600 million. The distribution of impact on the groundfish sectors is more balanced than under the other alternatives. Total groundfish falls by 22%, by 23% for the limited entry trawl fishery and by 20% for non-trawl groundfish.

Underlying the overall totals are some important geographical differences. Table 4.3-17 and figure 4.3-4 show that under the *Low OY Alternative*, the greatest overall reductions are in the Central and Southern California port areas of Santa Barbara, Monterey, and Los Angeles. This is the effect of the large reductions in nongroundfish fisheries required to minimize incidental catch of overfished species. In Los Angeles and San Diego, significant percentage increases in groundfish somewhat offset the reductions in other fisheries. However these increases are fairly slight in dollar terms. Under the *High OY Alternative*, the largest overall income reductions in percentage terms are experienced in Puget Sound and the at-sea sector. Several areas actually show a slight increase relative to baseline income levels, including Northwest Olympic Peninsula, Eureka, Fort Bragg, Los Angeles, and San Diego.

Table 4.3-17 and figure 4.3-5 show that under *Allocation Committee Alternative (no depth restrictions)*, nongroundfish income is reduced significantly, but less than under the *Low OY Alternative*. This is the only alternative other than the *Low OY Alternative* expected to have large impacts on nongroundfish fisheries. Limited entry trawl income is reduced overall by nearly as much as in the *Low OY Alternative*, and by at least

24% in every port area north of Monterey. Non-trawl groundfish income is harder hit in percentage terms, falling by 42% overall and with income in every port area north of Los Angeles reduced by at least 32%.

Adding depth restrictions under the *Allocation Committee Alternative (with depth restrictions)* improves coastwide income from all fishery sectors and also shows significant improvement in every port area. Coastwide total income for the non-trawl groundfish sectors improves proportionately relative to the no depth restrictions alternative, however this is mostly due to significant improvement in areas south of Fort Bragg.

Compared with the other alternatives, the *Council-preferred Alternative* is no worse for any port area overall than either the *Low OY Alternative* or the two *Allocation Committee Alternatives*, and significantly better than those alternatives for each area's non-trawl groundfish sectors. Limited entry trawl is also slightly better off overall, but slightly worse in two areas, Northwest Olympic Peninsula and Fort Bragg.

4.3.7.3 Employment Impacts Under the Alternatives

Table 4.3-6 shows the distribution of baseline commercial fisheries-related employment among port area groups and estimated changes under the five management alternatives. The table shows that employment is most severely affected under the *Low OY Alternative*, falling by 39% overall and by 82%, 78%, and 69% for Santa Barbara, Monterey, and Los Angeles, respectively. Under the *High OY Alternative*, overall employment is least affected, falling by just over 2%. The most heavily affected port area under this scenario is Puget Sound, which would lose 17% of fisheries-related jobs. Several port areas may actually show some gain in employment under this scenario, including San Diego, Eureka, and Northwest Olympic Peninsula. The patterns are the same, but magnitudes of impact differ under the two Ad Hoc Allocation Committee alternatives. Under both alternatives, Puget Sound is the most affected, losing nearly one third of fisheries-related jobs under the *no depth restrictions* variant, and nearly one quarter *with depth restrictions*. Overall, the *no depth restrictions* variant results in an 8.3% employment loss. The overall impact falls to 5.9% employment loss with depth-based management. Under the *Council-preferred Alternative*, overall job loss is estimated to be 5%. The worst-affected regions are Puget Sound (-21%), Newport (-13%), and Astoria/Tillamook (-12%). Under the *Council-preferred Alternative*, the biggest employment gainer is San Diego at 2.9%.

4.3.7.4 Cumulative Effects on Communities

The external economic environment, and especially the decline in resource-related economic sectors, will combine with expected income declines resulting indirectly from the management measures to produce cumulative effects. Smaller, more isolated, and more fishing-dependent coastal communities will be more hard hit. Oregon and Washington coastal communities will be most severely affected, because of high levels of unemployment relative to California, and greater dependence on groundfish fisheries. However, the *Low OY Alternative* would have coastwide effects since it reduces revenues across nongroundfish fisheries. Absolute declines in fishery-related income are much greater in Santa Barbara and Los Angeles port areas under this alternatives, in comparison to other alternatives, due to the closure of nongroundfish fisheries. But the larger urban and regional economies may mitigate the effect, reducing cumulative impacts.

4.3.8 Health and Safety

4.3.8.1 Summary of Impacts on Vessel Safety

The management alternatives for 2003 groundfish fisheries present a variety of safety risks, levels of risk, and mitigating factors. In general, alternatives with higher OYs pose fewer threats to commercial and recreational safety than *Low OY Alternatives*.

The *No Action Alternative* poses the fewest safety risks of all the alternatives, because it is the least restrictive. This alternative is the same as the 2002 management measures, without inseason adjustments. It is significantly less constraining than the other alternatives, but more constraining than management measures in previous years.

The *High OY Alternative* poses the next level of safety risk. It provides the longest rebuilding duration and the highest harvest allowed for overfished groundfish species. Like all of the other alternatives apart from the "no action" and "no depth restrictions" alternatives, this alternative uses depth-based restrictions and two-month cumulative landing limits. While it is more restrictive, it is significantly less restrictive than the *Low OY Alternative*. Many commercial fisheries would be pushed outside 150 fm or limited to 20 fm or less. Recreational fisheries north of Cape Mendocino would not be different than under the *No Action Alternative* option, but in the south recreational fishing would be closed between 20 fm and 150 fm.

The *Allocation Committee Alternative (wth depth restrictions)* and the *Council-preferred Alternative*, which are very similar alternatives, are the next step higher in terms of safety risks. In terms of restrictiveness, they are halfway between the *High OY Alternative* and the *Low OY Alternatives*. The *Allocation Committee Alternative* would push most fisheries outside 100 fm, except in the south, where fixed gear and open access fleets would be pushed outside 150 fm (or inside 20 fm). Depth-based restrictions would not apply to recreational fisheries north of Cape Mendocino unless certain harvest guidelines were met, in which case they would be confined within 20 fm. South of Cape Mendocino, there would be no recreational fishing for groundfish between 20 fm to 150 fm.

The *Council-preferred Alternative* would push the limited entry trawl fleet north of Cape Mendocino out to 250 fm (or within 100 fm) for part of the year. Apart from this difference and some other minor changes, this option is virtually the same as the *Allocation Committee Alternative*.

The *Low OY Alternative* poses the highest safety risks, because it is the most restrictive. Under this alternative, most fishing activities on the West Coast within the 0 fm to 150 fm depth zone would be affected. Limited entry trawl, limited entry fixed gear, and open access fleets would be restricted to fishing outside 150 fm under this alternative, both in the north and south. In Washington, recreational fishing would be confined to within 25 fm. In Oregon and California north of Cape Mendocino, recreational fishing would be confined to within 27 fm. South of Cape Mendocino, recreational fishing would be prohibited inside of 150 fm.

Finally, the "No Depth Restrictions" alternative is in a separate category. This alternative prohibits most limited entry fixed gear and open access fishing outside of 20 fm to 27 fm, and prohibits it altogether in Washington. The limited entry trawl fleet would be restricted to small footropes, which have no identified safety implications.

4.3.8.2 Effects of Depth-based Management on Vessel Safety

Rather than analyzing the specific safety risks posed by each alternative, below we address general safety risks posed by depth-based management. In general, the more management relies on distant fathom lines or restricts vessels within enclosed areas, the more safety is compromised. Finally, we discuss mitigating factors.

<u>Deferral of Maintenance</u>

As noted in section 3.3.7, poor vessel or equipment condition is a primary cause of fishing casualties. Survival gear must also be constantly maintained. Economic hardship often prevents vessel owners from conducting preventive maintenance, making repairs and replacing or upgrading equipment. Declines in revenue caused by more restrictive management measures will exacerbate these problems.

<u>Distance to Travel</u>

Many of these management measures require vessels to fish outside a 100, 150 or 250-fathom line. In California, this line is relatively close to shore, but in Oregon and Washington it can be a substantial distance out to sea—as much as 40 miles to the 250 fathom line in some places. Some smaller vessels are not equipped to safely travel so far offshore, but may be tempted to do so, because their nearshore fishing opportunities have declined. Even vessels equipped to transit into deeper waters may face difficulties if the weather suddenly changes and they are forced to return to port. Fishing boats are slow, and most operating off the West Coast are relatively small. Longer transits result in longer exposure to harsh weather conditions, especially in the winter. At the same time, urgent weather advisories may provide very little notice of changes in the weather, not allowing enough time for vessels to return to port before the weather deteriorates.

Limiting fisheries to within 20 fm also increases the potential for problems. This limit forces commercial, charter, and recreational fleets to fish in the same waters, increasing the risk of collisions at sea, especially in bad weather. As noted in section 3.3.7, many recreational boaters are less experienced and have less safety equipment than commercial skippers, and are often unfamiliar with bottom contours, wave dynamics, tides, and currents. This combination of vessel density, the inherent risks of navigating shallow waters, and, frequently, inexperience, increases the risks to recreational boaters.

Vessel Stability

Stability is an important factor in vessel safety. Greater depth requirements mean that more gear—such as wire, spools, and supplies—will be needed to fish. Additional topside weight can pose a substantial safety risk, especially in smaller vessels, when crew are not familiar with the importance of weight distribution, in bad weather, or when vessels have not been inspected for stability.

Risk Taking

Increasingly stringent management measures and market forces have reduced fishing revenue for several years. As in all activities, safety during fishing operations is a compromise between competing interests. Decisions regarding safety and risk must weigh weather and ocean conditions, vessel condition and size, crew skill, product quality and marketing considerations, and financial conditions. Business decisions based principally on profit and loss (and possibly influenced by severe economic stress) may override the risk of hazardous weather or seas. At the same time, competition for limited resources may increase the likelihood of taking undue risks.

Crew Skills

Section 3.3.7 describes the difficulties in finding skilled crew. The widely publicized cutbacks in the groundfish fishery are likely to exacerbate this situation, although it is possible a larger labor pool will become available as a result of widespread unemployment. Unskilled or inexperienced crew pose a safety risk, particularly when combined with the other factors described above.

Changing Coast Guard Priorities

The events of September 11, 2001, have led to a reorganization of Coast Guard priorities. At present, only one Coast Guard cutter is available to monitor fishing and recreational vessels off the West Coast, and domestic security needs may redirect the cutter to other activities.

Mitigating Factors

There are several mitigating factors associated with depth-based management. Implementation of an electronic VMS, which will be used to track movement of vessels through and within depth zones, is one such factor. Some VMS transceivers allow constant two-way communication between the vessel and shoreside monitors. If an accident were to occur, the monitor would know immediately. In addition, the Council's Enforcement Consultants have recommended that Coast Guard flyovers and large cutters (when available) monitor the fishing fleet until VMS is implemented.

4.4 Distribution of Landed Catch and Bycatch of Overfished Species Among Sectors

Total catch accountability is a critical element of all the management alternatives analyzed in this EIS. Indirect methods are presently available for monitoring total catch, which is a major source of uncertainty in deciding management specifications and strategies for 2003 groundfish fisheries. Improved data sources and catch accounting methods are anticipated to be available soon. Until then, methods previously approved by the SSC (and other Council advisors) and other strategies designed to minimize the risk of exceeding specified catch limits for overfished groundfish species are analyzed in this EIS and described in this section.

Observer data is anticipated to be available to refine modeled estimates of total catch inseason next year for some portions of the groundfish fishery. However, it is expected that a "critical mass" of observations, that are representative of the true nature of distributed bycatch across all sectors and strata of the West Coast groundfish fishery, won't be available for at least another year. Premature use of existing observer data risks grossly underestimating or overestimating bycatch with consequences to either rebuilding programs for overfished species or near term socioeconomic benefits. If the new NMFS Groundfish Observer Program had been established long enough to establish confidence that bycatch rates implied from direct observation represents true bycatch, a management strategy alternative, where bycatch caps are used to close fisheries inseason, would be considered in this EIS.

The Council and NMFS have reacted to the uncertainty in accounting for total catch of overfished species by adopting increasingly more conservative harvest specifications and management measures. Such conservative measures include specifying reduced harvest levels for overfished groundfish species consistent with rebuilding analyses and draft rebuilding plans, reduced harvest levels for co-occurring species (including very abundant targets such as the various flatfish assemblages), reduced trip and landing limits, increased seasonality and reduced bag limits in recreational groundfish fisheries, and gear restrictions such as small footropes on bottom trawls. New survey programs, and, most importantly, the NMFS Groundfish Observer Program have been implemented in recent years to better inform decision makers of stock and habitat status. Groundfish survey improvements include increasing the frequency and area coverage of shelf and slope trawl surveys, exploration of fixed gear surveys in a cooperative program with commercial fishers, exploration of non-extractive submersible surveys, technological survey gear improvements such as deployment of electronic bottom trawl net mensuration devices, and increased staff resources to improve survey design and analyze results. The Observer Program promises to significantly reduce uncertainty in monitoring total catch and estimating total fishing-related mortality.

However, new, more pessimistic assessments for bocaccio, canary rockfish, darkblotched rockfish, and yelloweye rockfish drive consideration for more risk-averse measures to ensure total fishing-related mortality of these and other overfished groundfish species is reduced to levels that comport with the new science. The Council and its advisors recommend a depth-based management strategy that prohibits some fisheries and fishing gears in the depth zones these species inhabit. This is considered a significantly precautionary strategy and, in effect, establishes (if ultimately adopted) the largest marine reserve in U.S. territorial waters. The *Low OY*, *High OY*, *Allocation Committee* (*with depth restrictions*), and the *Council-preferred* alternatives all consider depth restrictions that vary by area and season. The level of risk to rebuilding overfished species inferred in choosing one of these analyzed alternatives varies by how much of the range each species inhabits is closed to the fishing gears that may catch them next year and the harvest levels for each of these species, as well as co-occurring species and species complexes. This section analyzes the effect of the management measures associated with each of the alternatives, including the *No Action Alternative*, in controlling total fishing-related mortality of overfished groundfish species by fishery sector. This section concludes with an analysis of the cumulative effect of alternative management measures in controlling total fishing-related mortality of overfished groundfish species. Table 4.4-1 summarizes the estimated bycatch of overfished groundfish species by fishery sector under the *Council-preferred Alternative*.

4.4.1 Limited Entry Trawl

The GMT recommends the Hastie (2001) model, updated with the inclusion of fishing depth and vessel length strata, be used to determine total catch implications of considered depth-based management measures as a risk-averse strategy for managing the 2003 limited entry non-whiting trawl fishery. Specific refinements to this trawl bycatch model include the addition of depth-based widow rockfish bycatch data, the addition of depth-based bycatch data for the five species previously modeled, an expansion of the area and depth-based darkblotched rockfish bycatch data south to 38° N latitude, and a trawl vessel length stratification to predict differential participation and effort shifts by vessel size using depth-based restrictions. This model is also considered the best available scientific method for determining the total catch of groundfish species in the limited entry trawl fishery by the SSC. These Council advisors recognize direct observations of bycatch and discard in the trawl fishery would be a superior way to account for total catch; however, they also acknowledge these data are not yet available for use in management. Since the model did not incorporate more recent logbook data than 1999, the effect of the small footrope restrictions on bottom trawling on the shelf are not represented. Use of the model in 2003 may tend to overestimate the bycatch of overfished shelf rockfish species and, in effect, provides a conservative buffer against overfishing. The GMT anticipates the use of observer data for inseason management decisions. The Hastie (2001) trawl bycatch model is anticipated to be refined inseason in 2003 by incorporation of observer data.

The EIS alternatives, other than the *No Action Alternative,* were modeled by the refined trawl bycatch model to project the total catch of bocaccio, canary rockfish, darkblotched rockfish, lingcod, Pacific ocean perch, and widow rockfish in the 2003 limited entry non-whiting trawl fishery. The trawl bycatch implications of alternative management measures for the other overfished groundfish species are inferred using other data sources or addressed qualitatively.

4.4.1.1 Bycatch Implications Under the *No Action Alternative*

Projected total catch of bocaccio and other overfished shelf rockfish species in the 2003 limited entry trawl fishery under the *No Action Alternative* is not supported by the new stock assessments and rebuilding analyses. Small footropes are required when landing shelf rockfish species under the *No Action Alternative*, which would be expected to significantly reduce landings of bocaccio, canary rockfish, yelloweye rockfish, and lingcod. However, large footropes are still technically allowed when targeting flatfish species on the shelf under the *No Action Alternative*; shelf rockfish would not be allowably retained in this case. While it is not believed that large footropes have been frequently deployed on the shelf since the small footrope restrictions were put in place in 2000, there is still greater risk of shelf rockfish bycatch without tighter footrope restrictions. The conservative management standards imposed by the need to eliminate all significant sources of fishing mortality for bocaccio does not conform with the estimated 21 mt of bocaccio bycatch in limited entry commercial groundfish fisheries under the *No Action Alternative* (2002 bocaccio bycatch projected in last year's environmental assessment [EA]). Given how managing for the 100 mt bocaccio OY closed all nearshore trawl opportunities south of Cape Mendocino halfway through the 2002 season (mainly due to a high estimated recreational catch), the trawl landing limits under the *No Action Alternative* (Table 2.1-1), and the lack of depth restrictions are not consistent with new bocaccio harvest constraints. The same is true with respect to managing for the lower coastwide canary rockfish OY. The allowable trawl bycatch harvest guideline of canary rockfish in the trawl fishery under the *No Action Alternative*, given the higher OY of 93 mt, is considerably higher than the 57 mt under the *High OY Alternative* and the most liberal 80% commercial catch sharing scenario (Table 2.1-1). The lack of depth restrictions under the *No Action Alternative*, especially in the other fishery sectors, risks midwater trawl opportunities due to canary rockfish OY attainment. A brief midwater trawl opportunity in period six in 2002 was allowed. It is unlikely such an opportunity could occur with a reduced canary rockfish bycatch OY and no depth restrictions. Bycatch of cowcod and yelloweye rockfish in the trawl fishery under the *No Action Alternative* is not clear. The small footrope restrictions and no cowcod retention specifications under the *No Action Alternative* clearly inhibit targeting of these species, but are not as risk-averse as the depth restrictions and mandatory use of small footrope specifications of the alternatives.

The *No Action Alternative* creates similar problems managing for darkblotched rockfish OY as observed in 2002. The darkblotched rockfish OY of 168 mt was attained by the end of August 2002, and the trawl fishery was closed. An emergency rule to adopt a 250 fm depth restriction for the end of the season was requested by the Council and implemented in October by NMFS to allow trawl opportunities in deeper waters outside the darkblotched rockfish depth zone for DTS species. The bycatch implications of the Hastie trawl bycatch model, coupled with higher than expected darkblotched rockfish landings in ports south of Cape Mendocino, led to this early attainment. The Hastie model did not contemplate darkblotched rockfish catch south of Cape Mendocino. Conservative inseason action was recommended by the GMT on the basis of logbook analysis that denoted the darkblotched rockfish landings in the south originated from catch in the Monterey INPFC area, an analysis of the darkblotched rockfish bycatch implications of target groundfish species landed in the Monterey area in 2002 assuming bycatch rates estimated for the north, and the estimated bycatch in trawl fisheries north of Cape Mendocino. The 2003 management alternatives incorporate consideration for depth-based restrictions that completely limit trawling in the 100 fm to 150 fm depth zone within the range of darkblotched rockfish and seasonally limit trawling in the 50 fm to 100 fm and 150 fm to 250 fm depth zones. These alternatives to the *No Action Alternative* also specify a more southerly slope management line at Point Reyes, California (38° N latitude) to better encompass the latitudinal range of darkblotched rockfish (distribution of highest density; Table 3.2-1). It is noted the overall latitudinal distribution of darkblotched rockfish is north of 33° N latitude. However, the NMFS trawl slope survey and trawl logbooks have not recorded darkblotched rockfish south of Point Reyes and more southerly distributed slope rockfish species such as blackgill rockfish have often been confused with darkblotched rockfish. The *No Action Alternative* darkblotched rockfish harvest level of 168 mt is higher than the *Low OY* (100 mt) and *2001 OY* (130 mt) harvest levels and lower than under the *High OY Alternative*. While the *No Action Alternative* harvest level is also lower than specified under the *Allocation Committee Alternative* or the *Council-preferred Alternative*, the harvest rates are lower under these alternatives. The projected darkblotched rockfish biomass in 2003, under interim rebuilding plans adopted by the Council, is higher leading to higher OYs. The projected darkblotched rockfish OY in 2003 under the same harvest rate assumed in the *No Action Alternative* would be 184 mt.

The POP OY under the *No Action Alternative* (350 mt) is not anticipated to be attained in 2003 given any of the measures designed to stay within alternative harvest levels contemplated for darkblotched rockfish. For that matter, none of the alternative OYs considered for POP in 2003 are expected to be attained for the same reason.

The conservative harvest level for Pacific whiting under the *No Action Alternative* limits harvest of this species in 2003 to the same 129,600 mt OY specified for 2002 fisheries. Given that Pacific whiting biomass is projected to have increased in 2003, due to the estimated strength and predicted recruitment of the 1999 year class, specifying the *No Action Alternative* harvest in 2003 implies specification of a more conservative harvest rate than used in 2002 management. This constraint would likely shorten the 2003 whiting season and reduce the bycatch of other overfished groundfish species, most notably widow rockfish, in this trawl fishery sector.

The widow rockfish OY of 856 mt under the *No Action Alternative* is higher than under all the other considered alternatives except *High OY Alternative*, which specifies a lower rebuilding probability (50% probability of rebuilding within T_{MAX}); and therefore, a higher harvest rate. It is difficult to anticipate whether it is more likely that widow rockfish OY will be attained under the *No Action Alternative* without depth restrictions or under 2003 management alternatives with depth restrictions. Midwater trawl opportunities, where widow rockfish bycatch is most likely to occur, are highly dependent on the availability of canary rockfish. Although the canary rockfish OY under the *No Action Alternative* is significantly higher than under other alternatives, depth restrictions should reduce bycatch of canary rockfish.

4.4.1.2 Bycatch Implications Under the *Low OY Alternative*

The *Low OY Alternative* projects the lowest bycatch of all the overfished groundfish species and is the only alternative to meet the zero fishing mortality standard for bocaccio. This is accomplished by only allowing trawl fishing in depths outside a line approximating the 250 fm contour south of Cape Mendocino. The estimated impacts on bocaccio, canary rockfish, darkblotched rockfish, POP, and widow rockfish are estimated by the Hastie trawl bycatch model. The estimated bycatch of these species is well under their OYs under the *Low OY Alternative*, thus providing a buffer to management uncertainty, especially for the most constraining species (bocaccio, canary rockfish, and darkblotched rockfish). The *Low OY Alternative* harvest level for Pacific whiting is directly managed in the target trawl whiting fishery with a small set-aside to accommodate whiting bycatch in other sectors. The bycatch implications for the other overfished groundfish species resulting from the conservative depth restrictions under the *Low OY Alternative* can be inferred from the highest density depth distributions of these species (Table 3.2-1).

4.4.1.3 Bycatch Implications Under the *High OY Alternative*

The *High OY Alternative* liberalizes the non-whiting trawl depth restrictions more than the other alternatives and, consequently, is modeled to have the highest bycatch of overfished groundfish species. This is especially true north of Cape Mendocino where constraints imposed by the need to rebuild canary rockfish, darkblotched rockfish, and yelloweye rockfish are relaxed relative to all alternatives other than the *No Action Alternative* and *Allocation Committee Alternative (no depth restrictions)*. Coastwide canary rockfish bycatch under the *High OY Alternative* is projected to be 11 mt. This level of total catch is predicted by mandating small footrope trawls inside the specified 100 fm line and prescribing a more conservative 75 fm shallow line during July and August when canary rockfish are found in shallower depths. These restrictions also predict a total lingcod trawl catch of 81 mt.

A darkblotched rockfish bycatch of 146 mt is projected coastwide under the *High OY Alternative*. Some protection is still afforded for darkblotched rockfish and other species found on the shelf/slope interface by restricting trawling in the 100 fm to 150 fm depth zone in all areas north of Point Reyes. Relative to the other alternatives with depth restrictions, more opportunity is allowed in the 150 fm to 250 fm depth zone. This results in the highest bycatch of darkblotched rockfish and POP (141 mt) for all alternatives other than the *No Action Alternative*.

Higher harvest of widow rockfish and Pacific whiting is attained under *High OY Alternative* due to the higher harvest levels for both species and less of a bycatch constraint from canary rockfish relative to other 2003 alternatives. The *High OY Alternative* harvest level for Pacific whiting assumes the same harvest rate as the *No Action Alternative* and the *Low OY Alternative*, but applies this harvest rate to the projected estimated abundance of the exploitable whiting biomass in 2003, not 2002.

4.4.1.4 Bycatch Implications Under *Allocation Committee Alternative*

Table 2.1-11 depicts the projected bycatch of bocaccio, canary rockfish, darkblotched rockfish, lingcod, POP, and widow rockfish under the *Allocation Committee Alternative* with and without depth restrictions. In these scenarios, the harvest levels specified by the Council's Ad Hoc Allocation Committee are intermediate to those specified in *Low OY Alternative* and *High OY Alternative* and catch sharing of the non-tribal, consumptive harvest of canary rockfish is 50% commercial and 50% recreational. The effect of depth restrictions is evident when comparing the projected harvest of target species in the non-whiting trawl fishery and the projected bycatch of the modeled species when holding canary rockfish bycatch limits constant (Table 2.1-11). Restricting the depth zones where trawling can occur allows greater access to target species while reducing bycatch of overfished groundfish species. The two-month landing limits allowed under *Allocation Committee OY Alternative* probably could not be supported without depth restrictions given the high projected bycatch of 14 mt of bocaccio (compares to 3 mt with depth restrictions). Higher bycatch of darkblotched rockfish and POP is also projected under the *Allocation Committee Alternative* without depth restrictions.

4.4.1.5 Bycatch Implications Under the *Council-preferred Alternative*

The *Council-preferred Alternative* specifies the same harvest levels for overfished species as the *Allocation Committee Alternative*, but significantly more conservative management measures to reduce the risk of overfishing these species of concern. Trawling south of Cape Mendocino will be prohibited in the 60 fm to 250 fm depth zone year-round with a more conservative restriction (50 fm shallow line) in January and February when bycatch rates are estimated to be higher. This is estimated to result in a trawl bycatch of 1.5 mt of bocaccio, or about half the bycatch under *Allocation Committee Alternative* with depth restrictions. This is, because the fishery is allowed in the 150 fm to 250 fm zone during periods 1,2, 5, and 6 under the *Allocation Committee Alternative* in order to access abundant petrale sole in the winter. The Council specification is a year-round restriction of deeper water trawl opportunity to outside 250 fm with a more liberalized line specification during periods 1 and 6 north of Point Reyes that incorporates some important petrale sole fishing grounds. One condition of the liberalized 250 fm management line under *Council-preferred Alternative* is that it cannot be incorporate any depths less than 150 fm in any area north of Point Reyes. Bycatch under this alternative is therefore modeled specifying a 150 fm line during periods 1 and 6, which is a more liberal scenario than the actual specification. Allowing the nearshore trawl fishery to fish with small footropes to depths of 60 fm allows access to some important species (e.g., nearshore flatfish, Pacific sanddabs) without a significant bycatch of bocaccio (compare the doubled bocaccio bycatch under *Allocation Committee Alternative* with a year-round 50 fm shallow line depth restriction).

The projected coastwide catch of 13 mt of canary rockfish in the 2003 limited entry trawl fishery is 1 mt higher than under *Allocation Committee Alternative*, which specifies a 50:50 commercial:recreational fishery catch sharing. The canary rockfish harvest rate and rebuilding specifications under *Council-preferred Alternative* are the same as under *Allocation Committee Alternative* (Table 4.2-1), but the catch sharing is slightly higher than 50% for the commercial sectors to justify a slightly higher total catch OY of 44 mt.

The almost complete prohibition of trawling in the depth zone where the highest densities of darkblotched rockfish and other slope rockfish species are found (except for the open petrale sole grounds inside 250 fm during periods 1 and 6) projects a lower bycatch of darkblotched rockfish (87 mt) and POP (98 mt) than even the most conservative specifications under the *Low OY Alternative*.

The Pacific whiting harvest level under the *Council-preferred Alternative* (148,200 mt) is the same as for *Allocation Committee*, and intermediate to allowable harvest under the *No Action Alternative* and *Low OY Alternatives* (129,600 mt) and the *High OY Alternative* (173,600 mt). However, the whiting harvest rate under *Council OY* ($F_{45\%}$ with the 40-10 adjustment) is more conservative than under the other alternatives where the default harvest rate is applied. The lower whiting harvest alternatives, while applying a higher harvest rate, assume the exploitable abundance estimated in 2002, not 2003. The projected bycatch of widow rockfish under *Council OY* is intermediate to that projected for the other alternatives, primarily due to the intermediate amount of opportunity to target whiting.

It is assumed the trawl bycatch of other overfished groundfish species under *Council OY* not projected in the trawl bycatch model would be intermediate to the bycatch implied for other trawl alternatives based on the relative amount of trawl opportunity in the depth zones these species inhabit.

4.4.2 Limited Entry Fixed Gear

Without a comparably informative bycatch model for the fixed gear fisheries (including both the limited entry and open access sectors), there is much greater uncertainty estimating bycatch in these fisheries. These risk of overfishing the overfished groundfish species due to this uncertainty is mitigated by restricting fixed gear fisheries outside the depth zones where the highest densities of vulnerable overfished groundfish species reside. As mentioned in section 3.4, bocaccio, canary rockfish, cowcod, lingcod, and yelloweye rockfish are the most vulnerable overfished species to directed line fisheries. Therefore, all the management alternatives except the *No Action Alternative* consider depth-based restrictions for limited entry fixed gear fisheries to reduce bycatch of these species.

Yelloweye rockfish catch is a particular concern given their high market value, sedentary life style, and vulnerability to baited longlines. The GMT recommended prohibiting retention of yelloweye rockfish in 2003 fixed gear fisheries and restricting most of these fisheries to outside the 100 fm management line. No retention regulations were considered important by the GMT, because they believed even small landing limits for yelloweye rockfish in the fixed gear sectors would provide an incentive to target. The same logic led to the GMT recommendation to also prohibit retention of bocaccio, canary rockfish, and cowcod in fixed gear fisheries. The recommendation to prohibit fixed gears in waters shallower than 100 fm (except for the opportunities in the very nearshore areas (see section 4.5.2) was based on the results of the IPHC Halibut longline survey where 99.1% of the yelloweye rockfish were caught inside 100 fm (Table 4.2.-3).

The *No Action Alternative* management measures that specify higher total catch OYs for canary rockfish and bocaccio do not incorporate depth restrictions. Retention of canary rockfish, cowcod, and yelloweye rockfish is prohibited under this alternative. Therefore, inferring the bycatch of these species from landings in fixed gear fisheries is problematic, and impossible for yelloweye rockfish, which was managed as part of the minor *Sebastes* complex prior to 2002. The logic of depth-based restrictions as the only risk-averse strategy available for reducing overfished rockfish species bycatch in fixed gear fisheries leads to the conclusion that *No Action Alternative* management measures would not succeed in adequately restricting bycatch. The *No Action Alternative*, as mentioned before, also specifies higher OYs for these species of concern than the best available science can support.

Managing for the *Low OY Alternative* harvest levels requires a greater degree of conservatism than any of the other considered alternatives. Fixed gear fisheries south of Cape Mendocino would be restricted to waters deeper than the specified 150 fm line to avoid any bycatch of bocaccio. This action would preclude accessing any of the nearshore species and effectively eliminate the live-fish groundfish fishery in California south of Cape Mendocino. It would also provide significantly greater protection to cowcod, canary rockfish, and yelloweye rockfish in this area. Predicted fixed gear impacts in the north under the *Low OY Alternative* would also force fixed gear fisheries outside of 150 fm, mainly to reduce yelloweye rockfish bycatch to negligible amounts. Non-retention of canary rockfish and yelloweye rockfish under this alternative would deter targeting, but may not avoid bycatch to the degree needed to stay within OYs without this depth restriction. Although restricting the fishery to waters deeper than 150 fm is judged to adequately reduce bycatch of these species, according to the depth distribution of yelloweye rockfish bycatch in the IPHC halibut survey (yelloweye rockfish ranges deeper than the other three species of concern), it should be noted the depth range of highest density for yelloweye rockfish extends out to 220 fm (Table 3.2-1). Managing for a total catch OY of only 2.1 mt may require a more conservative restriction of 250 fm under this alternative.

The *High OY*, *Allocation Committee (with depth restrictions)*, and *Council-preferred* alternatives all specify no fixed gear opportunities (with one exception under *Council OY*) in the 20 fm to 150 fm zone south of Cape Mendocino (CRCA) to minimize bocaccio bycatch. The *Council OY* exception of allowing commercial line gear with no more than five hooks (number 2 or smaller) and up to five lbs of weight if the gear is closely attended is designed to allow some risk-averse target opportunities to catch Pacific sanddabs. The smaller hooks and the horizontal groundlines used in this fishery significantly reduce bocaccio impacts. Of the fixed line gears used on the West Coast south of Cape Mendocino, vertical longlines are more apt to catch bocaccio and horizontal longlines much less so. Unlike the *Low OY Alternative*, some nearshore opportunity exists under these alternatives. The estimated bocaccio impact for limited entry fixed gear fisheries under these alternatives is 0.1 mt (Table 4.4-1). Without these depth restrictions, only the nearshore areas shallower than 20 fm would be open to fixed gears. The bocaccio impact would be minimal under this alternative (*Allocation Committee* without depth restrictions), but sablefish and other important target species other than nearshore rockfish would be inaccessible.

The *High OY*, *Allocation Committee* (with depth restrictions), and *Council-preferred Alternative* all specify no fixed gear opportunities in the 27-100 fm zone north of Cape Mendocino in California and Oregon and restricts the fishery to outside of 100 fm in waters off Washington to minimize canary rockfish and yelloweye rockfish bycatch. The estimated total catch of canary rockfish and yelloweye rockfish in the limited entry fixed gear fishery under these alternatives is 1.0 mt of each species (Table 4.4-1). Without the depth restrictions, as modeled in the *Allocation Committee Alternative*, the fishery would be restricted to the nearshore 0 fm to 27 fm zone in Northern California and Oregon. Fixed gear fisheries would be eliminated in Washington without depth restrictions since Washington does not allow commercial groundfish fisheries in their coastal marine waters.

4.4.3 Directed Open Access

Open access fisheries that target federally-managed groundfish are subject to the same limitations under each of the alternatives and are estimated to have the same effect on bycatch of overfished groundfish species as the limited entry fixed gear fishery. The estimated coastwide bycatch by direct open access fisheries in 2003 under the *High OY*, *Allocation Committee* (with depth restrictions), and *Council-preferred* alternatives are depicted in Table 4.4-1. With the limitations described for these alternatives in the previous limited entry fixed gear section, the bycatch of bocaccio south of Cape Mendocino is estimated to be 0.2 mt, coastwide canary rockfish bycatch is 0.3 mt, and coastwide yelloweye rockfish bycatch is 0.5 mt.

4.4.4 Incidental Open Access

The projected bycatch of overfished groundfish species in 2003 incidental open access fisheries differs by fishery and area. Table 4.4-1 depicts the estimated coastwide bycatch by incidental open access fisheries in 2003 under the *High OY*, *Allocation Committee* (with depth restrictions), and *Council-preferred* alternatives.

Dungeness Crab: The commercial Dungeness crab fishery uses trap gear that typically does not catch shelf rockfish species. Crab trap specifications require escape ports and destruct openings to allow finfish bycatch to escape if they are caught. Only trace amounts (<0.01 mt) of overfished groundfish species are projected to be caught under the alternatives (including the *No Action Alternative*). The Council recommends no special groundfish restrictions for this fishery. Under the *Low OY Alternative*, where trace amounts of bocaccio or yelloweye rockfish may not be tolerated, some area closures may be contemplated for this fishery.

Gillnet Complex: Gillnets are a gear with a demonstrated bycatch of groundfish. The gillnet complex fishery primarily occurs in waters off California where bocaccio bycatch is a major concern. One of the specifications of the *Council-preferred Alternative* is to prohibit set gill and trammel nets with mesh sizes less than six inches within the CRCA. Allowed net gears, including the large mesh drift gillnets used in this fishery, are projected to catch about 0.5 mt of bocaccio next year under the *High OY Alternative*, *Allocation Committee*, and *Council-preferred* alternatives (Table 4.4-1). Bycatch for the other overfished groundfish species in this fishery is uncertain since bycatch has been unreported. PacFIN estimates have only been for aggregated groundfish species. These catches have been infrequent with only a few vessels landing any amount of groundfish species.

Pacific Halibut: The bycatch implications of the commercial Pacific halibut fishery can be inferred from the same data sources discussed in the directed groundfish fixed gear fisheries north of Cape Mendocino. There is a strong correlation between directed line fisheries that target Pacific halibut (both commercial and recreational) and bycatch of yelloweye rockfish. Therefore, using the IPHC halibut survey data to infer the depth-based yelloweye rockfish bycatch implications provides the basis for the *Council-preferred Alternative* specification that restricts this fishery to waters outside 100 fm. This same specification is part of the *Allocation Committee Alternative* (with depth restrictions) and *High OY Alternative*. These alternatives are estimated to incur a bycatch of about 0.5 mt of yelloweye rockfish in 2003 (Table 4.4-1). Under *Allocation Committee Alternative* without depth restrictions, the Pacific halibut fishery would risk too high a bycatch of yelloweye rockfish and probably could not be condoned. Under the *Low OY Alternative*, the fishery would have to be tightly regulated to areas where halibut are known to be caught without a corresponding bycatch of yelloweye rockfish. The halibut “hotspot” areas proposed for Washington recreational halibut fisheries under the *Low OY Alternative* may be a good example (Table 4.2-5). Otherwise, the fishery would have to be restricted to waters deeper than 150 fm which would dramatically reduce halibut opportunities.

Salmon Troll: Groundfish catch data were collected in a study of troll gear encounter rates for coho and chinook salmon (Lawson 1990) (see section 4.2.2.1). With four spreads (the current configuration in Oregon south of Cape Falcon), catch rate reductions associated with alternatives that require a 4 fm distance between the cannonball and the lower most spread would be: 95% for canary rockfish, 0% for yelloweye rockfish (only two were caught), and 89% for lingcod (Figure 4.2-4).

Alternatives that prohibit fishing outside 25 fm in Washington Marine Catch Areas 3 and 4 would eliminate almost all of the productive commercial salmon fishing waters in those areas, and the fleet would be displaced to other area or other fisheries. Approximately 48% of the yelloweye rockfish catch (0.05 mt), 15% of the widow rockfish catch (0.02 mt), and 10% of the canary rockfish catch (0.08 mt) in salmon troll fisheries coastwide occurred in those areas in 2001(Table 4.2-4). In the areas north of Cape Falcon, 100% of the yelloweye rockfish and widow rockfish, and 64% of the canary rockfish landings occurred in those areas.

Sea Cucumber: Observations of the total catch in the sea cucumber trawl fishery south of Cape Mendocino indicate a very low bycatch of bocaccio (trace amounts = <0.01 mt) and other overfished groundfish species. Under the *Low OY Alternative*, where no bycatch of bocaccio could occur, the fishery would be restricted to depths greater than 150 fm. This would seriously impact this fishery which primarily occurs in the 20 fm to 150 fm zone (Table 3.4-7). Under the *Council-preferred Alternative*, *Allocation Committee Alternative* (with depth restrictions), and *High OY*, and the *No Action OY Alternatives*, the fishery could occur, since the bocaccio bycatch is negligible. The *Council-preferred* and *Allocation Committee* alternatives add a further precaution of only allowing small footrope trawls targeting sea cucumber inside 50 fm north of Point Conception and inside 100 fm along the mainland coast (not including the Cowcod Conservation Areas) south of Point Conception. The GMT estimated these measures would result in a zero bycatch of bocaccio and other overfished groundfish species (Table 4.4-1).

Spot Prawn: Trap and trawl gears that target spot prawn exhibit differential bycatch rates; trawls are much more prone to catch overfished groundfish species (Table 3.4-9). However, with the zero tolerance for any bocaccio bycatch in the south under the *Low OY Alternative*, both gear types would be restricted to depths outside the bocaccio range. The same would be true for the *Allocation Committee Alternative* without depth restrictions since California does not allow trawls in state waters. Under the *High OY*, *Allocation Committee* (with depth restrictions) and *Council-preferred* alternatives, traps would be allowed within the CRCA but trawls would not. California revealed plans to either eliminate spot prawn trawls, convert the gear endorsements to trap only, or restrict spot prawn trawls to waters deeper than 150 fm. Despite the fact that spot prawn trawls are rare north of Cape Mendocino, Oregon plans to eliminate spot prawn trawls soon and Washington has already done so.

4.4.5 Recreational Fisheries

South of Cape Mendocino

Recreational fisheries south of Cape Mendocino face considerable restriction by the need to avoid bocaccio impacts. Opportunities to fish in traditional areas on the shelf are severely limited under all the 2003 alternatives. The *No Action Alternative*, which has some depth and seasonal restrictions (Table 2.1-3), does not conform to the latest science for bocaccio. Limiting fishing mortality to as close to zero as feasible, or to zero under the *Low OY Alternative*, is impossible under the *No Action Alternative*, given the recreational fishery has alone exceeded the total allowable harvest of bocaccio every year since 1999 (Table 3.4-3). The recreational fishery in 2002 could not be sustained with the management measures adopted for the fishery and had to be restricted to waters shallower than 20 fm halfway through the year when the total catch OY was again exceeded by this fishery alone. Bycatch of juvenile bocaccio that are not well represented in the most current stock assessment is apparently, the culprit in these higher recent harvests.

The *Low OY Alternative* would effectively end the recreational groundfish fishery in the south since the harvest rate on bocaccio would be set to zero. While other recreational fishing activities may be supportable in southern waters, these may be limited by the fact that bocaccio are not exclusively caught on the bottom or over hard substrate. They can be caught higher in the water column than some rockfish species. There may be areas where bocaccio can be successfully avoided by hook-and-line gear in waters shallower than 150 fm, but such geo-specific information is not currently available to critically analyze. Therefore, no exceptions are included to a prohibition to recreational fishing in any waters shallower than 150 fm south of Cape Mendocino, including nearshore waters shallower than 20 fm, under the *Low OY Alternative*. The *Allocation Committee Alternative* without depth restrictions has similar measures except there is some allowable incidental harvest of bocaccio and the ability to consider recreational fishing opportunities inside 20 fm (the nearshore line is considered a routine management measure).

The *High OY*, *Allocation Committee* (with depth restrictions), and the *Council-preferred* alternatives all allow some bocaccio mortality to avoid dire socioeconomic impacts to the fishery. However, the bocaccio mortality standards are still quite severe under these alternatives forcing the fishery to waters inside 20 fm along the coast. The *Council-preferred Alternative* considers some exceptions to the CRCA gear restrictions for the recreational fishery. Most notably, some opportunity to fish for California scorpionfish on Huntington Flats in waters 20 fm to 50 fm south of Point Fermin to the Newport south jetty during July and August is allowed. Other gear restrictions for nongroundfish recreational fisheries are prescribed in the CRCA under the preferred alternative (see section 2.2.5).

North of Cape Mendocino

The 2003 alternatives limit recreational fisheries relative to the *No Action Alternative* by the need to reduce fishing-related mortality for canary rockfish and yelloweye rockfish. The *No Action Alternative* allows a significantly higher harvest of canary rockfish, a species that is both targeted and incidentally caught in coastwide recreational fisheries. The total catch of yelloweye rockfish under the *No Action Alternative* is not clearly known since no retention regulations were in place for the species in 2002. While this was considered a risk-averse management measure designed to eliminate targeting of the species, it does result in reducing the ability to monitor fishing effects.

Under the *Low OY Alternative*, recreational fisheries would be subject to the same nearshore depth restrictions as contemplated in the south by the need to protect yelloweye rockfish. Fisheries would be restricted to depths shallower than 27 fm in Northern California and Oregon and inside 25 fm in Washington. Limited opportunity for other fisheries, such as the Washington recreational halibut fishery, could occur outside this depth zone under very restrictive conditions. These conditions and how they are derived for the *Low OY Alternative* are described as follows.

In the past, the yelloweye rockfish catch in the coastal recreational fishery off Washington has been significant (approximately 15 mt in 2001). The majority of the yelloweye rockfish is caught in the recreational halibut fishery, which opens on May 1 off the coast. Information from fishers suggests the yelloweye rockfish catch is not incidental to the halibut, but, rather, fishers target known yelloweye rockfish areas after they have caught their halibut.

In an effort to reduce the yelloweye rockfish harvest, the Council and the WDFW approved regulations that prohibited the retention of yelloweye rockfish in the Washington coastal recreational fishery in 2002. Through July 2002, based on portside angler interviews, the estimated catch of yelloweye rockfish in the recreational fishery is 2 mt. Again, the majority of the yelloweye rockfish catch occurred in the May/June halibut fishery.

Based on the 2001 stock assessment, the draft rebuilding analysis for yelloweye rockfish indicated that an appropriate OY would be between 2.1 mt and 3.9 mt for 2003; however, because a subsequent assessment is scheduled to be completed this summer, the Council also approved the *No Action OY Alternative*(13.5 mt) to be considered. In order to meet the lower end of the OY range for yelloweye rockfish, while providing access to halibut areas, WDFW proposed measures for its recreational and commercial groundfish fisheries that would significantly reduce the yelloweye rockfish harvest. The proposed measures include opening halibut "hotspots" only for the recreational halibut fishery. These "hotspots" would be relatively small areas (one to two square miles) that are known to have halibut, but which have little to no yelloweye rockfish.

WDFW held three public meetings to solicit input from charter boat operators and private anglers who have participated in the coastal halibut and groundfish fisheries on the location of these halibut "hotspots." Local recreational fishing interests provided latitude/longitude coordinates to WDFW staff. For the North Coast (Neah Bay/La Push) area, there are five "hotspots", being proposed; the south coast (Westport) is proposing four "hotspots" and the Columbia River area has one larger "hotspot" that encompasses their primary halibut areas (Table 4.2-5).

Under the *High OY*, *Allocation Committee* and *Council-preferred* alternatives, canary rockfish and yelloweye rockfish harvest is not as constrained, allowing greater fishing opportunities on the shelf. The no retention regulations would still be imposed on yelloweye rockfish in recreational fisheries, but a sublimit of one canary rockfish in the daily bag would be allowed in the north. This accommodates unavoidable bycatch and reduces the number of canary rockfish that are discarded dead. In the Council's judgement, this would not promote targeting of the species. A similar measure allowing some retention of yelloweye rockfish in Washington was not considered risk-averse in Washington, but was considered reasonable in Northern California and Oregon. Since the greater biomass of yelloweye rockfish exist in waters off Washington, it may make sense to have more restrictive measures in place in there. The Council and WDFW will also establish a Yelloweye Rockfish Conservation Area (YRCA) in waters off Washington under the *Council-preferred Alternative* that is, in effect, a marine reserve restricting recreational groundfish and halibut fishing starting in 2003 (Table 4.4-2). The Council revised the bounds of the YRCA at its November meeting upon the recommendation of the WDFW. The revised area is larger than the one initially considered and is described by latitude and longitude coordinates in REVISED Table 4.4-2. These alternatives all consider an inseason management measure that restricts recreational fisheries inside the shallow depth lines if the canary rockfish or yelloweye rockfish harvest guidelines are projected to be exceeded.

4.4.6 Tribal Fisheries

The tribal fishery will operate under the *No Action Alternative* management measures in place for 2002. Expected groundfish impacts are depicted in Table 4.3-13.

4.4.7 Other Nongroundfish Fisheries

CPS and *HMS*: No special groundfish regulations are proposed for CPS fisheries based on the minimal bycatch of groundfish species under *Council OY*.

4.4.8 Cumulative Fishing-Related Mortality

Table 4.4-1 depicts the cumulative fishing related mortality from all direct and indirect sources including fisheries, EFPs, and research under the *Council-preferred Alternative*.

4.5 Impacts to the Management Regime

4.5.1 Enforcement Impacts

Separate rule making currently underway will implement a Vessel Monitoring System (VMS) as part of a new West Coast groundfish fishery monitoring and enforcement program. This additional enforcement tool remotely tracks vessels using satellites and transponders. NMFS, in consultation with the Council and the Ad Hoc VMS Committee, is preparing a proposed rule and an associated Environmental Assessment/ Regulatory Impact Statement/ Initial Regulatory Flexibility Analysis for a pilot VMS program for 2003. This environmental assessment provides a description of the range of fishery monitoring alternatives considered, including their associated costs, as well as an analysis of their impacts. Publication of the final rule in the *Federal Register* is anticipated in the summer of 2003.

Quantitative analyses of the environmental impacts associated with enforcement under the management measure alternatives is not possible at this time. To date, groundfish management has been mainly structured the regulation of the amount of landed fish, based on cumulative trip limits. This type of measure has the advantage that monitoring and enforcement can be shore-based because limits are based on landings. This approach is problematic because bycatch cannot be directly monitored in the same way. As OYs are reduced and landing limits must be lowered correspondingly, bycatch becomes a bigger issue. Depth-based closed areas are proposed in four of the action alternatives as a way to reduce bycatch by keeping vessels out of areas where species of concern—overfished species—occur. However, this change in the management regime introduces a new set of enforcement issues because compliance must occur at sea, requiring different monitoring and enforcement methods. Obviously, the efficacy of management measures hinges on the degree to which fishers comply with them. Environmental impacts associated with enforcement therefore mainly result from the degree to which catch levels are exceeded because of noncompliance, and crucially, the degree to which these catches (or bycatch) remains unmonitored or under-reported. While recognizing that most fishers comply with the rules, the overall level of compliance is influenced by the tradeoff between risk and reward. Fisheries enforcement generally seeks to deter fishers from violating the rules through severe penalties because the cost of constant and comprehensive monitoring using conventional means is high. This strategy relies on a sufficient level of monitoring and enforcement so that the tradeoff between the risk of being caught and severely penalized and the benefits from harvesting fish illegally is tipped in favor of compliance for the great majority of fishers.

Alternatives may be divided into two categories based on the use of new, more extensive closed areas. The *No Action Alternative* and *Allocation Committee Alternative* without depth restrictions do not employ these closed areas while the remaining alternatives, including the *Council-preferred Alternative* do. If new closed areas are not used, impacts stemming from noncompliance would not be expected to differ from the level of impact (noncompliance) experienced in past years. It should be noted that trip limits under the *Allocation Committee Alternative* without depth restrictions are substantially lower. Although this may increase the level of bycatch, it should not affect compliance since landed catch is effectively monitored.

The *Low OY* and *High OY* alternatives, *Allocation Committee Alternative* with depth restrictions, and *Council-preferred Alternative* employ closed areas varying in size and configuration. Although these differences may affect enforcement ability, it is not possible to determine what these differences might be. For example, the *Low OY Alternative* would implement a large closed area. Its size could make enforcement more difficult because of the large area that would have to be monitored. On the other hand, the fact that in most areas it would stretch from shore to an outer boundary could simplify enforcement because it would be easier to determine when vessels were inside the closed area.

The existing methods of patrolling sea areas either by airplane or ship (carried out primarily by the Coast Guard, although state agencies have some capacity in this regard), and using fishery observers to monitor vessel position can be used to monitor and enforce closed areas. In fact, until VMS is implemented these will be the available methods. However, VMS is a superior enforcement technology because the position of vessels with transmitting units can be tracked at all times. Because violations can be relatively easily determined, VMS would also serve as an effective deterrent for participating vessels.

For the alternatives employing closed areas, the risk of exceeding OYs due to noncompliance would be greater if VMS is not used because total catch estimates would have to be based on landing data and bycatch estimates with assumptions about fishing effort in open areas. Enforcement relying on monitoring by airplanes and ships to identify incursions into the closed areas would not be as effective as VMS. A lot of time would have to be spent investigating any vessel appearing on enforcement vessel's radar, whether or not they are legitimately fishing in an area or not. This would reduce the ability of enforcement vessels to cover a large proportion of the closed area in a timely manner, reducing total monitoring and deterrence.

The risk of exceeding OYs would be less if VMS were implemented under any of these alternatives. One of the major benefits of VMS is its deterrent effect. If fishers know they are being monitored, and that a credible enforcement action will result, they are less likely to fish illegally in closed areas. In addition, the data collected with a VMS system can be used to better understand the distribution of fishing effort, which is likely to be affected by closed areas.

4.5.2 State-Managed Fishery Impacts

4.5.2.1 Nearshore Fishery Impacts South of Cape Mendocino

One of the consequences of limiting shelf fishing opportunities south of Cape Mendocino in 2003 is a significant commercial and recreational effort shift to nearshore areas. The southern nearshore fishery therefore, needs to be restructured in 2003 in order to prevent over-harvesting of 14 nearshore rockfish species (including California scorpionfish) that are found primarily inside 20 fm. This issue was considered by the Council, because it is expected a significant amount of fishing effort previously directed outside 20 fm will be redirected to the fishery inside 20 fm, and because the preferred depth range of some nearshore rockfish species during winter and spring months does not match the adopted <20 fm fishing opportunity.

For 2002, the southern nearshore rockfish OY was set at 662 metric tons (mt), which included an expected recreational catch of 532 mt. The *Allocation Committee* and *Council-preferred* alternatives' strategy is to divide the nearshore rockfish OY into three separate harvest guideline (HG) components:

- A shallow HG group composed of kelp, grass, black-and-yellow, China, and gopher rockfishes. This subset of nearshore species also forms the rockfish basis of the California nearshore live-fish fishery, and the commercial fishery for these rockfish species (along with California scorpionfish, cabezon, greenlings, and California sheephead) is restricted by a nearshore finfish permit required by the State of California.
- A deeper nearshore rockfish HG group composed of treefish, olive, brown, copper, quillback, calico, black, and blue rockfish.
- California scorpionfish is managed as a single-species HG.

The GMT has recommended a precautionary reduction of the nearshore rockfish OY to avoid overfishing nearshore species. The needs of the California recreational and open access live-fish fishery also predicated the need for a commmercial:recreational allocation. Table 4.5-1 shows allocation scenarios for three different groups of southern nearshore rockfish: shallow nearshore (species that are completely distributed inside 20 fm), scorpionfish (distributed shallower and deeper than 20 fm), and deeper nearshore rockfish (distributed shallower and deeper than 20 fm). Instead of managing for the current OY, the precautionary principle was applied by cutting the OY in half. A slightly different base period was used than in the past when the nearshore rockfish OY was originally determined. Calculating the proportion of catch occurring within 20 fm more accurately reflects the distribution of nearshore species. The result is an aggregate 1,082 mt average landing. The precautionary half OY is 541 mt. Table 4.5-2 shows the proportion of the recreational catch of overfished shelf rockfish species that occurred in depths shallower and deeper than 20 fm. Applying this catch proportion within 20 fm to the aggregate catch reduces the OY to 451.7 mt. Commercial and recreational catch shares, as per those adopted by the Council for analysis in June, were applied to this OY to generate the scenarios depicted in Table 4.5-1. The Ad Hoc Allocation Committee discussed the implications of anticipated effort shifts to nearshore areas south of Cape Mendocino in an effort to avoid bocaccio. They recommended Scenario #1B where the overall southern nearshore OY of 452 mt is allocated 20% to the commercial fishery and 80% to the recreational fishery.

The nearshore HGs for the three management groups were based on the “data poor” approach of using average recent landings as a proxy for ABC and then applying a precautionary adjustment of 50% to determine the proxy OY. Annual landings during 1994 through 1999 were selected, because it represents the most recent period when rockfish trip limits were not constraining for the nearshore fishery. Rockfish management OY’s after 1999 have been based on the 50% precautionary adjustment. Hence, it is not appropriate to include 2000 and later landings in current calculations, because that would further reduce the OY by an additional 50%. Years prior to 1994 were not used in the current analysis, because of uncertainty in “unspecified rockfish” and other aggregate market categories, and also, because RecFIN estimates were not available for 1990-92.

During the six-year period of the analysis, average annual nearshore landings were 1081.6 mt, one-half of which is 540.8 mt (below). This may be considered as a recalculated southern nearshore rockfish OY, unadjusted for those nearshore stock distributions that are predominately deeper than 20 fm. The recalculated 2003 OY does not exactly match the 2002 OY, because different time periods were used in the two analyses, and because the 2003 analysis more carefully decomposed the “unspecified rockfish”, “group bolina,” “group blue-black,” and “group gopher” market categories into their species components.

Southern *Sebastes* Nearshore Rockfish
Mean Annual Landings (mt), 1994-1999

	Mean	Mean x 0.5
Shallow Nearshore Rockfishes (w/o CA Scorpionfish)	209.6	104.8
CA Scorpionfish	169.8	84.9
Deeper Nearshore Rockfishes	702.2	351.1
Total	1081.6	540.8

Since some of the deeper nearshore rockfishes tend to be found largely outside of 20 fm during winter and spring months (i.e., copper, quillback, and calico rockfishes), it was determined necessary to concentrate fishing opportunities during summer and autumn months, when the deeper nearshore stocks typically undergo an inshore migration. In this way, nearshore fishing opportunities are focused during months when the stocks tend to be fully available within 20 fm. This approach matches fishing opportunities with the depth distribution of the resource, avoids over harvest of other deeper nearshore (i.e., non-permit) species that have a more shallow depth distribution (such as olive rockfish and treefish), and addresses concerns the proposed 20 fm restriction could increase the potential for localized depletion of those species with a preference for shallow habitat. These specifications form the basis for the *Council-preferred Alternative* harvest levels for the 2003 southern nearshore fishery.

Allocation Between Recreational and Commercial Sectors

The current set-aside of nearshore rockfish for the recreational fishery south of Cape Mendocino is 80% of the nearshore rockfish OY (for all 14 rockfish species combined including California scorpionfish), leaving 20% for the commercial fishery. This reflects the proportional set aside that has been in place on a pre-season basis in each of the last two years. The Council re-specified the overall 80:20 ratio between recreational:commercial sectors, while using the historical contributions of each sector during recent years to determine the allotment of the shallow rockfish species and California scorpionfish.

The California scorpionfish (sculpin) allotment was set at 75:25, which represents average catch sharing during 1994 through 1999. California scorpionfish occur primarily south of Point Conception. Commercial catches have fluctuated widely over the years, becoming an important component of the live fish fishery since the late 1980s (Leet *et al.* 2001). The recreational catch has been generally increasing since the late 1940s. The California scorpionfish allocation recommendation (75:25) is based on recent years (1994 through 2000) actual catches by the two fisheries. This ratio is close to the allocation recommended for the overall nearshore rockfish and sculpin group (80:20).

The shallow rockfish allotment (63:37) reflects an estimate of the average catch sharing during 1983 through 1989 and 1993 through 1999. These years are the ones used by CDFG to allocate cabezon, sheephead, and greenlings starting in 2001. It is important to note that, in late August 2002, the CDFG rejected a 56:44 allocation of shallow nearshore rockfish between the recreational and commercial fisheries, respectively. That was the average catch sharing of these fish during 1994 through 1999. Shallow water rockfish catch data are available for the recreational fishery for most years since 1983, but commercial data are unreliable for years prior to about 1994. It is likely the long-term sharing of these fish has shifted toward the commercial fishery since about 1989 due to development and expansion of the live fish fishery. Due to the lack of reliable commercial rockfish data for earlier years, cabezon catch data were used as a surrogate to estimate the shift in shallow water rockfish catches from the recreational fishery to the commercial fishery. Cabezon is a reasonable surrogate for shallow water rockfish, because they occupy similar habitats and have a similar geographic distribution. Sheephead were not used, because they primarily occur south of Point Conception. Greenlings co-occur with shallow water rockfish but yielded an allocation result that was intermediate to cabezon and sheephead. The shallow water rockfish percentage for the recreational fishery was derived using a natural log transformation, so that the result was constrained to not exceed 100%. The formula was as follows: Average shallow water rockfish percentage (63) = shallow water recreational percentage during 1994 through 2000 (44) X average cabezon recreational percentage during 1983 through 1989 and 1993 through 1999 (61) / average cabezon percentage during 1993-99 (42).

The deeper nearshore rockfish allotment (86:14) was adjusted, so the overall ratio between recreational and commercial fisheries is maintained at 80:20 (Table 4.5-3).

Expected Bycatch of Overfished Rockfish Species

The preferred depth range of bocaccio, canary rockfish and yelloweye rockfish is deeper than 20 fm. Since the allowable catch of these species has been severely restricted for 2003 in order to rebuild the stocks, a depth limit of 20 fm or less for 2003 rockfish fishing has been adopted. Despite their preference for deeper water, these overfished species will nevertheless be encountered at a reduced rate by persons targeting nearshore species in waters less than 20 fm. Consequently, retention of the overfished species will be prohibited to eliminate any incentive for targeting and to provide an opportunity for the incidental take to be released alive. The potential impact of nearshore fishing on these species may be estimated by (1) examining catch by depth from the recent recreational fishery; (2) estimating potential effort shift based on the recent performance of the recreational rockfish fishery during those periods when only 0 fm to 20 fm fishing was allowed; and (3) applying hooking mortality estimates to the bycatch of overfished species that will be inadvertently caught and released in the 0 fm to 20 fm fishery.

The 2001 fishery provides a “base case” for making 2003 projections. Data on depth of capture is available for the recreational fishery from MRFSS field samples. During 2001, the total catch for each of the three overfished species may be estimated for 0 fm to 10 fm, 10 fm to 20 fm and >20 fm, based on the depth distribution of sample weight for each species. The results show that fishing beyond 20 fm accounted for 81% of the bocaccio, 67% of the canary rockfish, and 74% of the yelloweye rockfish caught during 2001 (Table 4.5-2).

Restricting the rockfish fishery to less than 20 fm will affect the behavior of rockfish anglers. Some will choose to forgo rockfish fishing, because the most desirable species are found in the deeper waters. Others will move from the closed deeper waters to the shallow waters that remain open. The net effect is very difficult to analyze or predict, but the performance of the fishery during recent periods, when only nearshore fishing was allowed, may provide some insight. The areas/periods when this was in effect are: central area (Cape Mendocino/Point Conception) during May through June, 2001 and May through June 2002; southern area (south of Point Conception) during January through February 2001 and November through December 2001. The apparent effort shift during those four recent nearshore fishing periods ranged from +6.2% to +63.4%. Consequently, expected change in nearshore fishing effort for 2003 may be bounded by the lower quartile (14.7% increase) and the upper quartile (47.8% increase) from those observations.

Estimates of hooking mortality for rockfish caught in shallow water may be obtained from Albin and Karpov (1995). One aspect of their study was to determine sources of mortality for a rockfish tag and recapture project that was conducted along the Northern California coast during the 1990s. A total of 256 rockfish were held for five days to track mortality, most of which were captured in waters ranging from 50 feet to 150 feet deep. Overall mortality due to catching and handling the rockfish in the study was 35.5%. At the end of the holding period, 52.9% of the surviving specimens were deemed to be in "good" condition, 34.1% "fair", and 13.8% "poor". The direct cause of mortality for most dead fish could not be determined (23.0%). Mortality attributed to barotrauma (5.8%) was slightly greater than for hook injuries (5.1%). A minor source of mortality was due to injuries from inserting tags (1.6%). Of the directly attributed mortality (excluding the tag injuries), about half was due to barotrauma, and the rest was due to hook injuries.

Based on the Albin and Karpov (Albin and Karpov 1995) mortality results, it is possible to develop a range of plausible mortality impacts for rockfish released during the nearshore fishery. For the 0 fm to 10 fm depth zone, only hook injuries would apply; barotrauma is not an issue. The range of mortality for hook injuries is 5.1% to 15.9%. The low value was directly attributed to hook injuries from the study, and the high end of the range is obtained by assuming that hook injuries account for nearly half of all mortality, including those cases where the cause of mortality could not be directly determined.

For the 10 fm to 20 fm depth zone, both hook injuries and barotrauma are a factor. In a closely related unpublished study (Karpov, pers. comm.), about 24.0% of all nearshore rockfish required to be punctured (i.e., pinned) to relieve pressure from expanded swim bladders. For this depth zone, a reasonable range of mortality is 33.9% to 50.0%. The low end of the range is the overall mortality rate observed in the study, minus the tag injuries. The high end is estimated by assuming that the observed mortality will occur (33.9%), and also assuming that those fish in need of puncture will not receive the treatment, because recreational fishers are not trained or equipped to perform the procedure. Hence, the maximum mortality from barotrauma is greater than from the study findings, resulting in an upper bound of 50.0% from all sources of 10 fm to 20 fm mortality.

Estimates of "high impact" and "low impact" release mortality are provided in Table 4.5-2. The range for bocaccio was 9.4 mt to 4.1 mt. Since the adopted season for 2003 is shorter than for the "base year" and overall nearshore fishing opportunities will be reduced, because of constrained bag limits (see below), the expected bocaccio mortality for nearshore fishing is estimated at 5.0 mt.

Management Measures

New restrictions are required to provide an expectation the 2003 fishery will not exceed the adopted catch limits. The overall OY will be reduced from 662 mt during 2002 to 541 mt during 2003 (under the *Council-preferred Alternative*), which would only be available if the fishery is concentrated during summer and autumn months when nearshore rockfish stocks tend to be fully available within the 20 fm line due to onshore seasonal migration patterns. In addition to the lower overall OY limits, the OY would be divided into 3 separate components: shallow nearshore, deeper nearshore, and California scorpionfish (see above).

It is clear the lower OY range, new HG sub-groups, and new depth restrictions will require changes to the current regulations.

Adopted Recreational Fishery Management Measures

Prospective catches for the 2003 recreational fishery may be analyzed by using 2001 catches as a "base period," adjusted upward to account for nearshore seasonal closures that were in effect that year. Also, it is necessary to increase the "base period" catches to account for expected effort shift, as described above (see: "Expected Bycatch of Overfished Species"). A range has been identified for 2003 effort shift, resulting in "Low", "Medium", and "High" impact scenarios (Table 4.5-4). Under either the "Medium" or "High" scenario it is apparent that only a two to four-month season could be accommodated if bag limits remain unchanged from the base period. Consequently, in order to provide for a longer season, bag limits were re-structured to reduce the overall nearshore opportunity compared to the base period. This reduced opportunity should result in lower angler participation, rendering the "Low" effort shift scenario appropriate for 2003 projections, and providing for a six-month season. In addition, it is necessary to further reduce the expected catch of the shallow nearshore species, in order to stay within the recreational HG for that management group.

Based on the OY and allocation constraints for the 2003 recreational fishery, the following regulations were adopted by the Council:

Nearshore Groundfish (0 fm to 20 fm):

Season: July through December

Bag limits: 10 fish groundfish bag limit, with a sublimit of no more than 10 rockfish, a sublimit of no more than 2 shallow nearshore rockfish (down from a maximum possible of 10 fish during the "base period"), a sublimit of no more than 2 greenlings (down from 10 fish during the "base period"), and a sublimit of no more than 3 cabezon (down from 10 fish during the "base period")

2 fish lingcod – not included in the 10 fish groundfish bag limit. (unchanged from the "base period")

Reducing the cabezon and greenling bag limit to 3 and 2 fish, respectively, is not expected to greatly affect the total catch of either species. This is because anglers rarely catch more than 3 or 2 fish of these species, respectively, on the same day. However, reducing their season lengths from 12 to 6 months is expected to result in total season catches that closely meet the harvest levels specified under the *Council-preferred Alternative*. In 2002, for example, the season opened for both species on January 1 and the OY was attained and the fishery closed for greenlings on July 1 and for cabezon on July 29. Moreover, including these species in the groundfish bag limit has the added benefit of dampening or reducing the total rockfish catch, while still allowing anglers the opportunity to catch up to 10 rockfish per day, which was a high priority among the affected anglers who were involved in the Council regulation process.

California Scorpionfish (0 fm to 20 fm, except 0 fm to 50 fm at Huntington Flats during July through August):

Season: January through February and July through December

Bag limit: 5 fish bag limit (down from 10 fish during the "base period")

The Huntington Flats California scorpionfish fishery during July through August is expected to intercept the seasonal spawning run of these fish in this area and compliments a commercial fishery in the area during the same time period.

Adopted Commercial Fishery Management Measures

There was agreement among constituents at the September 2002 Council meeting that recreational and commercial seasons could be unlinked. The bi-monthly trip limits for nearshore rockfish that were in effect for 2002 (1,200 pounds/2 months) resulted in early attainment of the commercial HG, and it is clear that lower limits are needed to provide for a longer season during 2003. Based on a goal of providing for an extended season while concentrating the fishery during summer and autumn months, the following trip limits were adopted:

Fixed Gear (OA+LE):						
Species/Groups	JAN-FEB	MAR-APR	MAY-JUN	JUL-AUG	SEP-OCT	NOV-DEC
Shallow NS Rockfish	200/2 mo		400/2 mo	500/2 mo	400/2 mo	200/2 mo
Deep NS Rockfish	200/2 mo		200/2 mo	400/2 mo	200/2 mo	200/2 mo
CA Scorpionfish			800/2 mo	800/2 mo		
Shelf Rockfish	100/2 mo		200/2 mo	250/2 mo	200/2 mo	100/2 mo
Lingcod (OA)	300/mo		300/mo	300/mo	300/mo	300/mo
Lingcod (LE)			400/mo	400/mo	400/mo	

Shelf rockfish trip limits were set at half the shallow trip limit opportunity to provide for incidental take of shelf species in the 0 fm to 20 fm zone, while not encouraging the targeting of shelf species. Also, a small allowance for rockfish in nearshore trawl fisheries is provided, unchanged from 2002.

The commercial fishery HGs will be tracked inseason through the PacFIN "Quota System Management" (QSM) system next season, and adjustments to the trip limits will be employed to align the cumulative landings with the available tonnage for the commercial sector.

It is anticipated the CDFG will recommend to the California Fish and Game Commission closing a loophole in current regulations that allows individual Nearshore Finfish Permit holders to land more than one cumulative by-monthly trip limit. Allowing fishers to use multiple vessels to land multiple trip limits during each federal trip limit period accelerated attainment of the nearshore rockfish OY in 2002.

4.5.2.2 Nearshore Fishery Impacts North of Cape Mendocino

The consideration to ameliorate nearshore impacts north of Cape Mendocino from expected inshore effort shifts is to cap 2003 harvests at 2000 levels under the *Allocation Committee Alternative*. This consideration would largely apply to Oregon and Northern California fisheries in the Eureka INPFC area since there is a different strategy for Washington nearshore fisheries (no commercial nearshore fisheries in state waters). Table 4.5-5 shows the commercial and recreational landings of four select marine species groups caught off Oregon during 1995 through 2001. These groups include black and blue rockfish, other nearshore rockfish, cabezon, and greenling; the former two groups comprise the northern nearshore rockfish assemblage. Capping the 2003 nearshore OY of nearshore rockfish at the 2000 level would effectively create commercial and recreational harvest guidelines for these species. The commercial nearshore rockfish OY would be 134.3 mt and the recreational OY would be 395.5 mt for a total of 529.8 mt. The Ad Hoc Allocation Committee considered setting OYs for cabezon and greenling, but decided this was not needed for management. These species can be tracked in the QSM inseason process (all species and complexes with individual OYs are tracked inseason by the GMT using PacFIN data streams) without setting an OY by setting landing limits. Reliance on MRFSS is generally considered inadequate for inseason management. However, Oregon inseason data/catch estimates are available in a timely fashion. The GMT and the Ad Hoc Allocation Committee decided this was an appropriate precautionary recommendation for managing northern nearshore groundfish.

The *Council-Preferred Alternative* for northern nearshore groundfish fisheries is similar to that described under the *Allocation Committee Alternative* with a few notable exceptions. For waters off California north of Cape Mendocino, the Council adopted a similar nearshore strategy as for the south. The nearshore OY and recreational/commercial allocation would be based on a precautionary 50% reduction of the 1994 through 1999 average harvest of black and blue rockfish, and other nearshore rockfish species (Table 4.5-6). The Oregon plan is the same as described under the *Allocation Committee Alternative* except the recreational fishery would be managed with consideration for a 15% overage. This allows management flexibility given the fact that recreational catch estimates are delayed inseason. This may be risk-averse if overages are made up in future years or future nearshore species stock assessments do not show these harvests pose a risk to these species.

Subsequent to publication of the draft EIS, the Oregon Fish and Wildlife Commission (OFWC) adopted a more conservative Nearshore FMP than that described above for nearshore waters off Oregon. The OFWC adopted an Interim FMP for Oregon's Nearshore Commercial Fishery at their October 11, 2002 meeting. The action taken is only an interim measure pending the development of a comprehensive Nearshore FMP for the Oregon coast. The adopted interim plan addresses several goals and objectives for managing Oregon's nearshore fisheries: 1) Sustain biological resources at optimal levels, 2) Minimize the number of commercial nearshore vessels fishing off central and northern coastal waters in areas of high recreational use, 3) Allow the continuation of the black rockfish open access fishery, 4) Reduce commercial effort by at least 50%, and 5) Develop a cap on harvest levels of nearshore species.

The adopted plan goes into effect on January 1, 2003 and includes the following components:

1) Adds 21 nearshore species to the nearshore groundfish species list. The interim plan focuses on species that live predominantly in Oregon state waters, and do not have separate OYs determined by the Council. Black and blue rockfish are not included on the list because black rockfish are managed under a separate Council-specified OY and blue rockfish are caught incidentally with black rockfish and are often taken in the federally-managed EEZ. Landings of black rockfish in Oregon state waters will be tracked to determine further management needs. The species included in the plan are cabezon, kelp greenling, rock greenling, whitespotted greenling, painted greenling, buffalo sculpin, red Irish lord, brown Irish lord, kelp rockfish, brown rockfish, gopher rockfish, copper rockfish, black and yellow rockfish, calico rockfish, quillback rockfish, vermillion rockfish, china rockfish, tiger rockfish, grass rockfish, olive rockfish, and treefish.

2) Qualification criteria for initial permit issuance. Applicants for a permit must own a vessel that has landed at least 500 pounds of nearshore species managed under the FMP in any one calendar year between January 1, 1997 and July 1, 2001 from north of Heceta head or 750 pounds south of Heceta Head. The number of qualifying applicants is estimated to be between 70 and 75 boats. Current active fleet size targeting the interim plan species is between 90 and 110 boats. Although the criteria does not result in a 50% reduction in fleet size, a 50% reduction is a goal to be achieved through attrition of permits not meeting the annual renewal requirements.

3) Permit allocation by area. The permits will be issued for either north or south of Heceta Head based on where the majority of qualifying Oregon landings took place. It is expected that sixty-five vessels south of Heceta head qualify for permits while 6 qualify north of Heceta Head. The ratio of permits between the north and south coasts is consistent with the goal of minimizing nearshore commercial effort north of Heceta Head in areas of high recreational use. Allowing some effort preserves the opportunity to support a nearshore commercial fishery while minimizing user conflicts. The interim plan is also consistent with the goal of keeping effort from increasing in areas with more limited nearshore reef habitat north of Heceta Head.

4) Renewal Requirements. Permit holders receiving permits for 2003 must land at least 100 pounds of nearshore species listed in the interim plan and make 5 or more landings, to qualify the permit for renewal for the subsequent year. Nearshore Fisheries permits are nontransferable, except to another vessel owned or controlled by the permit holder.

5) Number of permits. No lottery for permits will occur until the number of participants falls below 50, or until stock assessments and harvest levels are determined by the majority of species on the nearshore Developmental Fisheries list. An initial target level of 50 vessels is consistent with the goal of reducing fleet size by at least 50%.

6) Gear Restrictions. Based on qualifying landings by gear type, permits would be issued for either hook-and-line gear (including longline gear) or traps (pots) for directed harvest of nearshore species. Traps will be limited to 50 per permit.

7) Information Requirements. Logbooks are required to be kept by permit holders.

8) Incidental Catch Allowance. Vessels without a permit for nearshore species may land up to 15 pounds of nearshore species as incidental catch, provided that the non-nearshore species comprise more than 75% of the catch and are caught with legal gear.

Other regulation changes that are part of the interim FMP include:

1) a cabezon size limit change: the minimum length required for cabezon is raised from 14 inches to 16 inches; and
2) area restrictions: reinstate black rockfish management areas and expand the restricted area off Coos Bay to include reefs near Bandon:
(1) It is unlawful to take or retain more than 200 pounds of black rockfish, or 65 fish, whichever is greater, per vessel from a single fishing trip within on the following areas:
(a) Tillamook Head (45°56' 45" N. lat.) to Cape Lookout (45°20' 25" N. lat.),
(b) Cascade Head (45°03" 50" N. lat.) to Cape Perpetua (44°18' N. lat.),
(c) From a point (43°30' N. lat.) approximately 8.5 nautical miles north of the Coos Bay north jetty to a point (43°03' N. lat.) adjacent to the mouth of Four-mile Creek,
(d) Mack Arch (42°13' 40" N. lat.) to the Oregon-California border (42°N. lat.).
(2) No vessel shall take, retain, possess, or land more than the allowed trip limit when fishing occurs for any species of fish within one of these restricted areas.

Adopting special black rockfish management areas minimizes user conflicts and recognizes differences in needs of the fishing communities up and down the coast. These management areas are established near port areas with significant recreational groundfish fisheries.

At its December 2002 meeting the Oregon Fish and Wildlife Commission approved the Council recommendation to cap commercial and recreational landings of federal nearshore species in 2003 to levels equal to landings in 2000 for four categories of fish: black and blue rockfish; other nearshore rockfish; cabezon; and greenling species. In February 2003, the Commission will take public testimony on proposals to reduce nearshore harvest levels beyond the 2000 cap that may be adopted in December, for both commercial and recreational fisheries. In March, the Commission expects to take action on the harvest cap proposals at their meeting in Newport.

4.6 Cumulative Effects

Cumulative effects must be considered when evaluating the alternatives in an EIS. These effects are the result of "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions," including those of other agencies, organizations and individuals (40 CFR 1508.7). In its guidance on evaluating cumulative impacts the Council on Environmental Quality (CEQ 1997) emphasizes the following principals:

- Cumulative effects are the aggregate of past, present and reasonable foreseeable actions.
- Cumulative effects are the total effect, or combination of direct and indirect impacts with external factors affecting components of the human environment.
- Cumulative effects are analyzed in terms of the specific resources, ecosystem components, and communities affected by the action.
- Cumulative impact analysis should focus on those effects that are truly meaningful rather than cataloging the universe of potential external factors.
- Cumulative effects are rarely aligned with political or administrative boundaries, so the actions of other agencies should be considered.
- Cumulative effects can be the additive effect of one type of impact occurring repeatedly, or synergistic—resulting from different factors combining to produce a sum greater than the parts.

- Cumulative effects can last much longer than the proposed action.
- Each affected resource, ecosystem component, and community should be evaluated in terms of its capacity to accommodate additional effects.

4.6.1 Methodology

Summarizing the above principals, the direct and indirect effects the proposed action (implemented through any of the alternatives, including the preferred alternative, described in Chapter 2) may produce cumulative effects in combination with other factors that are not a consequence of the proposed action. The next section identifies and describes other, external factors that may contribute to cumulative impacts. These effects fall into a set of broad domains similar to the resource categories used to describe direct and indirect impacts in sections 4.1 through 4.4. However, they may cumulatively affect a range of system components (or resource categories). (Table 2.4-1 summarizes the direct, indirect and cumulative impacts of the alternatives.) These external factors are considered in the evaluation of impacts, including cumulative impacts, in sections 4.1 through 4.4.

4.6.2 External factors

4.6.2.1 Meso-scale Climate Events and Climate Change

As discussed in section 3.1, Scientists have identified cyclic changes in ocean conditions that are more or less favorable to groundfish populations, which can last for a year or two, as in the case of El Niño and La Niña, to much longer cycles of 25 years to about 60 years, which are different phases of the Pacific Decadal Oscillation regime shift. A more general warming trend, commonly referred to as climate change and linked to anthropomorphic carbon dioxide emissions, is likely to have profound and essentially permanent effects (in the most directly measurable effects, like average surface temperature, exhibit a generally unidirectional upward trend). The ecological effects of cyclic climate change are becoming better understood; periods with warmer sea surface temperatures seem to be unfavorable for many groundfish species' population growth.

As would be expected, climate produces many broad-scale effects that can interact directly and indirectly with fishing activity. Climate regime effects are related to the proposed action through their effects on the productivity of stocks caught in fisheries. Different groundfish species may respond to these changes in different ways. Recruitment surveys also show that adverse environmental conditions during the 1990s affected some species, such as shortbelly rockfish, chilipepper rockfish and bocaccio much more than other species, such as widow, canary and black rockfish, as evidenced in fishery independent recruitment surveys (Dr. Alec MacCall, NMFS, pers. comm. 12/13/2002). Even shortbelly rockfish, a relatively pelagic species that is not exploited, has experienced severe declines during the last decade. Differential effects of climate regime likely correlate with the ecological habit of a particular species so that, for example, pelagic species show similar responses in comparison to neritic species. However, at present there is neither a strong theoretical basis or observational evidence that would allow prediction of such differential responses.

Changes in productivity are by themselves only relevant as another source of variation in a complex system. They become meaningful in the management context if an understanding of system response is critical to the desired outcome (maximum or optimum yield, for example). Fishery management is largely an exercise in prediction based on accumulated knowledge about how stocks have responded in the past to fishery removals. In developing assessment models it may be explicitly or implicitly assumed that past relationships—between stock size and recruitment, for example—are reasonably static and may apply in the future. (Bearing in mind that there may be considerable parametric uncertainty). If underlying conditions change, components of the predictive model may be wrong, resulting in the mis-specification of harvest levels.

MacCall (2002a) describes a simulation of stock response to the kind of low frequency environmental variability produced by the PDO. In the absence of fishing long-lived species are "remarkably insensitive to the magnitude of environmental fluctuations" due to their longevity and late recruitment age. These characteristics give the population a resilience to long periods of unfavorable environmental conditions. MacCall's simulation shows that a constant fishing rate harvest policy, as currently employed in managing groundfish, would be preferable for long-lived species because of the long lag in biomass response to environmental change. However, once overfished low frequency environmental variability can complicate rebuilding efforts.

The relationship between environmental regime, productivity and the management process is particularly relevant to rebuilding overfished stocks, because management is now largely structured around minimizing their harvest (both retained and bycatch). MacCall simulated rebuilding trajectories from the start of both a favorable and unfavorable environmental regime, in the absence of fishing. If started at the beginning of a favorable period, population increases faster than under unfavorable conditions, but the increase stalls just as the target is reached because of the advent of an unfavorable period. If initiated at the onset of unfavorable conditions it takes a 70 years, as opposed to 40 years, for the population to reach target biomass and again stalls as a second unfavorable period begins. Thus, in both cases "little happens during the first 10 yrs, because the recruiting cohorts already exist in the population and are little affected by the cessation of fishing" and in both cases "the population enters an unproductive period just as the target is reached, and no further rebuilding occurs fo the 30-yr duration of the unfavorable regime" (MacCall 2002a, p. 620). Any level of fishing would, of course, lengthen the rebuilding period, with the population stalling for an additional unfavorable phase in the environmental cycle, adding at least another 30 years to the trajectory. It is very important to recognize that these are models of idealized systems used to illustrate possible effects of environmental phenomena on population dynamics. They exclude the "noise," or stochasiticity, of real world systems, which can mask the underlying dynamic and make outcomes more erratic. In most cases, fishery managers do not yet have the time series data to build predictive models for actual fish stocks. Once this data were available, rebuilding analyses could be refined to incorporate predicted recruitment variability. But even if fishery scientists were in a position to reliably correlate environmental conditions and stock productivity in predictive models, management policies would have to account for environmentally induced variations in productivity over very long cycles, something that the current system is not well-equipped to do.

4.6.2.2 Ecosystem Structure

Ecosystem structure may change as a result of both natural and anthropomorphic effects. Structural change becomes an effect itself that could interact cumulatively with the effects of the alternatives. Ultimately, it is the presence and differing abundances of species that constitutes ecosystem structure. The abundance of a given species is in turn the result of physiographic conditions (water temperature, relief, depth, etc.), processes external to an arbitrarily bounded system (e.g., fishing mortality) and interactions between system components (trophic relationships). Structure can change as a result of internal feedback. For example, scientists have posited "cultivation/depensation effects" that may be lead to recruitment failure even though one would expect compensation to declines in biomass (Walters and Kitchell 2001). (Compensatory response assumes that growth and survival is density dependant). In the paper cited above (MacCall 2002a), MacCall also simulates this phenomenon, which has been posited for large rockfish species, which may be displaced by smaller rockfish species in some habitats. Large species have declined due to exogenous factors (including fishing mortality); the greater relative abundance of fish preying on juveniles—primarily other, smaller species of rockfish—depresses recruitment of the larger species. MacCall calculated surplus production curves for a single species and two-species model and points out that at low exploitation rates the two curves are similar and "the collapse in productivity would be unexpected under most conventional single-species fishery-management policies." Furthermore, because higher short-term yields could be achieved during a period of fishing down an unexploited population, "the change in productivity of the large species could be mistakenly attributed to low-frequency climate change" (MacCall 2002a, p. 634). Thus in the simulated two-species system the harvestable surplus for the larger species is much smaller and B_{MSY} is much larger in comparison to a single species model. The same qualifications and caveats made in the preceding section need to made here: fishery scientists cannot yet incorporate these ecological effects into predictive models for real world species. Because these interspecific dynamics substantially lengthen rebuilding time periods once the larger species become depleted, the management system has to adapt to very long planning horizons. MacCall (2002a, p. 626) concludes "The growing emphasis on rebuilding of depleted stocks may have an unexpected benefit to fishery management. In addition to the economic benefit of restoring fish productivity, stock rebuilding requires adoption of much longer planning horizons; specifically, planning horizons associated with the scale of long-term variability in fish stocks."

In addition to interspecific effects, a range of non-fishing impacts can affect essential fish habitat; these change physiographic conditions, which may produce changes in ecosystem structure. (Section 11.10.4 of the Groundfish FMP describes these effects). These activities—such as dredging, oil and gas exploitation, wastewater discharge, aquaculture and coastal development—generally affect inshore habitats. With some notable exceptions (such as the live fish fishery in Southern California) most limited entry and directed open access fisheries do not occur in the inshore areas directly affected by these activities. However, according to EFH descriptions in the Groundfish FMP, early life stages of some target species—such as Pacific cod, whiting, bocaccio, and English sole—use estuarine habitat, so these stocks could be affected if nearshore non-fishing activities reduce productivity by damaging habitat.

4.6.2.3 Past Federal Groundfish Management and Fishing Activity

Annual management measures are part of an ongoing process that must account for the effect of past measures and anticipate future stock response. Past management measures indirectly affect total fishing mortality in a given past year by constraining fisheries to some catch level. Past catches cumulatively affect fish stocks, contributing to current stock size. The need to sharply reduce harvest levels in recent years, culminating in severe and qualitatively different measures for 2003 is largely due to past overfishing, itself a result of mis-specification of harvest levels. This was a result of both scientific uncertainty and changes to the regulatory framework. Uncertainty results from missing or inaccurate information, which in turn contributes to a misunderstanding of causal relationships (model uncertainty). These problems are exacerbated, because few stocks have been fully assessed and data have been limited. A prime example is the historical reliance on landed catch for accounting, instead of total catch (which includes discards or bycatch). Further, until recently, landings for many rockfish species were reported in aggregate, making individual assessments difficult. It is also important to note that actual harvests can exceed the OY, because of the difficulty in monitoring catches in season. These varied sources of uncertainty contributed to scientists' conclusions about stock size and productivity, which in some cases were overestimated. Variable recruitment of some overfished species—such as whiting and bocaccio—due to poorly understood and difficult to predict environmental factors, also reduces certainty about future stock status. Most of the overfished species are rockfish, a group that, generally, are long-lived and not very productive. These characteristics makes it easy to "mine" stocks: high harvest rates can be sustained for several years before population collapse becomes obvious. It also results in slow recovery. For this reason, past harvests, in some cases—like Pacific ocean perch—going as far back as fishing in the 1960s by foreign distant-water trawlers, can have a major cumulative effect on stock size and productivity.

The changing regulatory framework has also contributed to overfishing. Before implementation of the Magnuson-Stevens Act extended U.S. jurisdiction, there was limited monitoring or control over foreign fishing of the West Coast, and as noted, essentially unregulated harvests before and immediately after passage of the Act contributed to current stock status. Also, the Magnuson-Stevens Act was more focused on "Americanization" of fisheries in the newly created EEZ (or Fisheries Conservation Zone as it was then known). Increasing domestic fishing capacity and "fishing stocks down to MSY" were emphasized. (The MSY model predicts maximum surplus production at a population level below carrying capacity or unfished biomass. Current harvest policy sets fishing rates to produce a biomass from 40% to 50% of unfished biomass, depending on the species.) More specific and stringent measures for preventing overfishing and rebuilding stem from the Sustainable Fisheries Act, passed in 1996. Pursuant National Standards Guidelines establish a more explicit framework for defining overfished stocks and actions to rebuild stocks to an MSY-producing size. In summary, faced with a lack of information (because fewer stocks were assessed) or inaccurate estimates of sustainable harvest rates, incomplete data (on bycatch for example), and a less explicit regulatory framework, managers permitted, in hindsight, harvest levels that were too high for some species, resulting in overfished stocks.

Bocaccio offers an instructive example of how a range of factors related to past overfishing contributed to the current restrictions. This species was declared overfished in 1999 after a stock assessment revealed the southern stock was 7% of its estimated unfished biomass. Under the default 40-10 policy, which applied before a rebuilding plan was developed, the OY would be set to zero. However, the Council chose a 230 mt OY in 1999 and 164 mt in subsequent years, in order to account for "unavoidable bycatch" and based on an optimistic assumption about the strength of the 1999 year class. A more recent stock assessment revealed that this year class was much smaller than originally and over-optimistically estimated. Actual catch exceeded these harvest specifications, because of the difficulty in monitoring harvests during the year and adjusting management measures in response. This is particularly a problem with recreational fisheries, which catch a significant share of some species, and are difficult to effectively monitor. In addition, a change in the way rebuilding analyses are structured had an important effect. Previously, the analyses was initiated in the current year, recalculating T_{MIN} (time needed for the stock to rebuild to size supporting MSY in the absence of fishing) and thus, the maximum rebuilding time period. The analysis was revised to fix the starting point for the analysis at the year when the stock was declared overfished (in this case 1999) and account for actual harvests in subsequent years up until the year when the analysis is performed (usually the current year). When the analysis accounted for the harvests in the intervening years the analyses showed that rebuilding was not possible within the maximum specified time period (T_{MAX}) even in the absence of fishing. Very low OYs for overfished species severely constrain managers' ability to devise management measures allowing healthier stocks to be caught without exceeding these low values; for bocaccio this has necessitated drastic measures to reduce harvests in the Mendocino and Conception management areas off California. In summary, current year management measures are tightly linked to past management measures, which cumulatively affect stock size. More broadly, changes in policy have cumulatively affected management objectives and the management framework.

Past fishing and related management measures also cumulatively affect ecosystem structure by contributing to changes in the abundance of different species and the living and non-living physical structure of fish habitat. (The effect of habitat impacts on ecosystem structure and function is not well understood, however.) Because benthic organisms affected by fishing gear are at the base of food webs leading to trophically higher fish targeted in fisheries, habitat damage may be amplified for target species (Pauly *et al.* 2002). As discussed above, these impacts may in turn affect diversity and productivity. Before implementation of the Groundfish FMP in 1982 no trawl gear restrictions were in place specifically intended to reduce habitat damage. The recently implemented small footrope regulation prohibits landing shelf rockfish when using bottom trawls with large rollers and chafing gear. (The preferred alternative for 2003 management prohibits use shallower than 150 fm.) These restrictions are intended to discourage fishing in and around rocky habitat, in order to reduce fishing related habitat damage.

4.6.2.4 Future Groundfish Management Measures

As with past management measures, future annual management may be viewed as part of continuing set of connected actions intended to achieve sustainable groundfish harvests. In addition, there are broader groundfish management initiatives that will cumulatively interact with annual management. The institution of depth-based management measures, which began in mid-2002 as part of inseason changes to management and is a central component of the alternatives considered for 2003, will likely be continued in future years, producing cumulative effects. As intended, this management regime will re-distribute fishing effort over the long term as residual effort shifts to open areas. This could concentrate fishing, and particularly bottom trawling, intensifying habitat impacts in these open areas. At the same time, ongoing impacts to habitat in closed areas will be reduced. (NMFS is currently preparing an EIS evaluating measures to protect essential fish habitat. This future action will likely evaluate habitat-related effects in greater detail while potentially affecting annual management if new habitat-related measures are adopted.)

Implementation of a VMS, while not part of the proposed action, is a connected action crucial to effective enforcement of depth-based restrictions, intended to reduce bycatch of overfished species. VMS implementation will, therefore, have an indirect effect on bycatch reduction if compliance is a major factor. The monitoring and enforcement benefits of VMS come with the direct cost of purchasing and installing transmitting units on participating vessels. However, these costs can also be compared to the cost of an increase in aerial and at-sea surveillance necessary to achieve the same level of monitoring, if these were even feasible given available resources. 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. (Section 3.5.3 describes VMS characteristics and considerations for implementation.) The Council recommended that NMFS pay for purchase and installation of onboard units, beginning with the limited entry sector. Because of the logistical complexity of setting up a VMS, a system will not be up and running at the start of the new year, although implementation in the limited entry fleet is expected to begin in mid-2003. The system being contemplated can track up to 10,000 vessels, so it may be possible to expand coverage to other sectors, such as the directed open access fleet, in the future. VMS may also have some safety benefits, depending on the type of unit installed on fishing vessels. Some units are capable of sending text messages or distress calls. Given safety concerns associated with depth-based management (see sections 3.3.7 and 4.3.7 for a description and evaluation of impacts on safety.)

Two amendments to the Groundfish FMP will affect annual management and there are a range of other potential actions that are more or less “reasonably foreseeable.” The Council is currently preparing Amendment 16, which establishes the process and standards for rebuilding plans and incorporates rebuilding measures into the FMP. Overfished species are currently managed under interim rebuilding plans, and it is not expected the final rebuilding plans will differ substantially, taking into account any changes that would be made to either type of plan as a result of new data on overfished stocks’ parameters. However, once Amendment 16 is implemented, rebuilding measures and the parameters on which they are based (such as the target year, unfished biomass estimate and rebuilding probability) will be part of the groundfish FMP (or regulations) and thus, less easily changed. It is hard to predict what effect this will have since the Council has not yet chosen a preferred process and standards alternative. Generally speaking, revising rebuilding measures in response to new information will be more difficult if many parameters are specified in the groundfish FMP. Stocks could rebuild faster if parameter estimates are inaccurate in a way that results in an under-estimate of stock growth, and procedural hurdles make it time consuming to adjust the parameters and rebuilding measures. Equally, parameters could over-estimate stock growth producing the converse situation.

Amendment 17, to be adopted by the Council at its November 2002 meeting, establishes a two-year management cycle for groundfish. This change has two main purposes. First, NMFS was challenged in court over its process of publishing its final action in the *Federal Register* late in the calendar year with public comment occurring after the measures had been implemented; this accommodated Council decision making, in which annual management measures were adopted at its November meeting. In losing this legal challenge NMFS must now establish a public notice and comment period that concludes before measures are implemented at the beginning of the new year. This is very difficult to achieve under the current cycle, because the stock assessment findings needed for decision making usually do not become available until mid-year, leaving a narrow window for the Council decision making process. (For 2002 and 2003 NMFS is using emergency rulemaking to implement management measures for the first two months of the year in order to allow public comment on measures for the rest of the year.) In devising a new management cycle, this need for about five months after the Council has adopted management measures for public notice and comment and the fishing industry’s preference for a January 1 start date; the management cycle had to be reconciled. The Council currently favors a three-meeting process (November, April, and June) for management measures implemented in the two years after a June decision. The disadvantage with this cycle is that stock assessments, which would have to be completed in time for the first November decision point, would be developed from data that would not be very recent, increasing the risk of mis-specifying OYs. The use of OYs covering one or two years is a second issue that has not been finalized. With two-year OYs there is a risk of fairly long fishery closures at the end of the period if catches are not effectively controlled during the early part of the period. Adoption of two one-year OY values for each species could make it easier to control harvests early in the cycle.

Although not as foreseeable as the amendments described above, the declaration of additional overfished species is possible, although a recent memo updating the status of fisheries report Congress states that no new declarations are anticipated within the next two years (Lohn 2002). As noted elsewhere, a minority of managed groundfish species have been assessed. As data become available and previously un-assessed species are assessed, new overfishing declarations may result. This will exacerbate the current management dilemma where overfished stocks are a limiting factor in allowing harvests of healthy stocks. It is expected that fishing effort will intensify in nearshore areas, particularly south of Cape Mendocino. This increases the risk of overfishing nearshore species. Conversely, if a nearshore stock, such as cabezon, is assessed and determined to be overfished, still more restrictive depth-based management could be implemented, potentially closing remaining inshore areas. A wide range of commercial and recreational fisheries would be affected.

Other management initiatives are less definite, but could be implemented in the reasonably foreseeable future. These are mainly efforts to reduce capacity and rationalize groundfish fisheries. Permit stacking was implemented in the fixed gear sablefish fishery in 2001. This allows longline and pot vessels with a sablefish-endorsed limited entry license to acquire licenses from other vessels (which are thus retired from the fishery). These licenses have associated cumulative landing limits, which are one of three tiers, awarded based on past fishery participation. The acquiring vessel also acquires the rights to cumulative limit associated with the vessel. This arrangement is functionally similar to individual tradable quotas (ITQs), but does not run afoul of the current prohibition of IFQ management measures under the Magnuson-Stevens Act A similar management regime is in development for the trawl fishery.

Although no panacea, economists have long argued that tradable quotas—by establishing a right to harvest a fixed quantity of fish—can result in more economically efficient resource utilization. ITQ programs in other fisheries—Pacific halibut for example—have harnessed market mechanisms to rationalize capacity and end the "race for fish" or "derby" fisheries that produce an array of problems for both managers and fishers alike. The current moratorium on ITQs expires on October 1 of this year, although Congress will probably renew it. If not lifted this year, Congress could act on ITQs as part of Magnuson-Stevens Act re-authorization. In either case, there is some chance that this management tool could be used in the future. Finally, as just mentioned, the Magnuson-Stevens Act is due for re-authorization and as part of this process Congress is re-examining its provisions. The 1996 Sustainable Fisheries Act, the product of the last major re-authorization, established several new requirements, such as new overfishing provisions, that have a substantial impact on management. The next re-authorization is likely to have similar effects. In addition to possible action on IFQs, more emphasis could be placed on ecosystem-based management principals, in contrast to the current greater emphasis on single-species management.

4.6.2.5 Non-federal Management and Other Fisheries

Many West Coast fisheries catch groundfish incidentally and most are not directly managed by the Groundfish FMP or other federal management regimes. The Groundfish FMP does allocate OY amounts among limited entry and so-called open access sectors. ("Open access" is somewhat of a misnomer in this context, because, although these fisheries are not license limited under the Groundfish FMP, many are subject to other, fishery-specific limited entry regimes.) As noted above, in the past, groundfish were managed based on landed catch without accurate accounting for discards. The increase in the number of overfished stocks has necessitated better bycatch accounting, but most attention has been focused on those directed fisheries, such as limited entry trawl, that catch most groundfish. In order to structure 2003 management measures, total catch of overfished species in all West Coast fisheries was estimated. However, these estimates are approximate, because landed catch of incidental species may not be well monitored, and there is very little information on bycatch. Unaccounted historical fishing mortality in these fisheries may have had an important cumulative effect, even if bycatch rates in individual fisheries were small. The accuracy of future estimates will have a similar effect. Because these fisheries are not federally managed, the ability of the states to implement necessary management measures for those fisheries, as identified in the alternatives, is a critical external factor that will cumulatively affect 2003 management.

4.6.2.6 Listing of Overfished Species Under the Endangered Species Act

Overfished stocks could be listed under the ESA. Such a listing has already been petitioned for bocaccio. A management framework based on that mandate could take precedence over Magnuson-Stevens Act-mandated rebuilding measures. Under the ESA, NMFS would have to authorize any incidental take of a listed species and as part of this process determine an incidental take that does not "jeopardize the continued existence of the species." These "no jeopardy standards," if stricter than rebuilding measures, would be used to determine harvest levels and resulting management measures. However, in the case of bocaccio NMFS determined that an ESA listing is not warranted at this time (67 FR 69704). The determination states:

> After reviewing the best scientific and commercial information available and considering the expected effects of conservation measures, NMFS has determined that listing the southern DPS [discrete population segment] of bocaccio is not warranted at this time. While NMFS recognizes that the southern stock of bocaccio has severely declined over the past several decades, NMFS believes that the catch rate of 0.5 percent (20 mt in 2003) recently adopted by the Council will prevent bocaccio from becoming endangered within the foreseeable future. NMFS will retain bocaccio on the Candidate Species list and closely monitor the status of the bocaccio population and future Council measures. If necessary, NMFS will re-evaluate its decision regarding whether the southern stock of bocaccio warrants listing under the ESA, including evaluating whether emergency listing is warranted and whether an additional status review is necessary. Reasons for a re-evaluation include, but are not limited to: (1) if future Council decisions allow for increased exploitation rate; or (2) if future data or analysis indicate that conservation efforts are inadequate. (page 69708)

4.6.2.7 Data Availability, Reliability, and Uncertainty

Sections 3.5.4 and 4.5 describe and evaluate the effects of uncertainty in the management process. Uncertainty with respect past management decision making, discussed above in section 4.6.2.3, contributed to past overfishing and is a crucial factor in ongoing management. Significant uncertainties in the data include bycatch amounts across all fisheries and reliable catch estimates for recreational fisheries. NMFS implemented an observer program for groundfish fisheries in 2001, and data from that program will become available in late 2002. These data will allow much more accurate bycatch estimation (rather than full accounting since observer coverage is not 100%) and will be progressively integrated into the trawl model currently used to project total catch under alternative management measures. However, considerable data uncertainty in recreational fisheries will remain.

4.6.2.8 Historical Change in Participation and Catch in West Coast Fisheries

Just as annual management measures are connected to past and future management, groundfish fisheries are part of the larger environment of West Coast fisheries. Historical patterns of landings and participation are relevant, because fishers can act strategically, moving in and out of fisheries depending on market and regulatory conditions. (This mobility is of course dependent on capital constraints, including the ability to switch gear types and human capital resources represented by the knowledge needed to participate in a given fishery. License limitation programs also present a financial barrier, depending on the purchase price or availability of a license.) Tables 3.3-1 and 2 show that while total West Coast landings for all species fell by 15% between 1981 and 2001, inflation-adjusted revenues fell by 65%. This greater drop in revenues is due to both a general decline in prices paid for fish and a shift in landings towards lower-value species, such as whiting. On a global scale the phenomenon of serial depletion and "fishing down the food chain" has been highlighted (Pauly *et al.* 2002). However, there is no clear-cut evidence that this is happening on the West Coast. Landings of some lower-trophic level species have increased, such as squid and other coastal pelagic species, but landings of some high value, high trophic level species—such as Pacific halibut—have remained stable. A general decline in the prices, aside from the direct economic impact on 2003 groundfish fisheries, makes it harder for fishing firms to remain viable if there is no concomitant decline in costs. For the same reason, groundfish fishers will have more difficulty shifting to other sectors. Reduced revenues also put downward pressure on capital investment (see section 4.6.2.11) and the other variable costs, such as labor, that firm owners have some control over. A reduction in payments to labor will affect quality, depending on opportunity cost. However, opportunity costs for crew members have likely also fallen, because of declines in the broad economic environment, particularly in rural areas (see below).

4.6.2.9 The Broad Economic Environment

Other resource sectors, such as forestry, have been in decline for more than a decade with substantial impacts on employment and social welfare in coastal communities. The national economy has also been in recession, and the unemployment rate has risen accordingly. This makes it harder for fishers to find alternative employment. By lowering opportunity cost, it could keep people in the fishery who might otherwise leave to find a job at the same pay rate outside of fishing.

4.6.2.10 Markets For Fishery Products and Supply Other Than West Coast Groundfish

As noted above, prices for fish products have seen a general downward trend. This is in part due to competition between and substitutability of different products. Salmon presents a well-known example; supply of aquacultured salmon, particularly from low-cost producers in other countries, has caused prices for all salmon, including wild-caught, to fall. Most consumers do not differentiate between products or attach a price premium to wild-caught fish, making it difficult for fishers to receive higher prices. Aquaculture producers have now turned their attention whitefish, with commercial aquaculture production of halibut becoming a reality and intensive development of production techniques for cod (Loy 2002). If aquacultured products can compete directly with groundfish at lower cost and more consistent supply, this will put still more downward pressure on prices. However, current production is negligible, and there is insufficient information to determine if aquaculture products of this type will compete directly with West Coast groundfish.

More generally, substitutability of other products, or the same product from elsewhere, is an issue. Flatfish are generally lower value than rockfish and production is market- rather than resource-constrained. Rockfish are higher quality and valued in West Coast fresh markets. However, equivalent product from Mexico, Canada, or Alaska could potentially substitute for West Coast production. Whiting, which is turned into surimi, a generic fish product, competes with other sources of supply such as Alaska pollack. Over the long-term, if other fish products substitute for West Coast groundfish it may be more difficult to market groundfish in the future as resource constraints become less stringent.

Consistent supply is also an important factor; groundfish processors and fishers have long advocated year-round fishing, even if this necessitates low periodic landing limits. Consistent supply is important for both marketing purposes and operations. For example, if a processing plant has to shut down, because of lack of supply, semi-skilled labor may find other employment, making them difficult to re-hire them when fish are again available. Other products with more consistent supply could potentially out-compete groundfish if supply is inconsistent.

4.6.2.11 Investment and Capital Stock

Long-term revenue decline constrains new investment and maintenance of capital stock. Perhaps the most important effect of lack of maintenance is on vessel safety. Owners may not be able to afford basic maintenance, or wish to exhaust capital stock before retiring it. New investments in safety equipment may also be deferred. Capital stock, such as fishing vessels and processing facilities, may be devoted to other purposes or retired if production is insufficient. To the degree that groundfish fisheries are over-capitalized, shrinkage of capital stock may be a net benefit, depending on the social and economic costs of loss employment in the fishery sector. Policy initiatives, such as government or industry finance vessel buyback programs, could also permanently reduce, temporarily reduce, or redeploy capital assets. Capital stock may be “lumpy” in that its size cannot be smoothly adjusted up or down. For example, if supply or revenues fall below a break point, a processing plant may have to shut down rather than incrementally reducing the number of processing lines, employment, etc. Loss of capital stock could be hard to reconstitute if supply increases at some future date. Thus, even if stocks recover, the infrastructure and marketing networks may not be there to exploit them.

4.7 Environmental Management Issues

This section summarizes effects that according to CEQ regulations must be considered in an EIS (40 CFR 1502.16). To a large degree these effects have been considered in the discussion of direct, indirect, and cumulative effects in section 4.1 through 4.6; thus, the analyses here rely on the findings in those sections. Mitigation measures to address unavoidable impacts are also described.

4.7.1 Short-term Uses Versus Long-term Productivity

Short-term uses generally affect the present quality of life for the public, in contrast to long-term productivity, which affects the quality of life for future generations, based on environmental sustainability. The proposed action indirectly affects the sustainability of marine resources by constraining fishing mortality to levels that are sustainable. This represents a tradeoff between short-term benefits, reflected in revenue generated from fishing in 2003, and long-term productivity of fish stocks, which determines the abundance of fish in the future, and thus future harvests. Managers must respond to changes in resource status, whether a result of harvests or other, environmental factors; this requires effective monitoring of total fishing mortality. A better understanding of the role of environmental and ecological factors play in affecting stock productivity would also enhance managers ability to predict future stock response to current harvest levels.

Annual management is based on the framework in the FMP, which dictates how harvest control rules should be set in order to produce sustainable harvests over the long term. While harvests in any one year affects long-term productivity, they are part of an ongoing activity, fishing over many years, that cumulatively affect productivity. Although harvest specifications for many—particularly unassessed—species are the same across all alternatives, differences exist for crucial stocks that need to be rebuilt to biomass levels supporting MSY. The bocaccio stock south of Cape Mendocino is one case. The *Council-preferred Alternative* contains management measures to limit total fishing mortality, in all fisheries, to less than 20 mt. These management measures also prevent catches of other species reaching their specified OY. (In the north canary rockfish, for shelf fisheries, and darkblotched rockfish, for deepwater slope fisheries, similarly constrain harvests of other stocks.) This represents an additional loss of short-term use. However, even with the less than 20 mt OY, current forecasts predict this stock will not rebuild to a level that can support MSY within the time period specified by the management framework. But this harvest level is predicted with high probability to prevent long-term decline in stock size. The OY is expressed as less than this value in recognition that the more current harvests (short-term use) can be decreased, the faster future productivity will increase. The *Low OY Alternative* includes a bocaccio OY of 0 mt. In order to achieve no fishing mortality, fisheries would have to be severely constrained, representing a deep cut in short-term use to achieve more rapid increases in long-term productivity. The *No Action Alternative*, which carries forward 2002 harvest specifications and management measures, is based on stock assessments that have since been superceded. For some stocks OYs are actually lower under the *No Action Alternative*, because stock abundance has increased. However, both canary rockfish and bocaccio OYs are unsustainably high under this alternative. Any short-term gain would be offset by the risk of continued decline of the already much diminished bocaccio stock and lower the probability of rebuilding within targets for darkblotched rockfish.

4.7.2 Irreversible Resource Commitments

An irreversible commitment represents some permanent loss of an environmental attribute or service. The use of non-renewable resources are irreversible; unsustainable renewable resource use may be irreversible if future production is permanently reduced or, at the extreme, is extinguished.

The use of non-renewable energy resources, such as fossil fuel, represents a pervasive irreversible commitment associated with the proposed action, because fishing vessels are mechanically powered. The use of energy is discussed below in section 4.7.4.

The proposed action, however, implemented under the alternatives, does not by itself represent an irreversible commitment; because harvest levels are specified and management measures set on an annual basis. Cumulatively, past, current, and future specifications have resulted in an irreversible commitment if the time necessary for overfished stocks to recover is considered so long as to be irreversible. For example, the target year for rebuilding cowcod is 2095. Although stock size should progressively increase during the intervening period, this may be considered an irretrievable commitment. In addition, the bocaccio stock south of Cape Mendocino has a less than 50% probability of recovering under the harvest level included in the *Council-preferred Alternative*. Recent analysis shows that even in the absence of fishing mortality (the case for the *Low OY Alternative*) bocaccio would not recover to the target biomass until 2111. Thus, cumulatively, harvests which are predicated on management measures, may have resulted in an irreversible commitment.

4.7.3 Irretrievable Resource Commitments

A resource is irretrievably committed if its use is lost for time, but is not actually or practically lost permanently. The analysis of direct, indirect and cumulative impacts in section 4.1-4.6 generally describe irretrievable resource commitments and in the case of renewable resources these parallel the tradeoff between short-term use and long-term productivity. All of the alternatives would constrain fish harvests to a level related to the harvest specifications. The fish that are harvested represent an irretrievable resource commitment, as do the inputs in terms of capital and labor (including energy and resources) needed to harvest and market these fish.

4.7.4 Energy Requirements and Conservation Potential of the Alternatives

The alternatives directly and indirectly affect the use of energy, primarily in the form of fossil fuels used to power surveillance craft and fishing vessels. Energy used in at-sea and aerial monitoring and enforcement activities is a direct effect. Changes in the level of this type of monitoring is hard to predict for several reasons. Generally, the use of depth-based restrictions, a feature of the *Council-preferred Alternative* and three of the other action alternatives, would require more surveillance to be effective. Implementation of VMS, which could begin in mid-2003 for the limited entry trawl fleet, would compensate somewhat for the increased surveillance need. Finally, the availability of ships and aircraft to conduct surveillance, which is partly contingent on Coast Guard mission priorities, will also dictate the level the number of patrols, affecting energy use. An increased emphasis on homeland security as part of the Coast Guard's mission, for example, could reduce the resources dedicated to fisheries enforcement. For these reasons its is difficult to predict how this type of energy use would change from baseline conditions. The proposed action indirectly affects fishing activity, and thus, the consumption of fuel by fishing vessels. Under all the action alternatives fishing revenue would decline from the baseline. (Revenues under the *No Action Alternative* are assumed to be roughly equivalent to the baseline.) Fishing activity will likely also decline, although not necessarily in proportion to revenues if firms are willing and able to accept lower profits. On an individual vessel basis some vessels may increase fuel consumption because of depth-based restrictions. All the alternatives using the restrictions limit fishing on the shelf, involving total or partial closures within 100 fm or 150 fm. Depending on gear type and fishing strategy, some vessels may fish in deeper water, and thus further offshore. This would increase their fuel consumption.

4.7.5 Urban Quality, Historic Resources, and the Design of the Built Environment

Sections 3.3.6.7 and 4.3.6 discuss effects on the built environment. In comparison to the baseline, the alternatives reduce income because of constraints imposed on catches by the management measures. The indirect impact on the urban quality, historic resources, and the built environment will be slight. Cumulative impacts could be greater. Fishing income has already fallen in many coastal communities, both because of declines in groundfish landings and in other fisheries such as salmon. Cumulative loss of income could lead to a fall in private investment that could curtail maintenance of buildings and other private infrastructure. Public investment, which includes shoreside amenities and marine-related infrastructure such as docks, boat basins, jetties, and navigable channels, is sensitive to changes in tax revenue. By itself, changes in fishing-related revenue may not have an overwhelming impact on local tax revenues, but external factors such as changes in the broader economy could act cumulatively. It is also possible that as private investment shrinks so that, for example, there are fewer fishing vessels using shoreside infrastructure, there will be less political motivation to devote public resources to these uses. In large urban centers, such as Seattle, San Francisco, and the Los Angeles area, the relative impact would be slight and probably not result in changes in urban quality substantially different from the baseline. For small communities, and especially those likely to be more hard hit by declining revenues, the effect on urban quality could be noticeable, especially over the long term (again, depending on external economic factors). These changes could also affect cultural and historic resources as fishing and fishing-dependent activities are supplanted or simply disappear, changing the character of a coastal community. Since the effects described above are largely speculative, it is not possible to compare the effects of the alternatives beyond projected changes in revenue. Alternatives that result in greater reductions in income, like the *Low OY Alternative*, are likely to have a large effect on the resources and characteristics discussed here.

4.7.6 Possible Conflicts Between the Proposed Action and Other Plans and Policies For the Affected Area

The proposed action affects other fisheries managed under Council FMPs or by the states. Sections 3.3 and 4.3 describe and evaluate effects on other fisheries. The management measures under the proposed action have been developed in consultation with the states and keeping in mind other FMPs so as not to directly conflict with these plans and policies.

4.7.7 Mitigation

The proposed action is itself mitigative. It seeks to constrain fishing mortality in order to prevent overfishing, rebuild overfished stocks and allow sustainable harvest of healthy fish stocks. Despite this, adverse impacts are possible or expected. The following mitigation measures could be implemented in addition to the proposed action to reduce both impacts from fishing and the impacts of the proposed action:

Increase observer coverage: As noted elsewhere, NMFS has begun putting observers on West Coast groundfish vessels. The current strategy is to ensure a statistically valid stratified sample of fishing activity by area, fishery and vessel type. Observer coverage at or near 100% would increase certainty and mitigate a possible "observer effect" whereby vessels carrying observers engage in different behavior than vessels without observers. Perhaps more important, high levels of coverage would allow implementation of more effective bycatch reduction measures, such as bycatch caps. NMFS could also expand direct observation to other sectors that catch groundfish incidentally in order to get better estimates of bycatch across all West Coast fisheries.

Improve recreational catch monitoring: The Marine Recreational Fishery Statistics Survey (MRFSS) administered by NMFS is not well-suited to fishery management. There is a long time lag between data gathering and publication of estimates. This survey relies on telephone and intercept survey instruments (Van Voorhees *et al.* 2001). Because of these methods, the resulting catch estimates are not believed to be sufficiently accurate for management purposes. During recreational salmon seasons dockside sampling occurs in ports north of Cape Mendocino, allowing more accurate recreational catch estimates for groundfish caught during these periods. However, this only applies during part of the year along part of the West Coast. The lack of timely and reliable recreational monitoring poses two problems. First, total fishing mortality cannot be as accurately estimated, opening up the possibility that OYs for particular species are being exceeded without managers' knowledge. Second, even if estimates are sufficiently accurate, the time lag before data are made available for management makes it difficult to implement inseason management measures to reduce or prevent additional catches of species nearing or at their OY level. NMFS has committed to an improved recreational fishery monitoring program for the West Coast, which may mitigate this problem.

Establish a vessel and permit buyback program: Excess capacity is a widely-recognized problem for some sectors of the West Coast groundfish fishery, such as the trawl sector (Ad-Hoc Pacific Groundfish Fishery Strategic Plan Development Committee 2000). Government grants, loans, or loan guarantees could be used to buy vessels and associated permits in the limited entry trawl fishery and retire them from fishing. (The program should be structured to ensure a permanent reduction in capacity across sectors. In addition to retiring permits, vessels need to be scrapped or re-sold with a non-fishery use requirement. There is a possibility that former vessels could enter other open access fisheries, and this issue might need to be addressed as well.) Congress has appropriated funds to seed an industry run buyback program for the limited entry trawl sector, but it has not yet been established or implemented.

Implement remote VMS and increase at-sea enforcement: As discussed elsewhere (see section 4.6), the efficacy of the depth-based restrictions that are part of the *Council-preferred Alternative* is at least partly contingent on effective monitoring and enforcement. A connected action currently in development (to be evaluated in a separate NEPA document) is establishing a vessel monitoring system. This would allow NMFS Enforcement to remotely monitor the position of vessels carrying VMS transmitters, helping to ensure that fishing does not occur in closed areas. At the current stage of development the coverage or implementation date have not yet been finalized. Although more costly and less effective, at-sea enforcement by the Coast Guard or state patrol vessels and aircraft could be used as a stopgap or to supplement a VMS.

Testing of new gear designs and refinement of already developed methods to reduce bycatch: The University of Washington and the Oregon Department Fish and Wildlife are testing bottom trawl gear that is more selective for flatfish, reducing roundfish catch (and therefore, bycatch of overfished rockfish). Other gear, such as finfish excluders used in shrimp trawls would benefit from additional testing and refinement to document and improve their effectiveness. Additional funding could be made available for research and testing programs of this nature. More selective gear, because it applies at the vessel level, would allow more effective management, lessening the need for relatively broad-brush measures such as depth-based closed areas.

Improve stock survey methods: Fishery-independent surveys are an important data source for most stock assessments. Given the harvest specifications for some overfished species, extractive methods, such as trawl surveys have become a consideration, because this catch can represent a significant portion of the harvest specification. Improved techniques and validation of non-extractive survey techniques, such as using submersibles to directly observe fish and hydroacoustic methods could be developed to reduce or eliminate the need for methods requiring capture.

Increase cooperative research: Involving fishers in research can have a variety of benefits in addition to the research results. First, participating fishers may gain a better understanding of research and survey techniques, helping to reduce suspicion about the validity of scientific methods that ultimately determine to what degree management measures will constrain their catches. Second, and relevant to the current situation in the Pacific groundfish fishery, cooperative research can offer an alternative means of employment for some fishers. This reduces fishing effort, even if by a small amount. It also could relieve some economic hardship as management measures foreclose fishing opportunity.

Rationalize fisheries: Over the long-term, as discussed in section 4.6, cumulative impacts, management measures that better coordinate the deployment of capital and labor and the availability of inputs (sustainably harvestable fish) could be implemented. As noted in that section, permit stacking has benefitted the fixed gear sector, and a similar program is under developed for the limited entry trawl sector. Individual fishing quotas may also be effective in some fisheries, although administrative complexity may limit their use in multi-species fisheries. Congress could lift the current prohibition on the individual fishing quotas.

4.7.8 Adverse Effects That Cannot Be Avoided

The proposed action represents a tradeoff between different adverse effects, balancing short-term resource and socioeconomic impacts against long-term sustainability of those resources. Thus, although a given adverse effect may avoided, it may be at the expense of incurring some other effect. All of the alternatives would likely incur the following adverse effects even if mitigation measures are implemented.

The risk or likelihood that certain fish stocks will not recover or decline further: Rebuilding analyses model the probability of stock recovery for a given harvest policy. The Council follows a risk-averse policy in that harvest policies have a greater than 50% probability of recovery within the maximum specified time period (T_{MAX}). But this means there is some likelihood, albeit less than 50%, of stocks not recovering. Furthermore, the current analysis does not take into account scenarios showing recovery to target biomass and subsequent decline due to recruitment variability. The results of the sustainability analysis, used to determine the OY "cap" for bocaccio, show that even in the absence of fishing there is still a 10% probability that this stock will decline over the next 100 years. A 22 mt harvest correlates with an 20% likelihood of decline, so fishing mortality between 0 mt and the 20 mt OY cap represents a probability of decline within this range.

The risk that total fishing mortality could exceed the OY for one or more species: For species with low OYs inaccurate total catch data, or data that is not available to managers in time, could result in total catch exceeding OYs. Managers would not have the necessary information in time to close fisheries or impose other management measures to prevent such an overshoot. As noted above under mitigation, this is especially a problem with recreational catch information.

The risk that OY values will be met early in the year: Even with the restrictive management measures developed for the 2003 season, there is some chance the harvest specification for one or more species may be met before the end of the fishing year. For critical overfished species such as darkblotched rockfish, canary rockfish, and bocaccio, the OY values are so low relative to possible landings that fisheries may have to be closed, because, for example, a few errant trawls catch a large proportion of the OY for one of these species. If a fishery is closed for a significant part of the year, firms may go out of business or may not be able to find the necessary skilled labor when they eventually reopen. (See the discussion in section 4.6, cumulative impacts).

Real declines in revenue for the groundfish fishery sector: Under the *Council-preferred Alternative*, revenue in the groundfish sector (excluding tribal landings) is projected to decline by $13.7 million or 22%.

5.0 CONSISTENCY WITH THE GROUNDFISH FMP AND MAGNUSON-STEVENS ACT NATIONAL STANDARDS

5.1 Consistency with the Groundfish FMP

The Groundfish FMP goals and objectives are listed below. The way in which the 2003 management measures address each objective is briefly described in italics below the relevant statement.

Management Goals.

Goal 1 - Conservation. Prevent overfishing by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.

Goal 2 - Economics. Maximize the value of the groundfish resource as a whole.

Goal 3 - Utilization. Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

Objectives. To accomplish these management goals, a number of objectives will be considered and followed as closely as practicable:

Conservation.

Objective 1. Maintain an information flow on the status of the fishery and the fishery resource which allows for informed management decisions as the fishery occurs.

The Council-preferred Alternative employs the same data sources that have been used in past years to monitor groundfish fisheries. In addition, data from the observer program begun by NMFS in 2001 will likely become available for management purposes in 2003. This should substantially improve monitoring of commercial groundfish fisheries. A vessel monitoring system, if implemented in 2003, will provide real-time location information for participating vessels. These information sources would also apply to all of the other alternatives evaluated in this EIS.

Objective 2. Adopt harvest specifications and management measures consistent with resource stewardship responsibilities for each groundfish species or species group.

The Council-preferred Alternative adopts harvest specifications and management measures that support rebuilding of overfished and precautionary stocks and sustainable harvest of healthy stocks. The other action alternatives fall within the management framework, but represent different tradeoffs between overfishing risk and socioeconomic impacts. The No Action Alternative would not meet this objective.

Objective 3. For species or species groups which are below the level necessary to produce maximum sustainable yield (MSY), consider rebuilding the stock to the MSY level and, if necessary, develop a plan to rebuild the stock.

All of the action alternatives, including the Council-preferred Alternative, sets harvest levels for overfished species—except bocaccio—that are risk averse (in that the probability of rebuilding within the specified time frame is greater than 50%). Bocaccio is a special case, because the rebuilding analysis estimates that even in the absence of fishing a "risk neutral" strategy cannot be achieved. The Low OY Alternative sets a zero OY for bocaccio, representing a 49% probability of rebuilding within the specified time frame (T_{MAX}). The other action alternatives specify an OY of less than 20 mt, which represents a more than an 80% probability of no decline in the population size over the next 100 years and greater than 33% probability of rebuilding within the specified time frame. All these alternatives also apply a precautionary reduction (based on the 40-10 rule) to harvest levels of stocks that are not overfished, but below the biomass necessary to support MSY. The No Action Alternative would not meet this objective.

Objective 4. Where conservation problems have been identified for nongroundfish species and the best scientific information shows the groundfish fishery has a direct impact on the ability of that species to maintain its long-term reproductive health, the Council may consider establishing management measures to control the impacts of groundfish fishing on those species. Management measures may be imposed on the groundfish fishery to reduce fishing mortality of a nongroundfish species for documented conservation reasons. The action will be designed to minimize disruption of the groundfish fishery, in so far as consistent with the goal to minimize the bycatch of nongroundfish species, and will not preclude achievement of a quota, harvest guideline, or allocation of groundfish, if any, unless such action is required by other applicable law.

None of the alternatives include new measures intended to control the impacts of groundfish fishing on nongroundfish stocks.

Objective 5. Describe and identify essential fish habitat (EFH), adverse impacts on EFH, and other actions to conserve and enhance EFH, and adopt management measures that minimize, to the extent practicable, adverse impacts from fishing on EFH.

The Council-preferred Alternative is likely to reduce EFH impacts to the degree that depth-based restrictions eliminate fishing-related impacts in those areas and any spillover of fishing effort into open areas does not produce greater compensating impacts. In addition, the requirement that bottom trawlers use small footropes, which may lessen habitat impacts by discouraging trawling in rocky areas, will apply to all vessels fishing within 150 fm, not just vessels landing shelf rockfish.

Economics.

Objective 6. Attempt to achieve the greatest possible net economic benefit to the nation from the managed fisheries.

Calculating net costs and benefits in 2003 (including the imputed value of non-market costs and benefits) and the present value of all future net benefits would be the best way to measure net benefit. Although the analysis estimates changes in income associated with the alternatives, there is no directly comparable measure of the conservation benefits of the alternatives (such as net present value of future harvests), so it is not possible to determine if the Council-preferred Alternative, or any of the other alternatives, achieves the greatest possible net economic benefit. Furthermore, future best use of resources (in terms of economic return), which would predicate future allocation decisions, cannot be predicted. However, the action alternatives fall within the management framework intended to achieve maximum sustained yield over the long term. This gives greater latitude for future decision making to achieve maximum economic net benefit. Although net present value of future benefits cannot be measured, the Council-preferred Alternative results in a decline in revenues from the baseline that is slightly greater than the High OY Alternative, but substantially less than the Low OY Alternative. Revenues in 2003 from the No Action Alternative, although not estimated, would be higher than the Council-preferred Alternative, but this would likely be offset by lower net present value of future benefits.

Objective 7. Identify those sectors of the groundfish fishery for which it is beneficial to promote year-round marketing opportunities and establish management policies that extend those sectors' fishing and marketing opportunities as long as practicable during the fishing year.

All of the alternatives have management measures intended to allow commercial fisheries year-round, bearing in mind that individual fisheries, such as the directed fixed gear sablefish fishery, are seasonally constrained. Given low harvest specifications for some overfished species, however, actual harvests may result in early attainment of a particular specification, necessitating the closure of particular fisheries.

Objective 8. Gear restrictions to minimize the necessity for other management measures will be used whenever practicable.

No new gear restrictions are proposed for directed groundfish fisheries. Under the action alternatives gear restrictions and/or modifications are proposed for a range of nongroundfish fisheries in order to minimize bycatch of overfished species.

Utilization.

> Objective 9. Develop management measures and policies that foster and encourage full utilization (harvesting and processing) of the Pacific Coast groundfish resources by domestic fisheries.

There has been no foreign fishing on the West Coast for more than a decade, so all of the alternatives meet this objective.

> Objective 10. Recognizing the multispecies nature of the fishery and establish a concept of managing by species and gear or by groups of interrelated species.

As in past years, management measures in all of the alternatives use species groups related to particular fisheries or gear to structure trip limits.

> Objective 11. Strive to reduce the economic incentives and regulatory measures that lead to wastage of fish. Also, develop management measures that minimize bycatch to the extent practicable and, to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch. In addition, promote and support monitoring programs to improve estimates of total fishing-related mortality and bycatch, as well as those to improve other information necessary to determine the extent to which it is practicable to reduce bycatch and bycatch mortality.

Depth-based restrictions are meant to reduce bycatch of overfished species by prohibiting fishing that generates significant bycatch in areas where these species are most abundant. (New depth-based closures are included in all the action alternatives except for a variation of the Allocation Committee Alternative, which only uses trip limits and existing closures to achieve harvest specifications). In addition, trip limits under all the alternatives are set through model projections that include estimated bycatch. The Observer Program implemented in 2001, which would apply under all the alternatives, will provide better estimates of total fishing-related mortality and bycatch than currently available; observer data are expected to be available for management purposes beginning in 2003.

> Objective 12. Provide for foreign participation in the fishery, consistent with the other goals to take that portion of the optimum yield (OY) not utilized by domestic fisheries while minimizing conflict with domestic fisheries.

This objective is no longer relevant since all stocks are fully utilized by domestic fishers.

Social Factors.

> Objective 13. When conservation actions are necessary to protect a stock or stock assemblage, attempt to develop management measures that will affect users equitably.

The Council process facilitates input from resource user groups, state and federal agencies, and the general public. This promotes the formulation of equitable management measures.

> Objective 14. Minimize gear conflicts among resource users.

Depth-based restrictions could increase crowding in nearshore areas, increasing gear conflicts. As noted above, these closures are part of the Council-preferred Alternative and three other action alternatives.

> Objective 15. When considering alternative management measures to resolve an issue, choose the measure that best accomplishes the change with the least disruption of current domestic fishing practices, marketing procedures, and the environment.

The depth-based restrictions included in all but one of the action alternatives are intended to allow continuing harvest at higher sustainable levels than would be possible using trip limit management alone. Proposed gear restrictions in action alternatives, such as fish excluders for shrimp trawls, also allow continued prosecution of these nongroundfish fisheries while minimizing bycatch of overfished species.

Objective 16. Avoid unnecessary adverse impacts on small entities.

Adverse impacts to small entities resulting from management measures in the alternatives are necessary to conserve fish stocks and achieve optimal yield over the long term. The Council-preferred Alternative will result in relatively less decline in projected revenues in comparison to the Low OY Alternative, and this decline is only slightly greater than the High OY Alternative. The relative reduction in the overall level of revenue under the Council-preferred Alternative reflects attempts to minimize adverse impacts. Although impacts may not fall equally on different-size entities, greater overall revenue will likely lessen the impact to small entities in comparison to alternatives with greater reductions in total revenue.

Objective 17. Consider the importance of groundfish resources to fishing communities, provide for the sustained participation of fishing communities, and minimize adverse economic impacts on fishing communities to the extent practicable.

The impacts of all the alternatives on communities are evaluated in section 4.3.6. Given the projected decline in income if the Council-preferred Alternatives, community impacts are like to be substantial, although considerably less than if the Low OY Alternative were implemented. Generally impacts will be greater for the limited entry trawl fleet and communities in Oregon and Washington where these vessels are concentrated.

Objective 18. Promote the safety of human life at sea.

Depth-based restrictions, part of the Council-preferred Alternative and two other action alternatives, could affect safety (see section 4.3.7), because closures could force more vessels further offshore exposing them to adverse weather conditions and making it more difficult to reach port.

5.2 Consistency with Magnuson-Stevens Act National Standards

An FMP or plan amendment and any pursuant regulations must be consistent with ten national standards contained in the Magnuson-Stevens Act (§301). These are:

National Standard 1 states that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

The action alternatives, including the Council-preferred Alternative, all include optimum yield values that reflect harvest rates below the overfishing threshold and include precautionary reductions to rebuild overfished stocks and other stocks that, while not overfished, are at a biomass below the level necessary to produce MSY. The No Action Alternative would not meet this standard.

National Standard 2 states that conservation and management measures shall be based on the best scientific information available.

Optimum yield values in the action alternatives, including the Council-preferred Alternative, are based on the most recent stock assessments, developed through the peer-review STAR process. This represents the best available science. The No Action Alternative OY values are based on stock assessments conducted before the 2002, the year to which the No Action Alternative management measures apply. Given that more recent stock assessments are available, that alternative does not use the best available science.

National Standard 3 states that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

Some groundfish stocks are managed as individual units with specific trip limits. However, given the multi-species nature of many groundfish fisheries, other stocks are grouped in stock complexes and managed accordingly. This generally applies to non-target species for which no individual stock assessments have been performed. Until recently many species were not reported individually in groundfish fisheries and, nongroundfish fisheries may not report incidental groundfish catches at the species level. This limits the amount of time series data available for stock assessments on which individual stocks could be managed. Stocks are managed throughout the range of that stock (as opposed to the species), although issues do arise in the case of stocks straddling international borders. For example, allocation of the harvestable surplus of Pacific whiting between the U.S. and Canada has not been fully resolved.

National Standard 4 states that conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishers, such allocation shall be (A) fair and equitable to all such fishers; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges. The proposed measures will not discriminate between residents of different states.

Management measures are developed through the Council process, which facilitates substantial participation by state representatives. Generally, state proposals are brought forward when alternatives are crafted and integrated to the degree practicable. Decisions about catch allocation between different sectors or gear groups are also part of this participatory process, and emphasis is placed on equitable division while ensuring conservation goals. For example, the allocation of canary rockfish ABC between recreational and commercial sectors produces different OY values because of the differing age composition between these two sectors. The OYs thus reflect conservation considerations, and the Council-preferred Alternative includes an equal division of the OY between recreational and commercial sectors. None of the management measures in the alternatives would allocate specific shares or privileges to one individual or corporation.

National Standard 5 states that conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

Management measures in the groundfish fishery are not designed specifically for the purpose of efficient utilization. However, lower OY levels and other restrictions are likely to result in further fleet capacity reduction as fishing becomes economically unviable for more vessels. There is broad consensus the capacity reduction in some sectors is needed to rationalize fisheries, although achieving this through business failure entails substantial social and economic costs.

National Standard 6 states that conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources and catches.

Management measures reflect differences in catch, and in particular bycatch of overfished species, among different fisheries. Because of the low harvest specifications for overfished species, especially yelloweye rockfish in the north and bocaccio in the south, management measures are proposed for nongroundfish fisheries to minimize bycatch of these species. Each fishery was evaluated for probable bycatch and management measures under the action alternatives are tailored to minimize bycatch and make sure that OY levels are not exceeded.

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The alternatives do not explicitly address this standard. Generally, by coordinating management, monitoring and enforcement activities between the three West Coast states duplication, and thus cost, is minimized. Necessary monitoring and enforcement programs, such as the use of fishery observers and implementation of a vessel monitoring system, increase management costs. But these efforts are necessary to effective management.

National Standard 8 states that conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

This document evaluates the effects of the alternatives on fishing communities (see section 4.3. 3) and these effects were taken into account in choosing the Council-preferred Alternative. The preferred alternative represents the Council's judgement of the best tradeoff between the need to conserve and rebuild fish stocks and the economic impacts of the necessary management measures. Generally, this tradeoff is resolved by structuring management measures to allow communities to access healthy, harvestable stocks while minimizing catch of overfished stocks. As noted above, in discussing FMP objectives, the Council-preferred Alternative, as well as the other alternatives, are projected to differentially affect coastal communities with more impacts, as measured by the change in share of total coastwide income, in Washington and Oregon than in California.

National Standard 9 states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

Minimizing bycatch, of all species and overfished species in particular, is an important component of the Council-preferred Alternative and of the other action alternatives. Depth-based management measures are meant to keep fishing away from areas where overfished species are most abundant, and therefore reduce bycatch. Trip limits are structured to discourage directed and incidental catch of these species, but where bycatch is unavoidable to allow some minimal retention. Integration of observer data into the management process, expected to begin in 2003, will allow more accurate estimates of bycatch rates, and thus total catch estimates.

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

Depth-based management, part of the Council-preferred Alternative and two other action alternatives, could affect safety if closures result in additional vessels fishing further offshore. This may be mitigated by the implementation of a vessel monitoring system capable of sending distress calls. In the absence of a vessel monitoring system, enforcement would rely on additional aerial and at-sea patrols, if assets are available. To the degree that there are additional patrols, Coast Guard vessels would be closer to the fishing grounds and thus able to respond more quickly.

6.0 OTHER APPLICABLE LAW

6.1 Endangered Species Act

Section 7(a)(2) of the Endangered Species Act (ESA), as amended, requires that federal agencies "shall, in consultation with and with the assistance of the Secretary [of Commerce or Interior], insure that any action authorized, funded, or carried out by such agency ... is not likely to jeopardize the continued existence of any endangered species, or result in the destruction or adverse modification of habitat of such species...." Based on this section of the law (section 7), action agencies consult with NMFS (for marine species) or U.S. Fish and Wildlife Service (USFWS) (for terrestrial and freshwater species) in cases where a "major construction activity" (which is considered equivalent to the "major federal action" standard under National Environmental Policy Act [NEPA]) could "jeopardize the continued existence" of an endangered species. For fishery management actions in federal waters NMFS is both the action and consulting agency (although different divisions fulfill these two roles). Consultations can begin informally, through "phone contacts, meetings, conversations, letters, project modifications and concurrences..." (USFWS and NMFS 1998). During consultations, if the lead agency is informed that listed species or critical habitat may be present in the action area, it prepares a biological assessment to disclose the likely adverse effects. Sections 3.2.3 and 4.2.3 in this EIS contain the information necessary for a biological assessment of the effects of the proposed action on ESA-listed species occurring in the action area. If the action agency determines the proposed action may affect listed species or designated critical habitat, formal consultation is required. The consulting agency (in this case, NMFS) must issue a Biological Opinions (BOs) within 135 days of the initiation of formal consultation. The BO may contain "reasonable and prudent measures" that the action agency must implement (in addition to any proposed mitigation) to ensure the proposed action does not jeopardize the continued existence of the species in question. (These may be referred to as "no jeopardy standards." The Council manages ocean salmon fisheries in part based on such standards for listed salmon species).

NMFS has issued several BOs to assess the effects of the groundfish fishery on ESA-listed salmon. (Salmon may be listed by individual spawning runs, because these are considered evolutionarily significant units [ESUs] for the purposes of listing). The most recent BOs was issued on December 15, 1999, covering the 22 ESUs listed by that time. This BO represents a re-initiation of previous consultations described in Opinions issued on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, and May 14, 1996.

During the 2000 Pacific whiting season, the whiting fisheries exceeded the chinook bycatch amount specified in the Pacific whiting fishery Biological Opinion's (December 19, 1999) incidental take statement estimate of 11,000 fish, by approximately 500 fish. In the 2001 whiting season, however, the whiting fishery's chinook bycatch was about 7,000 fish, which approximates the long-term average. After reviewing data from, and management of the 2000 and 2001 whiting fisheries (including industry bycatch minimization measures), the status of the affected listed chinook, environmental baseline information, and the incidental take statement from the 1999 whiting BO, NMFS determined that a re-initiation of the 1999 whiting BO was not required. NMFS has concluded that implementation of the groundfish FMP is not expected to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS, or result in the destruction or adverse modification of critical habitat.

Based on the information in sections 3.3.2 and 4.2.3 of this EIS, the 2003 management measures fall within the scope of these consultations. Further, this EIS serves as a biological assessment of the likely adverse effects to other listed species. Based best available scientific information, no adverse effects are expected.

6.2 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 is the principle federal legislation guiding marine mammal species protection and conservation policy in the United States. Under the MMPA, NMFS is responsible for the management and conservation of 153 stocks of whales, dolphins, porpoise, seals, sea lions, and fur seals, while the FWS is responsible for walrus, sea otters, and the West Indian manatee.

In the Washington, Oregon and California (WOC) region, the Steller sea lion (*Eumetopias jubatus*) Eastern stock, Guadalupe fur seal (*Arctocephalus townsendi*), and Southern sea otter (*Enhydra lutris*) California stock are listed as threatened under the ESA and the sperm whale (*Physeter macrocephalus*) WOC Stock, humpback whale (*Megaptera novaeangliae*) WOC - Mexico stock, blue whale (*Balaenoptera musculus*) Eastern north Pacific stock, and Fin whale (*Balaenoptera physalus*) WOC Stock are listed as depleted under the MMPA. Any species listed as endangered or threatened under the ESA; is automatically considered depleted under the MMPA.

The West Coast groundfish fisheries are considered a Category III fishery—denoting a remote likelihood of or no known serious injuries or mortalities to marine mammals–in the annual list of fisheries published in the *Federal Register*. Based on its Category III status, the incidental take of marine mammals in the West Coast groundfish fisheries does not significantly impact marine mammal stocks.

Section 4.2.3 of this EIS evaluates the impacts of the alternatives on marine mammals. None of the proposed management alternatives are likely to affect the incidental mortality levels of species protected by the MMPA.

6.3 Migratory Bird Treaty Act and Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds

The Migratory Bird Treaty Act of 1918 (MBTA) was enacted to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished populations of many native bird species. The MBTA states it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico, and Russia to protect a common migratory bird resource.

Executive Order (EO) 13186 supplements the MBTA by requiring federal agencies to work with the U.S. Fish and Wildlife Service to develop memoranda of agreement to conserve migratory birds. NMFS is scheduled to implement its memorandum of understanding by January 2003. The protocols developed by this consultation will guide agency regulatory actions and policy decisions in order to address this conservation goal. The EO also directs agencies to evaluate the effects of their actions on migratory birds in environmental documents prepared pursuant to the National Environmental Policy Act.

Section 4.2.3 in this EIS evaluates the impacts of the alternatives on seabirds, including the migratory birds covered by the MBTA and EO 13186. The proposed action is not expected to increase the incidental take of seabirds in managed groundfish fisheries.

6.4 Paperwork Reduction Act

In response to public complaints about the burden of federal paperwork, the Paperwork Reduction Act (PRA) and its implementing regulations require federal agencies to obtain clearance from the Office of Management and Budget (OMB) if they plan to collect information from the public. Collecting facts and opinions from ten or more people, by means of a survey for example; requiring individuals to provide information to the general public or to some third party; requiring items (e.g., boxes of fish, fishing gear) or vessels to be labeled or marked; or using technological methods to monitor public compliance with government requirements, including automated collection techniques such as Vessel Monitoring System (VMS), are all covered by the law and regulations.

The PRA requires agencies to compile an Information Collection Budget (ICB), the total burden the agency will be placing on the public, and to obtain OMB clearance by submitting an OMB-83I form (Paperwork Reduction Act Submission) and a supporting statement. The ICB is submitted annually and lists all new information collecting the agency plans for the upcoming fiscal year. As part of the ICB, for each planned collection the agency must describe the purpose of the collection, the approximate number of respondents, and the estimated time taken per respondent. If a proposed rule contains an information collection requirement needing clearance under the PRA, a clearance request needs to be submitted to OMB on or before the date the proposed rule is published in the *Federal Register*. Once OMB receives the request it has 60 days to review and act on it.

The proposed 2003 action does not have a direct effect on the federal paperwork burden however, a closely connected action identified in Section 4.6.2.4 will have such an effect. That action will require a certain set of vessels to carry VMS units and meet other reporting requirements. The VMS action is the subject of a separate regulatory process now under way and a proposed rule and associated analysis will be published shortly. While creating an additional paperwork burden the VMS system is expected to facilitate regulations that will allow fishers greater income than could otherwise be attained given current conservation problems with respect to overfished species.

6.5 Coastal Zone Management Act

Section 307(c)(1) of the Federal Coastal Zone Management Act (CZMA) of 1972 requires all federal activities that directly affect the coastal zone be consistent with the enforceable polies of approved state coastal zone management programs to the maximum extent practicable. The relationship of the Groundfish FMP with the CZMA is discussed in section 11.7.3 of the Groundfish FMP. The Groundfish FMP has been found to be consistent with the Washington, Oregon, and California coastal zone management programs.

The proposed action is within the scope of the actions contemplated under the management framework described in the Groundfish FMP and will be implemented in a manner that is consistent to the maximum extent practicable with the enforceable policies of the aforementioned coastal zone management programs. This determination has been submitted to the responsible state agencies for review under section 307(c)(1) of the CZMA by forwarding a copy of the Final Environmental Impact Statement (FEIS) to each of the relevant state agencies.

6.6 Regulatory Flexibility Act and EO 12866 (Regulatory Impact Review)

In order to comply with EO 12866 and the Regulatory Flexibility Act (RFA), this document also serves as a Regulatory Impact Review (RIR) and an Initial Regulatory Flexibility Analysis (IRFA).

6.6.1 EO 12866 (Regulatory Impact Review)

EO 12866, Regulatory Planning and Review, was signed on September 30, 1993, and established guidelines for promulgating new regulations and reviewing existing regulations. The EO covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. Section 1 of the Order deals with the regulatory philosophy and principles that are to guide agency development of regulations. It stresses that in deciding whether and how to regulate, agencies should assess all of the costs and benefits across all regulatory alternatives. Based on this analysis, NMFS should choose those approaches that maximize net benefits to society, unless a statute requires another regulatory approach.

The regulatory principles in EO 12866 emphasize careful identification of the problem to be addressed. The agency is to identify and assess alternatives to direct regulation, including economic incentives such as user fees or marketable permits, to encourage the desired behavior. Each agency is to assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only after reasoned determination the benefits of the intended regulation justify the costs. In reaching its decision agency must use the best reasonably obtainable information, including scientific, technical and economic data, about the need for and consequences of the intended regulation.

NMFS requires the preparation of an RIR for all regulatory actions of public interest, including the specification of annual management measures. The RIR provides a comprehensive review of the changes in net economic benefits to society associated with proposed regulatory actions. The analysis also provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve the problems. The purpose of the analysis is to ensure the regulatory agency systematically and comprehensively considers all available alternatives, so the public welfare can be enhanced in the most efficient and cost-effective way. The RIR addresses many of the items in the regulatory philosophy and principles of EO 12866.

The RIR analysis and an environmental analyses required by NEPA have many common elements and they have been combined in this document. The following table shows where the elements of an RIR, as required by EO 12866, are located.

Required RIR Elements	Corresponding Sections
Description of management objectives	Sections 1.3 and 1.4
Description of the fishery[6/]	Sections 3.0 and 4.3
Statement of the problem	Section 1.3
Description of each alternative considered in the analysis	Sections 2.1 through 2.3
An economic analysis of the expected effects of each selected alternative relative to the *No Action Alternative*	Sections 2.4 and 4.3

The RIR is designed to determine whether the proposed actions could be considered "significant regulatory actions" according to EO 12866. The following table identifies EO 12866 test requirements used to assess whether or not an action would be a "significant regulatory action" and identifies the expected outcomes of the proposed management alternatives. For the purposes of the EO, the *Low OY Alternative* (rejected) could potentially meet the significance criteria. A regulatory program is "economically significant" if it is likely to result in the effects described in item 1 in the table:

Summary of EO 12866 Test Requirements

EO 12866 Test of "Significant Regulatory Actions"	***No Action Alternative* (baseline)**	***Low OY Alt***	***High OY Alt***	***Allocation Committee Alternative***		***Council-pref Alt***
				No Depth-Based Mgmt	**With Depth-Based Mgmt**	
1) Have a annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities	-	Potential Changes: Exvessel Rev -$60 mil; Com Harvest Income Impacts -$274 mil; Rec Fishery Income Impacts -$64 mil.	Potential Changes: Exvessel Rev -$6 mil; Com Harvest Income Impacts -$16 mil; Rec Fishery Income Impacts -$1.2 mil.	Potential Changes: Exvessel Rev -$21 mil; Com Harvest Income Impacts -$67 mil; Rec Fishery Income Impacts -$1.2 mil.	Potential Changes: Exvessel Rev -$15 mil; Com Harvest Income Impacts -$40 mil; Rec Fishery Income Impacts -$1.2 mil.	Potential Changes: Exvessel Rev -$13 mil; Com Harvest Income Impacts -$35 mil; Rec Fishery Income Impacts -$25 mil.
2) Create a serious inconsistency or otherwise interfere with action taken or planned by another agency	None Identified	None Identified	None Identified	None Identified	None Identified	None Identified
3) Materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of recipients thereof	None Identified	None Identified	None Identified	None Identified	None Identified	None Identified

6/ In addition to the information in this document, basic economic information is provided annually in the Council's SAFE document.

Summary of EO 12866 Test Requirements

EO 12866 Test of "Significant Regulatory Actions"	*No Action Alternative* (baseline)	*Low OY Alt*	*High OY Alt*	*Allocation Committee Alternative* No Depth-Based Mgmt	With Depth-Based Mgmt	*Council-pref Alt*
4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this EO	None Identified	None Identified	None Identified	None Identified	None Identified	None Identified

6.6.2 Impacts on Small Entities (Regulatory Flexibility Act, RFA)

The RIR is also designed to determine whether the proposed rule has a "significant economic impact on a substantial number of small entities"[7/] under the RFA. The purpose of the RFA is to relieve small businesses, small organizations, and small governmental entities of burdensome regulations and record-keeping requirements. Major goals of the RFA are; (1) to increase agency awareness and understanding of the impact of their regulations on small business, (2) to require agencies communicate and explain their findings to the public, and (3) to encourage agencies to use flexibility and to provide regulatory relief to small entities. The RFA emphasizes predicting impacts on small entities as a group distinct from other entities and the consideration of alternatives that may minimize the impacts while still achieving the stated objective of the action. An IRFA is conducted unless it is determined that an action will not have a "significant economic impact on a substantial number of small entities." The RFA requires that an IRFA include elements that are similar to those required by EO 12866 and NEPA. Therefore, the IRFA has been combined with the RIR and NEPA analyses. The following table references the location of these RFA-required elements:

Required IRFA Elements	Corresponding Sections
A description of the reasons why action by the agency is being considered.	Section 1.2
A succinct statement of the objectives of, and the legal basis for, the proposed rule.	Section 1.4
A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply (including a profile of the industry divided into industry segments, if appropriate).	Sections 3.3 and 4.3
A description of the projected reporting, record keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record.	Section 6.4 Section 4.6.2.4 (future connected action)
An identification to the extent practicable, of all relevant federal rules that may duplicate, overlap, or conflict with the proposed rule.	No Subject Rules Identified
A description of any significant alternatives to the proposed rule that accomplish the stated objectives that would minimize any significant economic impact of the proposed rule on small entities.	No Other Alternatives Identified

7/ The Small Business Administration defines a small business in commercial fishing "as a fish harvesting or hatchery business that is independently owned and operated and not dominant in its field of operation" with "annual receipts not in excess of $3,500,000."

No federal rules have been identified that duplicate, overlap, or conflict with the preferred alterative. Public comment is hereby solicited identifying such rules. No alternatives, other than those considered here, have been identified that would reduce the impact of the preferred alternative on small entities. The Council process for developing a preferred alternative is conducted in an open forum with industry advisory groups that assist the Council in developing options that meet regulatory objectives, and conservation goals in particular, with the least possible impact on fishing business, most of which are small entities.

Commercial Fishery: - For purposes of evaluating impacts, the analysis segregates the commercial groundfish fleet into subgroups based on involvement and dependence on the groundfish fishery, gear type, size of vessel, and possession of a limited entry permit. The degree of harvest reduction expected under the preferred alternative makes the action potentially significant (Tables 4.3-1). The reduction in groundfish revenue as a percent of total groundfish revenue is projected to be 20% under the preferred alternative. Individual groups may experience greater or lesser reductions (Tables 4.3-2 through 4.3-12).

Table 4.3-3a shows that among limited entry trawl vessels, vessels landing more than $200,000 in annual revenues are the hardest hit as a proportion of total exvessel revenue. However, among limited entry fixed gear and open access vessels, it is the vessels landing less than $5,000 that are the most adversely affected as a proportion of total exvessel revenue. This pattern holds under each of the alternatives. When vessels are grouped by length, Table 4.3-5a shows that among limited entry trawl vessels, vessels less than 40 feet in length are the hardest hit as a proportion of total exvessel revenue. Among limited entry fixed gear and groundfish open access vessels, impacts are generally more evenly distributed, although vessels in the intermediate length 50-60 foot class appear somewhat worse affected as a proportion of total exvessel revenue. Again, this holds under each of the alternatives.

The Council chose an OY level which mitigated the severe economic impact of the non-preferred low OY, but not to the detriment of the long term health of the resources involved. While it does not seem true that vessels in any particularl revenue or length category are disproportionately affected in terms of revenue impacts, it is probably true that many vessels will experience greater costs and difficulty in traversing longer distances to fish in the areas remaining open under the *Council-Preferred Alternative*. This is particularly true for smaller vessels.

	Number of Vessels	*Low OY Alternative*	*High OY Alternative*	*Alloc Committee Alternative (no depth-based)*	*Alloc Committee Alternative (with depth-based)*	*Council-preferred Alternative*
Overall Change (Table 4.3-1)		Percent Change in Exvessel Revenue				
Percent Change In Groundfish Revenue	1,701	-38%	-9%	-36%	-25%	-21%
Percent Change In Total Revenue	4,579	-26%	-2%	-9%	-6%	-5%
		Percent Change in Total Revenue (All Species)				
Involvement (Table 4.3-4)						
Top 50% of Groundfish Revenue	93	-30%	-13%	-29%	-22%	-20%
Next 20%	80	-22%	0%	-25%	-10%	-8%
Next 10%	64	-23%	2%	-26%	-11%	-7%
Next 10%	123	-31%	-3%	-28%	-17%	-10%
Next 10%	1,341	-18%	-2%	-14%	-5%	-4%
No Groundfish Landings	2,878	-24%	-	-1%	-	-

	Number of Vessels	*Low OY Alternative*	*High OY Alternative*	*Alloc Committee Alternative (no depth-based)*	*Alloc Committee Alternative (with depth-based)*	*Council-preferred Alternative*
Dependence on Groundfish (Summarized from Table 4.3-2)		Percent Change in Total Revenue (All Species)				
0% - 5%	538	-13%	0%	-10%	-1%	-1%
5% - 35%	246	-18%	-1%	-14%	-8%	-5%
35% - 65%	199	-25%	-3%	-21%	-14%	-10%
65% - 95%	220	-35%	-10%	-30%	-22%	-19%
95% - 100%	498	-38%	-10%	-37%	-22%	-19%
No groundfish landings	2878	-24%	0%	-1%	0%	0%

Substantially less information is available on the recreational fishing industry. In 2001 it is estimated that there were 753 recreational charter vessels on the West Coast, 106 in Washington, 232 in Oregon and 415 in California. Limited information on the vessels in the fishery and lack of detailed information on effort prevents segregation of the fleet into smaller units for analysis. The best index available of economic effect on the recreational fishing industry of the alternatives is changes in projected personal income associated with the fishery. The text table in section 6.8.1 contains a summary of changes in personal income impacts by option.

	Number of Charter Vessels	*Low OY Alternative*	*High OY Alternative*	*Allocation Committee Alternative*	*Council-preferred Alternative*
Overall Change (Table 4.3.-12)		Percent Change in Personal Income Impacts in the Recreational Fishery (Baseline is $256 Million)			
Recreational Fishery Impacts	753	-25%	-1%	-1%	-10%

6.7 EO 12898 (Environmental Justice)

EO 12898 obligates federal agencies to identify and address "disproportionately high adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations in the United States" as part of any overall environmental impact analysis associated with an action. NOAA guidance, NAO 216-6, at §7.02, states that "consideration of EO 12898 should be specifically included in the NEPA documentation for decision making purposes." Agencies should also encourage public participation—especially by affected communities—during scoping as part of a broader strategy to address environmental justice issues.

The environmental justice analysis must first identify minority and low-income groups that live in the project area and may be affected by the action. Typically, census data are used to document the occurrence and distribution of these groups. Agencies should be cognizant of distinct cultural, social, economic or occupational factor that could amplify the adverse effects of the proposed action. (For example, if a particular kind of fish is an important dietary component, fishery management actions affecting the availability or price of that fish could have a disproportionate effect.) In the case of Indian tribes, pertinent treaty or other special rights should be considered. Once communities have been identified and characterized and potential adverse impacts of the alternatives are identified, the analysis must determine whether these impacts are disproportionate. Because of the context in which environmental justice developed, health effects are usually considered and three factors may be used in an evaluation: whether the effects are deemed significant, as the term is employed by NEPA; whether the rate or risk of exposure to the effect appreciably exceeds the rate for the general population or some other comparison group; and whether the group in question may be affected by cumulative or multiple sources of exposure. If disproportionately high adverse effects are identified, mitigation measures should be proposed. Community input into appropriate mitigation is encouraged.

Sections 3.3.6 and 4.3.7 describe coastal communities affected by the proposed action and impacts to those communities. Available demographic data show that, coastal counties where these communities are located are variable in terms of social indicators like income, employment and race and ethnic composition. However, equivalent data specific to the groups directly affected by the proposed action are not available. Generally, the proposed action will have effects across a range of communities and user groups up and down the West Coast. Thus, no disproportionate effect is expected on minority and low income groups.

6.8 EO 13132 (Federalism)

EO 13132 enumerates eight "fundamental federalism principles." The first of these principles states "Federalism is rooted in the belief that issues that are not national in scope or significance are most appropriately addressed by the level of government closest to the people." In this spirit the EO directs agencies to consider the implications of policies that may limit the scope of or preempt states' legal authority. Preemptive action having such "federalism implications" is subject to a consultation process with the states; such actions should not create unfunded mandates for the states; and any final rule published in the *Federal Register* must be accompanied by a "federalism summary impact statement."

The Council process offers many opportunities for states (through their agencies and Council appointees) to participate in the formulation of management measures. This process encourages states to institute complementary measures to manage fisheries under their jurisdiction that may affect federally-managed stocks. Further, §306 of the Magnuson-Stevens Act addresses state jurisdiction over fisheries. Generally, states may regulate fishing by vessels registered in that state if no federal FMP applies, or if a federal FMP delegates such authority to the states.

The proposed action does not have federalism implications.

6.9 EO 13175 (Consultation and Coordination With Indian Tribal Governments)

EO 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates on Indian tribes.

Pursuant to Executive Order 13175, this rule was developed after meaningful consultation and collaboration with tribal officials from the area covered by the FMP. Under the Magnuson-Stevens Act at 16 U.S.C. 1852(b)(5), one of the voting members of the Pacific Council must be a representative of an Indian tribe with Federally recognized fishing rights from the area of the Council's jurisdiction. In addition, regulations implementing the FMP establish a procedure by which the tribes with treaty fishing rights in the area covered by the FMP request new allocations or regulations specific to the tribes, in writing, before the first of the two groundfish meetings of the Council. The regulation at 50 CFR 660.324(d) further states that "the Secretary will develop tribal allocations and regulations under this paragraph in consultation with the affected tribe(s) and, insofar as possible, with tribal consensus." The tribal management measures in this proposed rule have been developed following these procedures. The tribal representative on the Council made a motion to adopt the tribal management measures, which was passed by the Council, and those management measures, which were developed and proposed by the tribes, are included in this proposed rule.

7.0 LIST OF PREPARERS

List of Preparers:

Mr. Mike Burner, Staff Officer, Groundfish Dr. Christopher Dahl, Staff Officer, NEPA Mr. John DeVore, Staff Officer, Groundfish Ms. Jennifer Gilden, Associate Staff Officer Mr. Jim Seger, Staff Economist Mr. Chuck Tracey, Staff Officer, Salmon/Halibut Mr. Edward Waters, Staff Economist	Pacific Fishery Management Council
Ms. Yvonne de Reynier Ms. Carrie Nordeen Ms. Becky Renko	NMFS Northwest Region

Administrative Support (PFMC)

Ms. Carolyn Porter
Ms. Kerry Aden
Ms. Renee Heyden
Ms. Donde Hayes

8.0 AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS STATEMENT WERE SENT

Alaska Department of Fish and Game

California Department of Fish and Game

Fishing Vessel Owner's Association

Idaho Department of Fish and Game

Northwest Indian Fisheries Commission

Oregon Department of Fish and Wildlife

Pacific States Marine Fisheries Commission

U.S. Fish and Wildlife Service

U.S. Coast Guard, 13^{th} District

Washington Department of Fish and Wildlife

9.0 BIBLIOGRAPHY

Adams, P. 1986. Status of lingcod (*Ophiodon elongatus*) stocks off the coast of Washington, Oregon and California. Pages 60 *in* Status of the Pacific Coast groundfish fishery through 1986 and recommended biological catches for 1987. Pacific Fishery Management Council, Portland.

Adams, P. B. 1987. Diet of widow rockfish *Sebastes entomelas* in central California. Pages 37-47 *in* W. H. Lenarz, and D. R. Gunderson, editors. Widow Rockfish, Proceedings of a Workshop. NMFS, Tiburon, CA.

Adams, P. B., and J. E. Hardwick. 1992. Lingcod. Pages 161-164 *in* L. W.S, C. M. Dewees, and C. W. Haugen, editors. California's Living Marine Resources and Their Utilization. California Sea Grant Program, Davis, CA.

Adams, P. B., E. H. Williams, K. R. Silberberg, and T. E. Laidig. 1999. Southern lingcod stock assessment in 1999. Appendix to Status of the Pacific Coast groundfish fishery through 1999 and recommended acceptable biological catches for 2000 (SAFE Report). Pacific Fishery Management Council, Portland.

Ad-Hoc Pacific Groundfish Fishery Strategic Plan Development Committee 2000. Pacific Fishery Management Council groundfish fishery strategic plan "transition to sustainability. Pacific Fishery Management Council, Portland, OR, October 2000.

Albin, D., and K. Karpov 1995. Northern California sport fish project lingcod hooking mortality study, CDFG Cruise Report 95-M-10.

Allen, M. J. 1982. Functional structure of soft-bottom fish communities of the southern California shelf. Ph.D Dissertation. University of California, San Diego, California.

Allen, M. J., and G. B. Smith 1988. Atlas and zoogeography of common fishes in the Bering Sea and northeastern Pacific, NOAA NMFS Tech. Rep. 66.

Archibald, C., P. D. Fournier, and B. M. Leaman. 1983. Reconstruct of stock history and development of rehabilitation strategies for Pacific ocean perch in Queen Charlotte Sound, Canada. N. Amer. J. Fish. Mgmt. 3:283-294.

Archibald, C., W. Shaw, and B. M. Leaman 1981. Growth and mortality estimates of rockfishes (Scorpaenidae) from B.C. coastal waters, 1977-1979, Canadian Technical Report of Fisheries and Aquatic Sciences No. 1048.

Auster, P. J., and R. W. Langton. 1999. The effects of fishing on fish habitat. L. R. Benaka, editor. Fish Habitat: Essential Fish Habitat and Rehabiliation. American Fisheries Society, Bethesda, MD.

Bailey, K. M. 1982. The early life history of the Pacific hake, *Merluccius productus*. Fish. Bull. 80:589-598.

Bailey, K. M., R. C. Francis, and P. R. Stevens. 1982. The life history and fishery of Pacific whiting, *Merluccius productus*. Calif. Coop. Oceanic Fish. Invest. Rep. 23:81-98.

Bakun, A. 1996. Patterns in the ocean: ocean processes and marine population dynamics. California Sea Grant College System National Oceanic and Atmospheric Adminstration in cooperation with Centro de Investigaciones Biológicas del Noroeste, La Jolla, Calif.

Barth, J. A., S. D. Pierce, and R. L. Smith. 2000. A separating coastal upwelling jet at Cape Blanco, Oregon and its connection to the California current system. Deep-Sea Research 47:783-810.

Beamish, R. J. 1979. New information on the longevity of Pacific ocean perch (*Sebastes alutus*). J. Fish. Res. Board Canada 36:1395-1400.

Beamish, R. J., and G. A. McFarlane. 1988. Resident and dispersal behavior of adult sablefish (*Anoplopoma fimbria*) in the slope waters off Canada's West Coast. Can. J. Fish. Aquat. Sci. 45:152-164.

Becker, D. S. 1984. Resource partitioning by small-mouthed pleuronectids in Puget Sound, Washington. Ph.D Dissertation. University of Washington, Seattle, Washington.

Bence, J. R., and J. E. Hightower. 1990. Status of bocaccio in the Conception/Monterey/Eureka INPFC areas in 1990. Appendix to Status of the Pacific Coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991 (SAFE Report). Pacific Fishery Management Council, Portland.

Bence, J. R., and J. B. Rogers. 1992. Status of bocaccio in the Conception/Monterey/Eureka INPFC areas in 1992. Appendix to Status of the Pacific Coast groundfish fishery through 1992 and recommended acceptable biological catches for 1993 (SAFE Report). Pacific Fishery Management Council, Portland, OR.

Bernton, H. 2000. New cool-water cycle in Pacific sends marine populations soaring. The Seattle Times, Seattle.

Boehlert, G. W. 1977. Timing of the surface-to-benthic migration in juvenile rockfish, *Sebastes diploproa*, off southern California. Fish. Bull. 75:887-890.

Boehlert, G. W. 1980. Size composition, age composition, and growth of canary rockfish, *Sebastes pinniger*, and splitnose rockfish, *S. diploproa* from the 1977 rockfish survey. Mar. Fish. Rev. 42:57-63.

Boehlert, G. W., and R. F. Kappenman. 1980. Variation of growth with latitude in two species of rockfish (*Sebastes pinniger* and *S. diploproa*) from the northeast Pacific ocean. Mar. Ecol. Prog. Ser. 3:1-10.

Boehlert, G. W., and M. Y. Yoklavich. 1985. Larval and juvenile growth of sablefish *Anoplopoma fimbria* as determined from otolith increments. Fish. Bull. 83:475-481.

Bond, C. E. 1979. Biology of fishes. Saunders College Publishing, Philadelphia.

Brodziak, J., L.Jacobson, R. Lauth, and M. Wilkins. 1997. Assessment of the Dover sole stock for 1997. Appendix to Status of the Pacific Coast groundfish fishery through 1997 and recommended biological catches for 1998 (Stock assessment and fishery evaluation). Pacific Fishery Management Council, Portland, OR.

Butler, J. L., L. D. Jacobson, J. T. Barnes, H. G. Moser, and R. Collins. 1999. Stock assessment of cowcod. Appendix to Status of the Pacific Coast groundfish fishery through 1998 and recommended acceptable biological catches for 1999 (SAFE Report).

Cailliet, G. M., L. W. B. J., G. Brittnacher, G. Ford, M. Matsubayashi, A. King, D. L. Watters, and R. G. Kope. 1996. Development of a computer-aided age determination system: Evaluation based on otoliths of bank rockfish off southern California. Trans. Am. Fish. Soc. 128:874-888.

Cailliet, G. M., E. K. Osada, and M. Moser. 1988. Ecological studies of sablefish in Monterey Bay. Calif. Dept. Fish and Game 74:133-153.

Caribbean Fishery Management Council 1998. Regulatory Impact Review and Initial Regulatory Flexibility analysis for the Draft of Amendment 1 for the Fishery Management Plan for Corals and Reef Associated Plants and Invertebrates of Puerto Rico and the Unites States Virgin Islands (DRAFT), August 1998.

Carlson, H. R., and R. E. Haight. 1972. Evidence for a home site and homing of adult yellowtail rockfish, *Sebastes flavidus*. J. Fish. Res. Bd. Canada 29:1011-1014.

Casillas, E., L. Crockett, Y. deReynier, J. Glock, M. Helvey, B. Meyer, C. Schmitt, M. Yoklavich, A. Bailey, B. Chao, B. Johnson, and T. Pepperell. 1998. Essential Fish Habitat, West Coast Groundfish. Appendix to Amendment 11 of the Pacific Coast Groundfish Plan, Fishery Management Plan Environmental Impact Statement for the California, Oregon Washington Groundfish Fishery. National Marine Fisheries Service, Seattle.

CEQ (Council on Environmental Quality). 1993. CEQ guidance regarding biodiversity. Council on Environmental Quality, Washington, D.C., January 1993.

CEQ (Council on Environmental Quality). 1997. CEQ guidance regarding cumulative effects. Council on Environmental Quality, January 1997.

Chess, J. R., S. E. Smith, and P. C. Fisher. 1988. Trophic relationships of the shortbelly rockfish, *Sebastes jordani*, off central California. CalCOFI Rep. 29:129-136.

Collier, P. C., and R. W. Hannah. 2001. Ocean Shrimp. Pages 118-120 *in* W. S. Leet, C. M. Dewees, R. Klingbeil, and E. J. Larson, editors. California's Living Marine Resources: A Status Report. California Sea Grant Program, Davis, CA.

Committee to Review Individual Fishing Quotas. 1999. Sharing the Fish, Toward a National Policy on Individual Fishing Quotas. National Academy Press, Washington, D.C.

Crone, P. R., R. D. Methot, R. J. Conser, and T. L. Builder. 1999. Status of the canary rockfish resource off Oregon and Washington in 1999. Status of the Pacific Coast groundfish fishery through 1998 and recommended acceptable biological catches for 1999 (SAFE Report). Pacific Fishery Management Council, Portland, OR.

Cross, J. N. 1987. Demersal fishes of the upper continental slope off southern California. Calif. Coop. Oceanic Fish. Invest. Rep. 28:155-167.

Culver, B. N. 1986. Results of tagging black rockfish (*Sebastes melanops*) off the Washington and northern Oregon coast. Proc Int. Rockfish Symp. Alaska Sea Grant College Program, Anchorage, Alaska.

Dark, T. A., and M. E. Wilkins 1994. Distribution, abundance, and biological characteristics of groundfish off the coast of Washington, Oregon and California, 1977-1986. NOAA, NMFS Tech. Rep. 117.

DOC (U.S. Dept. of Commerce). 2001. Fisheries of the United States 2000, August 2001.

Dorn, M. W. 1995. Effects of age composition and oceanographic conditions on the annual migration of Pacific whiting, *Merluccius productus*. Calif. Coop. Oceanic Fish. Invest. Rep. 36:97-105.

Dorn, M. W. 2000. Advice on West Coast rockfish harvest rates from Bayesian meta-analysis of stock-recruitment relationships. North American Journal of Fisheries Management (22):280-300.

Dunn, J. R., and C. R. Hitz. 1969. Oceanic occurrence of black rockfish (*Sebastes melanops*) in the central north Pacific. J. Fish. Res. Bd. Canada 26:3094-3097.

Dunn, J. R., and A. C. Matarese. 1987. A review of early life history of northeast Pacific gadoid fishes. Fish. Res. 5:163-184.

Emmett, R. L., S. L. Stone, S. A. Hinton, and M. E. Monaco 1991. Distribution and abundance of fishes and invertebrates in West Coast estuaries, Volume II: Species life history summaries. NOAA/NOS Strategic Environmental Assessments Division, Rockville, Maryland, ELMR Rep. No. 8.

EPAP (Ecosystem Principles Advisory Panel). 1999. Ecosystem-based fishery management: A report to Congress by the Ecosystem Principles Advisory Panel. National Marine Fisheries Service, April 1999.

Erickson, D. L., and E. K. Pikitch. 1993. A histological description of shortspine thornyhead, *Sebastolobus alascanus*, ovaries: Structures associated with the production of gelatinous egg masses. Environ. Biol. Fish. 36:273-282.

Eschmeyer, W. N., E. S. Herald, and H. Hammon. 1983. A Field Guide to Pacific Coast Fishes of North America. Houghton Mifflin, Boston Massachussetts.

Fiscus, C. H. 1979. Interactions of marine mammals and Pacific hake. Mar. Fish. Rev. 41:1-9.

Forney, K. A., B. J., M. M. Muto, M. Lowry, J. Baker, G. Cameron, J. Mobley, C. Stinchcomb, and J. V. Carretta 2000. U.S. Pacific marine mammal stock assessments: 2000. National Marine Fisheries Service, NOAA Technical Memorandum.

Forrester, C. R. 1969. Life history information on some groundfish species, Fish. Res. Bd. Canada Tech. Rep. 105.

Fraidenburg, M. E. 1980. Yellowtail rockfish, *Sebastes flavidus*, length and age composition off California, Oregon, and Washington in 1977. Mar. Fish. Rev. 42:54-56.

Francis, R. C., S. R. Hare, A. B. Hollowed, and W. S. Wooster. 1998. Effects of interdecadal climate variability on the oceanic ecosystems of the NE Pacific. Fish. Oceanogr. 7:1-21.

Freese, L., P. J. Auster, J. Heifetz, and B. L. Wing. 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. Mar. Ecol. Prog. Ser. 182:119-126.

Friedlander, A. M., G. W. Boehlert, M. E. Field, J. E. Mason, J. V. Gardner, and P. Dartnell. 1999. Sidescan-sonar mapping of benthic trawl marks on the shelf and slope off Eureka, California. Fish. Bull. 97:786-801.

FVCTF (U.S. Coast Guard's Fishing Vessel Casualty Task Force). 1999. Living to Fish, Dying to Fish: Report of the U.S. Coast Guard's Fishing Vessel Casualty Task Force. U.S. Coast Guard Office of Investigations and Analysis, Washington, D.C.

FVCTF (U.S. Coast Guard's Fishing Vessel Casualty Task Force). 2001. Boating Statistics, 2000. U.S. Department of Transportation, Washington, D.C., Publication COMDTPUB P16754.14.

Gabriel, W. L., and W. G. Pearcy. 1981. Feeding selectivity of Dover sole, *Microstomus pacificus*. Fish. Bull. 79:749-763.

Garrison, K. J., and B. S. Miller 1982. Review of the early life history of Puget Sound fishes. University of Washington Fish. Res. Inst., Seattle, Washington, UW 8216.

Gilden, J. 1999. Oregon's Changing Coastal Fishing Communities. Oregon Sea Grant, Oregon State University, Corvallis OR.

Gilden, J., and F. Conway 2000. An investment in trust: Communication in the commercial fishing and fisheries management communities. Oregon Sea Grant, Corvallis, OR, Publication #ORESU-G-01-004.

Giorgi, A. E. 1981. The environmental biology of the embryos, egg masses and nesting sites of the lingcod, *Ophiodon elongatus*, Seattle, Washington, NWAFC Proc. Rep. 81-06.

Giorgi, A. E., and J. L. Congleton. 1984. Effects of current velocity on the development and survival of lingcod, *Ophiodon elongatus*, embryos. Env. Bio. Fish. 10:15-27.

Golden, J. T., and R. L. Demory. 1984. Appendix 6: A progress report on the status of canary rockfish (*Sebastes pinniger*) in the INPFC Vancouver, Columiba and Eureka areas in 1984. P. F. M. Council, editor. Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991: stock assessment and fishery evaluation. Pacific Fishery Management Council, Portland, OR.

Gotshall, D. W. 1981. Pacific Coast Inshore Fishes. Sea Challengers and Western Marine Enterprises Publication, Los Osos California.

Gunderson, D. R. 1971. Reproductive patterns of Pacific ocean perch (*Sebastodes alutus*) off Washington and British Columbia and their relation to bathymetric distribution and seasonal abundance. J. Fish. Res. Board Canada 28:417-425.

Gunderson, D. R. 1979. Results of cohort analysis for Pacific ocean perch stocks off British Columbia, Washington, and Oregon and an evaluation of alternative rebuilding strategies for these stocks. Unpublished report prepared for the Pacific Fishery Management Council, Portland OR.

Gunderson, D. R. 1981. An updated cohort analysis for Pacific ocean perch stocks off Washington and Oregon. Unpublished report prepared for the Pacific Fishery Management Council, Portland, OR.

Gunderson, D. R. 1997. Spatial patterns in the dynamics of slope rockfish stocks and their implications for management. Fish. Bull. 95:19-230.

Gunderson, D. R., D. A. Armstrong, Y. Shi, and R. A. McConnaughey. 1990. Patterns of estuarine use by juvenile English sole (*Parophrys vetulus*) and Dungeness crab (*Cancer magister*). Estuaries 13:59-71.

Hagerman, F. B. 1952. Biology of the Dover sole. Calif. Dept. Fish and Game, Fish. Bull 85:1-48.

Hallacher, L. E., and D. A. Roberts. 1985. Differential utilization of space and food by the inshore rockfishes (Scorpaenidae: *Sebastes*) of Carmel Bay, California. Environ. Biol. Fish. 12:91-110.

Hankin, D., and R. W. Warner. 2001. Dungeness Crab. Pages 107-111 *in* W. S. Leet, C. M. Dewees, R. Klingbeil, and E. J. Larson, editors. California's Living Marine Resources: A Status Report. California Sea Grant Program, Davis, CA.

Hare, S. R., and N. J. Mantua. 2000. Empirical evidence for North Pacific regime shifts in 1977 and 1989. Prog. Oceanogr. 47(2-4):103-146.

Hare, S. R., N. J. Mantua, and R. C. Francis. 1999. Inverse production regimes: Alaskan and West Coast Salmon. Fisheries 24(1):6-14.

Hart, J. L. 1988. Pacific Fishes of Canada. Bull. Fish. Res. Bd. Canada 180:1-730.

Hastie, J. 2000. Analysis of the open access fishery. Pacific Fishery Management Council, Portland, OR, June 2001, Council Briefing Book Exhibit C.9, Attachment 2.

Hastie, J. 2001. Evaluation of bycatch and discard in the West Coast groundfish fishery. Unpublished report prepared for the Pacific Fishery Management Council, Portland, OR.

Helser, T. E., M. W. Dorn, M. W. Saunders, C. D. Wilson, M. A. Guttormsen, K. Cooke, and M. E. Wilkins 2002. Stock assessment of Pacific whiting in U.S and Canadian Waters in 2001. Volume I: Status of the Pacific Coast groundfish fishery through 2002 and recommended acceptable biological catches for 2003 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland OR.

Hilborn, R., J. L. Valero, and M. Maunder. 2001. Status of the sablefish resource off the U.S. Pacific coast in 2001. Appendix to the status of the Pacific Coast groundfish fishery through 2001 and acceptable biological catches for 2002 (Stock assessment and fishery evaluation). Pacific Fishery Management Council, Portland, OR.

Hobson, E. S., and D. F. Howard. 1989. Mass strandings of juvenile shortbelly rockfish and Pacific hake along the coast of northern California. Calif. Dep. Fish and Game 75:169-183.

Hogue, E. W., and A. G. Carey. 1982. Feeding ecology of 0-age flatfishes at a nursery ground on the Oregon coast. Fish. Bull. 80:555-565.

Hollowed, A. B. 1992. Spatial and temporal distribution of Pacific hake, *Merluccius productus*, larvae and estimates of survival during early life stages. Calif. Coop. Oceanic Fish. Invest. Rep. 33:100-123.

Hulberg, L. W., and J. S. Oliver. 1979. Prey availability and the diets of two co-occurring flatfish. Pages 29-36 *in* S. J. Lipovsky, and C. A. Simenstad, editors. Fish Food Habits Studies, Proceedings of the Second Pacific Northwest Technical Workshop. Washington Sea Grant University of Washington, Seattle.

Ianelli, J., and M. Zimmerman 1998. Status and future prospects for the Pacific ocean perch resource in waters off Washington and Oregon as assessed in 1998. Pacific Fishery Management Council, Portland, OR.

Ianelli, J. N., M. Wilkins, and S. Harley. 2000. Status and future prospects for the Pacific ocean perch resource in waters off Washington and Oregon as assessed in 2000. Appendix to Status of the Pacific coast groundfish fishery through 2000 and recommended Acceptable Biological Catches for 2001 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Ito, D. H. 1986. Comparing abundance and productivity estimates of Pacific ocean perch in waters off the United States. Pages 287-298 *in* Proc. Int. Rockfish Symposium. Alaska Sea Grant College Program, University of Alaska, Anchorage, Alaska.

Jacobson, L. D., and R. D. Vetter. 1996. Bathymetric demography and niche separation of thornyhead rockfish: *Sebastolobus alascanus* and *Sebastolobus altivelis*. Can. J. Fish. Aquat. Sci. 53:600-609.

Jagielo, T., P. Adams, M. Peoples, S. Rosenfield, K. R. Silberberg, and T. E. Laidig 1997. Assessment of lingcod in 1997. Pacific Fishery Management Council, Portland, OR.

Jagielo, T., and J. Hastie 2001. Updated rebuilding analysis for lingcod. Unpublished report prepared for the Pacific Fishery Management Council, Portland, OR.

Jagielo, T., D. Wilson-Vandenberg, J. Sneva, S. Rosenfield, and F. Wallace. 2000. Assessment of lingcod (*Ophiodon elongatus*) for the Pacific Fishery Management Council in 2000. Appendix to Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Jagielo, T. H. 1990. Movement of tagged lingcod, *Ophiodon elongatus*, at Neah Bay, Washington. Fish. Bull. 88:815-820.

Jensen, W. S. 1996. Pacific Fishery Management Council West Coast Fisheries Economic Assessment Model. William Jensen Consulting, Vancouver, WA.

Johnson, L. L., J. T. Landahl, L. A. Kubin, B. H. Horness, M. S. Meyers, T. K. Collier, and J. E. Stein. 1998. Assessing the effects of anthropogenic stressors on Puget Sound flatfish populations. Journal of Sea Research 39:125-137.

Johnson, S. L., W. H. Barss, and R. L. Demory 1982. Rockfish assessment studies on Hecata Bank, Oregon, 1980-81. Oregon Department of Fish and Wildlife Project Annual Report, NMFS Project No. 1-151-R-2.

Jow, T. 1969. Results of English sole tagging off California. Pac. Mar. Fish. Comm. Bull. 7:16-33.

Kendall, A. W., Jr., and W. H. Lenarz. 1986. Status of early life history studies of northeast Pacific rockfishes. Pages 99-128 *in* Proc. Int. Rockfish Symp. Alaska Sea Grant College Program, Anchorage, Alaska.

Kendall, A. W., Jr., and A. C. Matarese. 1987. Biology of eggs, larvae, and epipelagic juveniles of sablefish, *Anoplopoma fimbria*, in relation to their potential use in management. Marine Fisheries Review 49:1-13.

Ketchen, K. S. 1956. Factors influencing the survival of the lemon sole (Parophrys vetulus) in Hecate Strait, British Columbia. Fish. Res. Bd. Canada 13:647-694.

Kihara, K., and A. M. Shimada. 1988. Prey-predator interactions of the Pacific cod, *Gadus macrocephalus*, and water temperature. Bull. Jpn. Soc. Sci. Fish. 54:2085-2088.

Klovach, N. V., O. A. Rovnina, and D. V. Kol'stov. 1995. Biology and exploitation of Pacific cod, *Gadus macrocephalus*, in the Anadyr-Navarin region of the Bering Sea. J. Ichthy. 35:9-17.

Kramer, S. H., J. S. Sunada, and S. P. Wertz. 2001. California Halibut. Pages 195-198 *in* W. S. Leet, C. M. Dewees, R. Klingbeil, and E. J. Larson, editors. California's Living Marine Resources: A Status Report. California Sea Grant Program, Davis, CA.

Laidig, T. E., S. Ralston, and J. R. Bence. 1991. Dynamics of growth in the early life history of shortbelly rockfish *Sebastes jordani*. Fish. Bull. 89:611-621.

LaRiviere, M. G., D. D. Jessup, and S. B. Mathews. 1980. Lingcod, *Ophiodon elongatus*, spawning and nesting in San Juan Channel, Washington. Calif. Dept. Fish and Game 67:231-239.

Laroche, W. A., and S. L. Richardson. 1980. Development and occurrence of larvae and juveniles of the rockfishes *Sebastes flavidus* and *Sebastes melanops* (Scorpaenidae) off Oregon. Fish. Bull. 77:901-923.

Larson, M. F. 2001. Spot Prawn. Pages 121-123 *in* W. S. Leet, C. M. Dewees, R. Klingbeil, and E. J. Larson, editors. California's Living Marine Resources: A Status Report. California Sea Grant Program, Davis, CA.

Lawson, P. W. 1990. Differential selectivity of three gear arrays used in commercial trolling for coho and chinook salmon. Oregon Department of Fish and Wildlife, Ocean Salmon Management Program, Newport, OR.

Lenarz, T. E., R. J. Larson, and S. Ralston. 1991. Depth distributions of late larvae and pelagic juveniles of some fishes of the California current. Calif. Coop. Oceanic Fish. Invest. Rep. 32:41-46.

Lenarz, W. H. 1980. Shortbelly rockfish, *Sebastes jordani*: A large unfished resource in waters off California. Mar. Fish. Rev. 42:34-40.

Lenarz, W. H. 1992. Shortbelly Rockfish. W. S. Leet, C. M. Dewees, and C. W. Haugen, editors. California's Living Marine Resources and Their Utilization. California Sea Grant Program, Davis, CA.

Lenarz, W. H. 1993. An initial examination of the status of the darkblotched rockfish fishery off the coasts of California, Oregon, and Washington. Appendix C in Appendices to the status of the Pacific Coast groundfish through 1993 and recommended acceptable biological catches for 1994.

Lohn, D. R. (Northwest Regional Administrator, NOAA Fisheries). 2002. Memo to J. H. Dunnigan, Director, Office of Sustainable Fisheries, NOAA: 2002 Report to Congress on Status of Fisheries. September 10, 2002.

Longhurst, A. R. 1998. Ecological geography of the sea. Academic Press, San Diego.

Lorz, H. V., W. G. Pearcy, and M. Fraidenburg. 1983. Notes on the feeding habits of the yellowtail rockfish, *Sebastes flavidus*, off Washington and in Queen Charlotte Sound. Calif. Fish. Game 69:33-38.

Love, M. 1992. Bank Rockfsih. Pages 129-130 *in* W. S. Leet, C. M. Dewees, and C. W. Haugen, editors. California's Living Marine Resources and Utilization. California Sea Grant Program, Davis, CA.

Love, M. S. 1991. Probably more than you want to know about the fishes of the Pacific coast. Really Big Press, Santa Barbara, California.

Love, M. S., M. H. Carr, and L. J. Haldorson. 1991. The ecology of substrate-associated juveniles of the genus *Sebastes*. Environ. Biol. Fish. 30:225-243.

Love, M. S., P. Morris, M. McCrae, and R. Collins 1990. Life history aspects of 19 rockfish species (Scorpaenidae: *Sebastes*) from the southern California bight, NOAA, NMFS Tech. Rep. 87.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. Univeristy of California Press, Berkeley.

Loy, W. 2002. Here Come the halibut farmers, a look inside Scotian Halibut, Ltd. Pacific Fishing 23(10):36-37.

Lynn, R. J., and J. J. Simpson. 1987. The California Current system: The seasonal variability of its physical characteristics. J. Geophys. Res. 92(C12):12947-12966.

MacCall, A. D. 2002a. Fishery-management and stock-rebuilding prospects under conditions of low frequency environmental variability and species interactions. Bull. Mar. Sci. 70:613-628.

MacCall, A. D. 2002b. Status of bocaccio off California in 2002. Volume 1 Status of the Pacific Coast groundfish fishery through 2002 and recommended acceptable biological catches for 2003 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

MacCall, A. D., and X. He. 2002a. Bocaccio rebuilding analysis for 2002. Volume 1: Status of the Pacific Coast groundfish fishery through 2002 and recommended acceptable biological catches for 2003 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

MacCall, A. D., and X. He. 2002b. Bocaccio rebuilding analysis for 2002 (final revised version).

MacCall, A. D., D. P. S. Ralston, and E. Williams. 1999. Status of bocaccio off California in 1999 and outlook for the next millennium. Appendix to Status of the Pacific Coast groundfish fishery through 1999 and recommended acceptable biological catches for 2000 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Mace, P., and M. P. Sissenwine. 2002. Coping with uncertainty: Evolution of the relationship between science and management. Pages 9-28 *in* J. M. Berkson, L. L. Kline, and D. J. Orth, editors. Incorporating Uncertainty into Fishery Models, volume American Fisheries Society Symposium 27. American Fisheries Society, Bethesda.

MacGregor, J. S. 1986. Relative abundance of four species of Sebastes off California and Baja California. Calif. Coop. Oceanic Fish. Invest. Rep. 27:121-135.

Mantua, N. in press. The Pacific Decadal Oscillation. A. Goudie, and D. J. Cuff, editors. Encyclopedia of global change: environmental change and human society. Oxford University Press, Oxford (U.K.).

Markle, D. F., P. M. Harris, and C. L. Toole. 1992. Metamorphosis and an overview of early life history stages in Dover sole, *Microstomus pacificus*. Fish. Bull. 90:285-301.

Markle, R. L. 2000. Frequently Asked Questions About Raft Servicing [Web site]. U.S. Coast Guard. Accessed: Oct. 7, 2002 at <http://www.uscg.mil/hq/g-m/MSE4/raftsvcfaq.htm>.

Mason, J. C., R. J. Beamish, and G. A. McFarlane. 1983. Sexual maturity, fecundity, spawning, and early life history of sablefish (*Anoplopoma fimbria*) in waters off the Pacific coast of Canada. Pages 137-141 *in* Proc. Int. Sablefish Symp. Alaska Sea Grant College Program, University of Alaska, Anchorage, Alaska.

Mason, J. E. 1995. Species trends in sport fisheries, Monterey Bay, California, 1959-86. Mar. Fish. Rev. 57:1-16.

Mathews, S. B., and M. LaRiviere. 1987. Movement of tagged lingcod, *Ophiodon elongatus*, in the Pacific Northwest. Fish Bull. 85:153-159.

Matthews, K. R. 1992. A telemetric study of the home ranges and homing routes of lingcod, *Ophiodon elongatus*, on shallow rocky reefs off Vancouver Island, British Columbia. Fish. Bull. 90:784-790.

MBC (MBC Applied Environmental Sciences). 1987. Ecology of important fisheries species offshore California. Minerals Management Service, Pacific Outer Continental Shelf Region, Washington, D.C.

McCrae, J. 2001. Oregon's sardine fishery, 2000. Oregon Department of Fish and Wildlife, Newport, Oregon.

McCrae, J. 2002. Oregon's sardine fishery, 2001 summary. Oregon Department of Fish and Wildlife, Newport, Oregon.

McFarlane, G. A., and R. J. Beamish. 1983a. Biology of adult sablefish (*Anoplopoma fimbria*) in waters off western Canada. Pages 59-80 *in* Proc. Int. Sablefish Symp. Alaska Sea Grant College Program, University of Alaska, Anchorage.

McFarlane, G. A., and R. J. Beamish. 1983b. Preliminary observations on the juvenile biology of sablefish (*Anoplopoma fimbria*) in waters off the West Coast of Canada. Pages 119-135 *in* Proc. Int. Sablefish Symp. Alaska Sea Grant College Program, University of Alaska, Anchorage, Alaska.

McFarlane, G. A., and R. J. Beamish. 1986. Biology and fishery of Pacific hake *Merluccius productus* in the Strait of Georgia. Int. N. Pac. Fish. Comm. Bull. 50:365-392.

McFarlane, G. A., J. R. King, and R. J. Beamish. 2000. Have there been recent changes in climate? Ask the fish. Prog. Oceanogr. 47((2-4)):147–169.

Methot, R., and K. Piner. 2002a. Rebuilding analysis for canary rockfish update to incorporate results of coastwide assessment in 2002. In Volume 1 Status of the Pacific Coast groundfish fishery through

2002 and recommended acceptable biological catches for 2003 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Methot, R., and K. Piner. 2002b. Status of the canary rockfish resource off California, Oregon and Washington in 2001. Volume 1 Status of the Pacific Coast groundfish fishery through 2002 and recommended acceptable biological catches for 2003 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Methot, R., and J. Rogers 2001. Rebuilding analysis for darkblotched rockfish. Unpublished report prepared for the Pacific Fishery Management Council, Portland, OR.

Methot, R., F. Wallace, and K. Piner 2002. Status of yelloweye rockfish off the U.S. West Coast in 2002. Unpublished report to the Pacific Fishery Mangement Council, Portland, OR.

Methot, R. D. 2000a. Rebuilding analysis for canary rockfish. Unpublished report prepared for the Pacific Fishery Management Council, Portland, OR.

Methot, R. D. 2000b. Technical description of the stock synthesis assessment program, NOAA Technical Memorandum NMFS-NWFSC-43.

IMPLAN Professional Social Accounting & Impact Analysis Software. 2000. ver. 2.0. Stillwater MN, Minnesota IMPLAN Group, Inc.

Miller, D. J., and J. J. Geibel. 1973. Summary of blue rockfish and lingcod life histories; a reef ecology study and giant kelp Macrocystis pyrifera, experiments in Monterey Bay, California. Calif. Dept. Fish and Game, Fish Bull. 158:131.

Miller, D. J., and R. N. Lea. 1972. Guide to the coastal marine fishes of California. Calif. Dept. Fish and Game, Fish. Bull. 157:249.

Moore, S. L., and M. J. Allen. 1999. Distribution of anthropogenic and natural debris on the mainland shelf of the Southern California Bight. Pages 137-142 *in* S. B. Weisberg, and D. Hallock, editors. Southern California Coastal Water Research Annual Report 1997-1998. Calif. Coastal Water Res. Proj., Westminster, CA.

Moore, S. L., and P. W. Wild. 2001. White Croaker. Pages 234-235 *in* W. S. Leet, C. M. Dewees, R. Klingbeil, and E. J. Larson, editors. California's Living Marine Resources: A Status Report. California Sea Grant Program, Davis, CA.

Moser, H. G., and E. H. Ahlstrom. 1978. Larvae and pelagic juveniles of blackgill rockfish, *Sebastes melanostomus*, taken in midwater trawls off southern California and Baja California. J. Fish. Res. Bd. Canada 35:981-996.

Moser, H. G., R. L. Charter, P. E. Smith, D. A. Ambrose, S. R. Charter, C. A. Meyer, E. M. Sandknop, and W. Watson. 1993. Distributional atlas of fish larvae and eggs in the California Current region Taxa with 1000 or more total larvae, 1951-1984. CalCOFI Atlas 31:233.

Mulligan, T. J., and B. M. Leaman. 1992. Length-at-age analysis: Can you get what you see? Can. J. Fish. Aquat. Sci. 49:632-643.

Myers, R., K. G. Bowen, and N. Barrowman. 1999. Maximum reproductive rate of fish at low population sizes. Canadian Journal of Fisheries and Aquatic Sciences (56):2404-2419.

Nichol, D. G., and E. K. Pikitch. 1994. Reproduction of darkblotched rockfish off the Oregon coast. Trans. Am. Fish. Soc. 123:469-481.

NMFS STAT and OT STAT (National Marine Fisheries Service Stock Assessment Team and Ocean Trust Stock Assessment Team). 1998. Status of the shortspine thornyhead resource off the U.S. Pacific coast in 1998. In: Appendix to Status of the Pacific coast groundfish fishery through 1998 and recommended acceptable biological catches for 1999. Stock assessment and fishery evaluation. Pacific Fishery Management Council, Portland, OR.

NOAA (National Oceanic and Atmospheric Administration). 1990. West coast of North America coastal and ocean zones strategic assessment: Data atlas. OMA/NOS, Ocean Assessments Division, Strategic Assessment Branch, NOAA.

Norton, E. C., and R. B. MacFarlane. 1995. Nutritional dynamics of reproduction in viviparous yellowtail rockfish, *Sebastes flavidus*. Fish. Bull. 93:299-307.

NTSB (National Transportation Safety Board). 1999. Evaluation of U.S. Department of Transportation efforts in the 1990s to address operator fatigue. National Transportation Safety Board, Washington, DC, Safety Report NTSB/SR-99/01.

O'Connell, V. M., and D. W. Carlile. 1993. Habitat-specific density of adult yelloweye rockfish *Sebastes ruberrimus* in the eastern Gulf of Alaska. Fish. Bull. 91:304-309.

O'Connell, V. M., and F. C. Funk. 1986. Age and growth of yelloweye rockfish (*Sebastes ruberrimus*) landed in southeastern Alaska. Pages 171-185 *in* Proc. Int. Rockfish Symposium, volume 87-2. Alaska Sea Grant College Program, Anchorage, Alaska.

Oda, K. T. 1992. Chilipepper. Pages 122 *in* W. S. Leet, C. M. Dewees, and C. W. Haugen, editors. California's Living Marine Resources and Their Utilization. California Sea Grant Program, Davis, CA.

ODFW (Oregon Department of Fish and Wildlife). 2002. 13th Annual Pink Shrimp Review.

ODFW, and WDF (Oregon Department of Fish and Wildlife, and Washington Department of Fisheries). 1989. Status Report: Columbia River Fish Runs and Fisheries, 1960-88.

Oregon Coastal Zone Management Association 2002. Oregon's Groundfish Fishery: Trends, Implications and Transitioning Plans. Oregon Coastal Zone Management Authority, Newport OR, June 2002.

Ostrom, E. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press, Cambridge (UK).

Owen, S. L., and L. D. Jacobson. 1992. Thornyheads. Pages 132-133 *in* W. S. Leet, C. M. Dewees, and C. W. Haugen, editors. California's Living Marine Resources and Their Utilization. California Sea Grant Program, Davis, CA.

Palsson, W. A. 1990. Pacific cod in Puget Sound and adjacent waters: Biology and stock assessment. Wash. Dept. Fish. Tech. Rep. 112:137.

Pauly, D., V. Crhistensen, S. Guénette, T. J. Pitcher, U. R. Samuaila, C. J. Walters, R. Watson, and D. Zeller. 2002. Towards sustainability in world fisheries. Nature 418:689-695.

Pearcy, W. G. 1992. Movements of acoustically-tagged yellowtail rockfish *Sebastes flavidus* on Heceta Bank, Oregon. Fish. Bull. 90:726-735.

Pearcy, W. G., M. J. Hosie, and S. L. Richardson. 1977. Distribution and duration of pelagic life of larvae of Dover sole, *Microstomus pacificus*; rex sole, *Glyptocephalus zachirus*; and petrale sole, *Eopsetta jordani*, in waters off Oregon. Fish. Bull. 75:173-183.

Pearson, D. E., and S. L. Owen. 1992. English sole. Pages 99-100 *in* W. S. Leet, C. M. Dewees, and C. W. Haugen, editors. California's Living Marine Resources and Their Utilization. California Sea Grant Program, Davis, CA.

Pedersen, M. G. 1975a. Movements and growth of petrale sole tagged off Washington and southwest Vancouver Island. J. Fish. Res. Bd. Canada 32:2169-2177.

Pedersen, M. G. 1975b. Recent investigations of petrale sole off Washington and British Columbia. Wash. Dept. Fish. Tech. Rep. 17:72.

PFMC (Pacific Fishery Management Council). 1996. Status of the Pacific coast groundfish fishery through 1996 and recommended acceptable biological catches for 1997. Pacific Fishery Management Council, Portland, OR.

PFMC (P. F. M. Council). 1998. Amendment 8 (to the northern anchovy fishery management plan) incorporating a name change to: the coastal pelagic species fishery management plan. Pacific Fishery Management Council, Portland, OR, December 1998.

PFMC. 1999. West Coast Community Descriptions (Draft) [web site/pdf]. Accessed: at <http://www.pcouncil.org/communities/comdoc.html>.

PFMC (Pacific Fishery Management Council). 2001a. Draft fishery management plan and environmental impact statement for U.S. West Coast highly migratory species. Pacific Fishery Management Council, Portland, OR, December 2001.

PFMC (P. F. M. Council). 2001b. Environmental assessment/regulatory impact review/initial regulatory flexibility analysis fo proposed groundfish acceptable biological catch and optimum yield specifications and management measures for the 2002 Pacific coast groundfish fishery. Pacific Fishery Management Council, Portland (OR), December 2001.

PFMC (Pacific Fishery Management Council). 2002. Environmental assessment for the proposed 2002 management measures for the ocean salmon fishery managed under the Pacific Coast Salmon Plan. Pacific Fishery Management Council, Portland, OR, April 2002.

Phillips, J. B. 1957. A review of the rockfishes of California (Family Scorpaenidae). Calif. Dep. Fish and Game, Fish Bull. 104:158.

Phillips, J. B. 1964. Life history studies in ten species of rockfishes (genus *Sebastodes*). Calif. Dep. Fish and Game, Fish Bull. 126:70.

Piner, K., and R. Methot. 2001. Stock status of shortspine thornyhead off the Pacific west coast of the United States 2001. Appendix to Status of the Pacific Coast Groundfish Fishery Through 2001 and Acceptable Biological Catches for 2002 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Punt, A. E. 2002. SSC default rebuilding analysis: Technical specifications and user manual. Pacific Fishery Management Council, Portland, OR.

Punt, A. E., and J. N. Ianelli 2001. Revised rebuilding analysis for Pacific ocean perch. Unpublished report to the Pacific Fishery Management Council, Portland, OR.

Ralston, S. 1999. Trends in standardized catch rate of some rockfishes (*Sebastes* spp.) from the California trawl logbook database, NMFS - SWFSC Admin. Rep. SC-99-01.

Ralston, S., D. A. R. E.B. Brothers, and K. M. Sakuma. 1996a. Accuracy of age estimates for larval *Sebastes jordani*. Fish. Bull. 94:89-97.

Ralston, S., J. N. Ianelli, D. E. Pearson, M. E. Wilkins, R. A. Miller, and D. Thomas. 1996b. Status of bocaccio in the Conception/Monterey/Eureka INPFC areas in 1996 and recommendations for management in 1997. Appendix Vol. 1: Status of the Pacific Coast groundfish fishery through 1996 and recommended acceptable biological catches for 1997 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Reilly, C. A., T. W. Wyllie-Echeverria, and S. Ralston. 1992. Interannual variation and overlap in the diets of pelagic juvenile rockfish (Genus: *Sebastes*) off central California. Fish. Bull. 90:505-515.

Richardson, S. L., and W. A. Laroche. 1979. Development and occurrence of larvae and juveniles of the rockfishes *Sebastes crameri*, *Sebastes pinniger*, and *Sebastes helvomaculatus* (Family Scorpaenidae) off Oregon. Fish. Bull. 77:1-46.

Rickey, M. H. 1995. Maturity, spawning, and seasonal movements of arrowtooth flounder, *Atheresthes stomias*, off Washington. Fish. Bull. 93:127-138.

Robinson, M. K. 2000. Summary of the 2000 trial purse seine fishery for Pacific sardine (*Sadinops sagax*). Washington Department of Fish and Wildlife, Montesano, WA.

Rogers, J. B. In prep. Species allocation of 1965-1977 United States west coast foreign rockfish (*Sebastes* and *Sebastolobus* sp.) catch.

Rogers, J. B., T. L. Builder, P. R. Crone, J. Brodziak, R. D. Methot, R. J. Conser, and R. Lauth. 1998. Status of the shortspine thornyhead (*Sebastolobus alascanus*) resource in 1998. Appendix to Status of the Pacific coast groundfish fishery through 1998 and recommended acceptable biological catches for 1999 (Stock assessment and fishery evaluation). Pacific Fishery Management Council, Portland, OR.

Rogers, J. B., L. D. Jacobson, R. Lauth, J. N. Ianelli, and M. Wilkins. 1997. Status of the thornyhead resource in 1997. Appendix to Status of the Pacific coast groundfish fishery through 1997 and recommended acceptable biological catches for 1998 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Rogers, J. B., M. Wilkins, D. Kamakawa, F. Wallace, T. Builder, M. Zimmerman, M. Kander, and B. Culver. 1996. Status of the remaining rockfish in the Sebastes complex in 1996 and recommendations for management in 1997. Appendix to Status of the Pacific coast groundfish fishery through 1996 and recommended acceptable biological catches for 1997 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Rogers-Bennett, L., and D. S. Ono. 2001. Sea Cucumbers. Pages 131-134 *in* W. S. Leet, C. M. Dewees, R. Klingbeil, and E. J. Larson, editors. California's Living Marine Resources: A Status Report. California Sea Grant Program, Davis, CA.

Rosenthal, R. J., L. Haldorson, L. J. Field, V. Moran-O'Connell, M. G. LaRiviere, J. Underwood, and M. C. Murphy 1982. Inshore and shallow offshore bottomfish resources in the southeastern Gulf of Alaska (1981-1982). Alaska Dept. Fish and Game, Juneau, Alaska.

Rosenthal, R. J., V. Moran-O'Connell, and M. C. Murphy. 1988. Feeding ecology of ten species of rockfishes (Scorpaenidae) from the Gulf of Alaska. Calif. Dept. Fish and Game 74:16-36.

Sakuma, K. M., and S. Ralston. 1995. Distribution patterns of late larval groundfish off central California in relation to hydrographic features during 1992 and 1993. Calif. Coop. Oceanic Fish. Invest. Rep. 36:179-192.

Sampson, D. B. 1996. Appendix C: Stock status of canary rockfish off Oregon and Washington in 1996. P. F. M. Council, editor. Status of the Pacific coast groundfish fishery through 1996 and recommended acceptable biological catches for 1997: stock assessment and fishery evaluation. Pacific Fishery Management Council, Portland, OR.

Sampson, D. B., and C. Wood. 2001. Stock status of Dover sole off the west coast in 2000. Appendix to the Status of the Pacific Coast Groundfish Fishery Through 2001 and Acceptable Biological Catches for 2002 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Schirripa, M. J. 2002. Status of the sablefish resource off the continental U.S. Pacific coast in 2002. Volume 1: Status of the Pacific Coast groundfish fishery through 2002 and recommended acceptable biological catches for 2003 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Schirripa, M. J., and R. Methot. 2001. Status of the sablefish resource off the U.S. Pacific coast in 2001. Appendix to the Status of the Pacific Coast Groundfish Fishery Through 2001 and Acceptable Biological Catches for 2002 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Shaffer, J. A., D. C. Doty, R. M. Buckley, and J. E. West. 1995. Crustacean community composition and trophic use of the drift vegetation habitat by juvenile splitnose rockfish *Sebastes diploproa*. Mar. Ecol. Prog. Ser. 123:13-21.

Shaw, W. N., and T. J. Hassler 1989. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest) -- lingcod. Army Corps of Engineers TR EL-82-4, USFWS Biol. Rep. (11.119).

Shimada, A. M., and D. K. Kimura. 1994. Seasonal movements of Pacific cod, Gadus macrocephalus, in the eastern Bering Sea and adjacent waters based on tag-recapture data. Fish. Res. 19:68-77.

Simenstad, C. A., B. S. Miller, C. F. Nybalde, K. Thornburgh, and L. J. Bledsoe 1979. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca. US Interagency (NOAA, EPA) Energy/Environ. Res. Dev. Prog. Rep., Washington , D.C.

Smith, B. D., G. A. McFarlane, and A. J. Cass. 1990. Movements and mortality of tagged male and female lingcod in the Strait of Georgia, British Columbia. Trans. Am. Fish. Soc. 119:813-824.

Smith, K. L., and N. O. Brown. 1983. Oxygen consumption of pelagic juveniles and demersal adults of the deep-sea fish Sebastolobus altivelis, measured by depth. Mar. Biol. 76:325-332.

Smith, P. E. 1995. Development of the population biology of the Pacific hake, *Merluccius productus*. Calif. Coop. Oceanic Fish. Invest. Rep 36:144-152.

SSC Economic Subcommittee (E. S. Scientific and Statistical Committee). 2000. Report on overcapitalization in the West Coast groundfish fishery. Pacific Fishery Management Council, Portland, OR.

Stanley, R. D., B. M. Leaman, L. Haldorson, and V. M. O'Connell. 1994. Movements of tagged adult yellowtail rockfish, *Sebastes flavidus*, off the West Coast of North America. Fish. Bull. 92:655-663.

Stauffer, G. D. 1985. Biology and life history of the coastal stock of Pacific whiting, *Merluccius productus*. Mar. Fish. Rev. 47:2-9.

Stehn, R. A., K. Rivera, S. Fitzgerald, and K. D. Wohl. 2001. Incidental catch of seabirds by longline fisheries in Alaska. In. Pages 61-77 *in* E. F. Melvin, and J. K. Parish, editors. Seabird Bycatch: Trends, Roadblocks, and Solutions. University of Alaska Sea Grant, Fairbanks.

Stein, D., and T. J. Hassler 1989. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific southwest): Brown rockfish, copper rockfish, black rockfish. U.S. Fish and Wildlife Service, Biol. Rep. 82 (11.113).

Stein, D. L., B. N. Tissot, M. A. Hixon, and W. Barss. 1992. Fish-habitat associations on a deep reef at the edge of the Oregon continental shelf. Fish. Bull. 90:540-551.

Steiner, R. E. 1978. Food habits and species composition of neritic reef fishes off Depoe Bay, Oregon. M.S. Thesis. Oregon State University, Corvallis, Oregon.

Stull, J. K., and C. Tang. 1996. Demersal fish trawls off Palos Verdes, southern California, 1973-1993. Calif. Coop. Oceanic Fish. Invest. Rep. 37:211-240.

Sullivan, C. M. 1995. Grouping of fishing locations using similarities in species composition for the Monterey Bay area commercial passenger fishing vessel fishery, 1987-1992. Calif. Dept. Fish and Game Tech. Rep. 59:37.

Sumida, B. Y., and H. G. Moser. 1984. Food and feeding of Bocaccio and comparison with Pacific hake larvae in the California current. Calif. Coop. Oceanic Fish. Invest. Rep. 25:112-118.

Sunada, J. S., J. B. Richards, and L. M. Laughlin. 2001. Ridgeback Prawn. Pages 124-126 *in* W. S. Leet, C. M. Dewees, R. Klingbeil, and E. J. Larson, editors. California's Living Marine Resources: A Status Report. California Sea Grant Program, Davis, CA.

Tagart, J. V. 1991. Population dynamics of yellowtail rockfish (*Sebastes flavidus*) stocks in the northern California to Vancouver Island region. Ph.D. Dissertation. University of Washington, Seattle, Washington.

Tagart, J. V., J. T. Golden, D. K. Kimura, and R. L. Demory 1980. Evaluation of alternative trip limits for Pacific ocean perch. Unpublished report prepared for the Pacific Fishery Management Council, Portland, OR.

Tanasich, R. W., D. M. Ware, W. Shaw, and G. A. McFarlane. 1991. Variations in diet, ration, and feeding periodicity of Pacific hake (*Merluccius productus*) and spiny dogfish (*Squalus acanthias*) off the lower West Coast of Vancouver Island. Can. J. Fish. Aquat. Sci. 48:2118-2128.

USFWS and NMFS (U.S Fish and Wildlife Service and National Marine Fisheries Service). 1998. Endangered Species Consultation Handbook, Washington, D.C., March 1998.

Van Voorhees, D. A., A. Lowther, T. Sminkey, R. Andrews, P. Zielinski, and M. C. Holliday. 2001. Marine Recreational Fisheries Statistics Survey [Web page]. Fisheries Statistics and Economics Division, NOAA. Accessed: October 4, 2002 at <http://www.st.nmfs.gov/st1/recreational/survey/overview.html>.

Vojkovich, M., and S. Crooke. 2001. White Seabass. Pages 206-208 *in* W. S. Leet, C. M. Dewees, R. Klingbeil, and E. J. Larson, editors. California's Living Marine Resources: A Status Report. California Sea Grant Program, Davis, CA.

Wakefield, W. W., and K. L. Smith. 1990. Ontogenetic vertical migration in *Sebastolobus altivelis* as a mechanism for transport of particulate organic matter at continental slope depths. Limnol. Oceanogr. 35:1314-1328.

Wallace, F. R. 2002. Status of the yelloweye rockfish resource in 2001 for northern California and Oregon waters. Appendix to the Status of the Pacific Coast Groundfish Fishery Through 2001 and Acceptable Biological Catches for 2002 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Walters, C. J. 1986. Adaptive Management of Renewable Resources. McGraw-Hill, New York.

Walters, C. J., and J. F. Kitchell. 2001. Cultivation/depensation effects on juvenile survival and recruitment: implications for the theory of fishing. Can. J. Fish Aquat. Sci. 58:39-50.

Weinberg, K. L. 1994. Rockfish assemblages of the middle shelf and upper slope off Oregon and Washington. Fish. Bull. 92:620-632.

Wessells, C. R. a. J. E. W. 1992. Inventory dissipation in the Japanese wholesale salmon market. University of Rhode Island / Oregon State University, October 1992, RI-92-108.

Westrheim, S. J. 1975. Reproduction, maturation, and identification of larvae of some *Sebastes* (Scorpaenidae) species in the northeast Pacific Ocean. J. Fish. Res. Board Canada 32:2399-2411.

Westrheim, S. J., and A. R. Morgan. 1963. Results from tagging a spawning stock of Dover sole, *Microstomus pacificus*. Pac. Mar. Fish. Comm. Bull. 6:13-21.

Wilbur, A. R., and M. W. Pentony. 1999. Human-induced nonfishing threats to essential fish habitat in the New England region. L. R. Benaka, editor. Fish Habitat: Essential Fish Habitat and Rehabiliation. American Fisheries Society, Bethesda, MD.

Williams, E. H., A. D. MacCall, S. Ralston, and D. E. Pearson. 2000. Status of the widow rockfish resource in Y2K. Appendix to Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Williams, E. H., S. Ralston, A. D. MacCall, D. Woodbury, and D. E. Pearson. 1999. Stock assessment of the canary rockfish resource in the waters off southern Oregon and California in 1999. Status of the Pacific coast groundfish fishery through 1999 and recommended acceptable biological catches for 2000 (Stock Assessment and Fishery Evaluation). Pacific Fishery Management Council, Portland, OR.

Wishard, L. N., F. M. Utter, and D. R. Gunderson. 1980. Stock separation of five rockfish species using naturally occurring biochemical genetic markers. Mar. Fish. Rev. 42(3-4):64-73.

Wyllie Echeverria, T. 1987. Thirty-four species of California rockfishes: Maturity and seasonality of reproduction. Fish. Bull. 85:229-240.

Yang, M. S. 1995. Food habits and diet overlap of arrowtooth flounder (*Atheresthes stomias*) and Pacific halibut (*Hippoglossus stenolepis*) in the Gulf of Alaska. Pages 205-223 *in* In Proc. Int. Symp. Pac. Flatfish. Alaska Sea Grant College Program, University of Alaska, Anchorage, Alaska.

Yang, M. S., and P. A. Livingston. 1985. Food habits and diet overlap of two congeneric species, *Atheresthes stomias* and *A. evermanni*, in the eastern Bering Sea. Fish. Bull. 84:615-623.

10. RESPONSE TO COMMENTS RECEIVED

10.1 Summary of Comments and Responses

A notice of availability for the Draft EIS for Groundfish Annual Specifications and Management Measures was published in the Federal Register on October 25, 2002 (67 FR 65564), with the comment period ending on December 9, 2002. Three comment letters were received, from the EPA, The Ocean Conservancy, and the Natural Resources Defense Council. In responding to comments, the action agency may: (1) modify the alternatives proposed in the DEIS or develop new alternatives, (2) modify, supplement or improve analyses and make factual corrections, and/or (3) explain why the comments do no warrant further response (40 CFR 1503.4). Comments and recommendations in the three comment letters are summarized below, followed by the agency response. These summaries represent a best effort to extract the relevant points made by commenters that are specific to the EIS. Responses may cite additional, qualifying discussion in the letters in formulating the response. Where a comment has resulted in the modification or revision of the EIS, the relevant sections are noted. Because only three comment letters were received, they are also reproduced in full after the comment and response list.

Environmental Protection Agency Comments

Bocaccio Harvest

1. *The FEIS should address the environmental and policy implications of choosing an alternative which falls below the NSG guidelines for probability of rebuilding bocaccio stocks. Mitigation to address this inconsistency, if any, should be included in the FEIS. Given the potentially significant impacts to bocaccio stocks if any harvest is allowed, EPA encourages NMFS to consider implementing the Low OY alternative, which prohibits any harvest of bocaccio.*

Bocaccio rockfish stock status and the potential effects of the 2003 specifications and management measures package on the bocaccio stock are discussed in Sections 3.2.1.1 and 4.2.1.1, respectively. During its specifications and management measures process, the Council considered the Low OY alternative for all overfished species. This response provides more detail on the NMFS sustainability analysis and on the process for developing management recommendations for a species with rebuilding needs that fall outside of the National Standard Guidelines parameters.

In 2002, a new stock assessment was prepared for bocaccio rockfish in the Conception and Monterey areas, the statistical areas where the bocaccio rockfish stock is overfished. This new assessment uses a length-based stock synthesis model similar to that used for the 1999 assessment, but differs from the previous assessment in that it (1) includes new information from a larger area of southern California; (2) moves the beginning of the assessment time period back 18 years; (3) updates estimates of commercial and recreational landings data; (4) uses a "jackknife" statistical method to estimate precision of abundance indexes rather than using assumed values of precision, which is a useful procedure when the data dispersion or distribution are wide or extreme; (5) omits triennial survey data from hauls where the trawl gear did not actually fish on the ocean floor (so-called "water hauls"); (6) adds an index of larval abundance reflecting spawning biomass; (7) adds a recreational "catch per unit effort" (CPUE) index for 1980-2001; and (8) includes a new recruitment index based on the impingement rate of juvenile bocaccio rockfish in saltwater intakes at southern California electric power plants between 1972-2000.

The new bocaccio rockfish assessment is consistent with the finding in previous assessments that there has been a declining biomass trend since 1969. The new assessment estimates that the bocaccio rockfish spawning stock biomass in the Monterey and Conception areas is at about 3.6% of its unfished biomass. The estimated biomass for 2002 (age 2+ fish) is 2,914 mt. The ABC for bocaccio rockfish, which is based on the new assessment with an F_{MSY} proxy of $F_{50\%}$, is 198 mt.

Bocaccio was declared overfished in 1999. Since 2000, the bocaccio OY has been set to be a constant harvest level of 100 mt. This level was based on the 1999 rebuilding analysis and was estimated to have a 67% probability of rebuilding the stock to B_{MSY} by 2033. The new assessment in 2002 found that the rate of rebuilding would probably be lower than projected from the 1999 assessment and that the harvest level would need to be lowered. Based on the new stock assessment and a new rebuilding analysis, the Council, at its June 2002 meeting, recommended for further analysis a bocaccio rockfish OY for 2003 of 5.8 mt. This new OY was associated with a constant mortality rate and a 50% probability of rebuilding to B_{MSY} by the year 2109 (T_{MAX}). At this same meeting, the Council requested that the rebuilding analysis be updated using procedures recommended by the SSC. Following the June 2002 Council meeting and prior to revision of the bocaccio rebuilding analysis, the rebuilding model for all overfished species was refined to more accurately account for actual catch occurring during and after the initial year of rebuilding.

In the revised bocaccio rebuilding analysis prepared following the June Council meeting, the stock failed to have a 50% probability of rebuilding by T_{MAX}, even in the absence of fishing. T_{MAX} is the maximum time for rebuilding established by the National Standard Guidelines (50 CFR 600, subpart D). This failure is due to lower estimated recruitment of the 1999 year class and recent landings that exceeded the rebuilding OYs. Bocaccio landings in 2000 and 2001 were respectively 69 and 47 mt over the OY levels set in 2000. In addition, hindsight shows, based on the new rebuilding analysis' calculation of the actual strength of the 1999 year class, that the OYs for 2000 and 2001 had been set too high in view of the actual strength of the 1999 year class. The OYs set for 2000 and 2001 created a "rebuilding deficit" that will take more than T_{MAX} to recover from. NMFS subsequently prepared a sustainability analysis for bocaccio rockfish. A rebuilding analysis addresses the fishing rates associated with rebuilding an overfished stock to a target abundance within a specified time frame, whereas a sustainability analysis addresses the fishing rates that would lead to no further decline in abundance over a specified time frame. In both types of analysis, the uncertainty of future reproductive successes requires that the results be described in terms of probabilities rather than certainties. The sustainability analysis shows that a harvest level of #20 mt would provide a 50% probability for the stock to rebuild in 170 years, with a high probability (>80%) of no further decline in the spawning biomass over the next 100 years. The Council's SSC concluded that the sustainability analysis represented the best available science and endorsed its use in setting 2003 harvest levels. The Council agreed with the SSC recommendation. The National Standard Guidelines do not address the situation where, based on the updated rebuilding analysis, that a stock cannot be rebuilt within T_{MAX}, even with zero fishing mortality. Therefore, the National Standard Guidelines do not provide sufficient guidance for the bocaccio rockfish situation and instead the Magnuson-Stevens Act must be looked to directly for guidance. Section 304(e)(4)(A)(i) states that a rebuilding period shall "be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem."

The Magnuson-Stevens Act requires that the Council and NMFS meet the conservation needs of the stock (National Standard 1), and also consider the needs of fishing communities (National Standard 8). Balancing these considerations, zero fishing mortality is not required for this situation. Zero fishing mortality would seriously adversely affect fishers and communities in California south of Cape Mendocino, California. In this area, commercial fisheries (including fisheries for non-groundfish species) and recreational fisheries that incidentally catch bocaccio would be severely curtailed or closed for many years into the future. Bocaccio is taken incidentally in a wide variety of fisheries, ranging from recreational fisheries that operate off piers and jetties taking juvenile bocaccio in nearshore waters, to commercial purse seine fisheries for squid and other coastal pelagic species.

The OY recommended by the Council, which is based on the sustainability analysis, the needs of fishing communities, and the biology of the stock, has a low probability of driving the stock into further decline and will not materially jeopardize future rebuilding. The large historical biomass of bocaccio occurred through accumulation over time of biomass from several intermittent, large recruitments. These large recruitment events are thought to be connected to currently unknown and unpredictable ocean conditions. Bocaccio rebuilding depends on the future occurrence of similarly large recruitment successes. Although the 1999 year class was in fact smaller than had been projected in 1999, it is still the largest year class since 1991. The recruitment success observed in 1999 indicates that the current spawning biomass is capable of initiating the rebuilding, but substantial rebuilding awaits the future occurrence of several such successes. Based on the current information, bocaccio will still be able to rebuild at the proposed OY level. The analysis shows an 80% probability of no further decline after 100 years, a 50% probability (the standard reference probability level) of rebuilding within 170 years, and a 33% probability of rebuilding by the year 2109. Thus the recommended OY is consistent with the Magnuson-Stevens Act.

The Council has recommended a broad series of management measures intended to mitigate for the effects of the recreational and commercial fisheries on bocaccio and other overfished species. Depth-based management measures intended to prevent vessels from fishing in depths where they are most likely to encounter bocaccio will be applied south of Cape Mendocino. These closures will apply to both groundfish and non-groundfish fisheries that are likely to encounter bocaccio. Shrimp and prawn trawlers coastwide are being required by the states to carry bycatch reduction devices and the use of trawl gear is being phased out of the spot prawn fishery. The recreational fisheries for groundfish off California have been constrained to a six month season with lower bag limits for species that associate with bocaccio.

2. *The FEIS should include an updated discussion on the listing status of bocaccio under the Endangered Species Act.*

On November 19, 2002 (67 FR 69704,) NMFS announced its 12-month finding on a petition to list the southern population of bocaccio as a threatened species and to designated critical habitat under the ESA. In that announcement, NMFS found that listing of the southern population of bocaccio was not warranted. In that notice, NMFS specifically found that the bocaccio catch rate proposed by the Council for 2003 would prevent bocaccio from becoming endangered within the reasonably foreseeable future. NMFS could re-evaluate its decision to not list bocaccio in the future. Reasons for a re-evaluation would include, but are not limited to: (1) if future Council decisions allow for an increased exploitation rate; or (2) if future data or analyses indicate that conservation efforts are inadequate. Section 4.6.2.6 (cumulative impact factors, listing of species) has been updated to describe this decision.

Enforcement

3. *The FEIS should provide a thorough discussion of how NMFS and PFMC will ensure enforcement of the proposed guidelines. The current status of efforts to obtain funding and technical assistance to implement Vessel Monitoring Systems and/or increased observer coverage on vessels as a means of enforcing the 203 specifications should also be discussed. In the absence of these methods of enforcement, the FEIS should provide a substantive discussion of how NMFS and the Council will monitor and enforce depth and area closures in 2003 through other management measures.*

NMFS, in consultation with the Council and the Ad Hoc VMS Committee, is preparing a proposed rule and an associated Environmental Assessment/ Regulatory Impact Statement/ Initial Regulatory Flexibility Analysis (RIR/IRFA) for a pilot VMS program for 2003. The RIR/IRFA provides a description of the range of fishery monitoring alternatives considered, including their associated costs, as well as an analysis of their impacts. Sections 3.5.3 (Fishery Management and Enforcement) and 4.5.1 (Enforcement Impacts) have been revised to address this comment.

State and Federal Fisheries

4. *The FEIS should clarify the management authority relationship between NMFS, PFMC, and the states, and whether the proposed action by NMFS and PFMC includes all waters to 20 fathoms. In addition, actions by Washington, Oregon, and California in their nearshore fisheries which might have an impact on federal management of the Fishery Management Plan should be discussed.*

A new section, Section 3.5.4, has been added to the DEIS, describing the roles and responsibilities of federal, state, and tribal governments in managing marine fisheries. (The heading Uncertainty and Risk in the Management Process has been re-numbered section 3.5.5.)

Trawl Exemptions

5. *Given the large percentage of trawlers in the groundfish fleet, the FEIS should address the specific impacts associated with trawl exemptions to depth and area closures. In particular, the document should*

discuss the effectiveness of gear adjustments in avoiding or limiting impacts on overfished species, and the impacts to essential fish habitat.

Additional discussion and analysis has been added to Section 4.2.1.1 (Impacts to Overfished Stocks) to address impacts of trawl exemptions on overfished species. Impacts to essential fish habitat are considered in revisions to Section 4.1 (Impacts to Ecosystem, Habitat and Biodiversity).

Ecosystem Impacts

6. *The FEIS should discuss the indirect effects on the ecosystem through changes in the relative numbers and size structure of various species populations. In particular, the document should address whether some species are more affected by density dependent predator prey dynamics and what impacts that has on rebuilding models.*

The Ocean Conservancy (comment #3) and NRDC (comment #20) also commented on the adequacy of the analysis related to ecosystem effects. The EPA comment describes a variety of ways in which stock productivity can be affected by changes in climate regime and trophic structure. These types of effects are described in Section 3.1 and 4.1. Although additional information can be, and has been, added to the EIS, based on a recent paper by MacCall {, 2002 #597} (see section 4.6.2, covering factors cumulatively affecting the ecosystem), it must be emphasized that the current state of scientific knowledge does not allow us to quantitatively predict the magnitude of ecological effects of a suite of management measures. Indeed, fishery scientists are only beginning to explore incorporating climatological and ecological factors into the population models forming the basis of stock assessments and rebuilding analyses. The current state of knowledge about exploited marine ecosystems is, in most cases, insufficient to reliably incorporate such ecological effects into these models (Drs. Alec MacCall and Richard Methot, NMFS, pers. comm., 12/13/2002). The ability to predict the ecological effects of a suite of management measures would be a further extension of this research. (Section 3.1 has been expanded to include an overview of current research into fishery ecosystem dynamics specific to the northeast Pacific.) Thus, while it is possible describe these effects, both of climate regime on fish stocks and fishing on habitat and ecosystem (as the EIS already does), it is not possible to quantitatively predict the magnitude of the habitat and ecosystem effects of management measures in each alternative. In the absence of this predictive ability, the EIS is meant to disclose some of the potential effects of fishing, and in necessarily speculative fashion, compare the relative effects of the alternatives on habitat and ecosystem. The relative effects are presumed to correlate with total fishing effort and its distribution under the alternatives, which must also be evaluated qualitatively since currently we do not model projected fishing effort across all fisheries. It is this approach that led to the apparently contradictory statements pointed out by The Ocean Conservancy and NRDC: we know that the alternatives would have differential effects on ecosystem and habitat but we cannot specify the magnitude of those effects with any precision. Thus, the alternatives are "indistinguishable" in that we do not know precisely what these effects will be, yet if we assume the effects are correlated with fishing effort then we can infer the <u>relative</u> effects of the alternatives based on an assessment of the level of fishing that would occur. Statements in Table 2.4-1 have been re-worded to clarify this point.

CEQ regulations recognize that it may not be possible to fully predict the effects of an action because of the insufficiency of information (40 CFR 1502.22). In this case, in addition to recognizing that information is "incomplete or unavailable," the statement shall describe the relevance of this lack of information to evaluating significant adverse impacts, summarize "existing creditable scientific evidence" and evaluate impacts "based upon theoretical approaches or research methods generally accepted in the scientific community." The description and evaluation in this EIS are meant to comport with these dictates.

Tribal Fishing Rights

7. *The FEIS should provide a more thorough discussion of tribal fishing rights in the Pacific coast groundfish fishery, including information on NMFS and PFMC's coordination with tribes in managing Pacific coast groundfish, and the federal government's tribal trust and/or treaty responsibility to uphold tribal fishing rights.*

See EPA comment #4 above. A new section has been added to the FEIS addressing federal, state, and tribal roles and responsibilities in fishery management.

Alternatives

8. *The FEIS should provide a brief definition and introduction of the concept of depth-based management before the individual alternatives, in Chapter 2, stating what constitutes the shallow and deep lines, how these restrictions help meet harvest goals, and whether they are intended solely to deal with bycatch or also as a means to limit/extend the fishing season over the year for allowable directed harvest of some species.*

Additional material has been added to sections 2.1 and 2.2 to better describe the concept of depth-based management.

The Ocean Conservancy Comments

1. *Explain why socioeconomic impacts under the Low OY Alternative, particularly for recreational fishing, are so much greater than under the other alternatives.*

On the commercial side, an explanation of the calculation of gross revenues for the Low OY Alternative is provided in Section 4.3.2.1. In that section a list of the California fisheries that could potentially catch bocaccio and would therefore have to be closed or restricted into areas in which they have very low catch per unit effort is provided.

In the DEIS, the reduction in recreational trips needed to conserve bocaccio was overestimated due to problems with the RecFIN algorithms used to generate these estimates from MRFSS data. As a result, new estimates have been generated as discussed in the FEIS in Section 4.3.4.1 and presented in Table 4.3-12. The new estimates are based on the assumption that all recreational groundfish trips south of Cape Mendocino would have to be prohibited under a zero bocaccio OY. In addition to the recreational groundfish fisheries that are the basis of the estimates, other fisheries – particularly recreational fisheries that do not target on groundfish but which have bocaccio bycatch, and shore-based fishing for which there are records of juvenile bocaccio harvest – would also likely need to be restricted. These fisheries are not included in the estimates.

2. *The Final EIS should include an analysis of an alternative proposed by The Ocean Conservancy under which "all bottomfishing is prohibited in prime bocaccio habitat, except under an EFP" and with 100% observer coverage. Referring to prime bocaccio habitat, this measure would apply in the California Rockfish Conservation Area (CRCA), which occurs within the range of the southern bocaccio stock. So-called "hard bycatch caps" would also be applied to fishing within the CRCA, under which fisheries would close once total catch reached a specified amount. In order to implement this measure NMFS may need to pre-empt the State of California's authority to manage exempted trawl fisheries such as California halibut, sea cucumbers, pink shrimp, spot prawns, and ridgeback prawns. In addition, regulations based on a "take and retain, possess or land" standard should be modified so that bycatch of bocaccio and other overfished rockfish species may be controlled and effectively monitored.*

The California Rockfish Conservation Area (CRCA), which is specified under the Council-Preferred Alternative, encompasses the affected area of prime bocaccio habitat. Under this preferred alternative, gears are prohibited from fishing within the CRCA that have demonstrated a bycatch of bocaccio. Such gears include trawl nets, fishing lines with more than 1 lure/hook and 6 oz or more of weight attached, fish traps and fish pots, and set gill and trammel nets with mesh sizes less than 6 inches. The exemptions that allow fishing opportunities within the CRCA are estimated to have a minimal bocaccio impact while providing for significant socioeconomic benefits to California fishing communities. The cumulative estimated total mortality of bocaccio under the Council-Preferred Alternative is 10.3 mt (see Table 4.4-1 in the EIS). Sources of mortality include the exemptions to the CRCA fishing restrictions, EFPs, and research fisheries. While The Ocean Conservancy comment that these exemptions should only occur under the auspices of an EFP with 100% observer coverage has merit in terms of reducing uncertainty in monitoring bycatch, the concept was not analyzed in the EIS for the following reasons: 1) all fisheries exempt from the CRCA that have a probability of some bocaccio bycatch will be subject to the NMFS Observer Program by federal and state regulations, and 2) requiring 100% observer coverage in these exempt fisheries would deplete the pool of observers in the NMFS Observer Program and compromise observer availability for other sectors of the West Coast groundfish fishery that operate outside the CRCA. The general concept of managing fisheries using observer data and bycatch caps was also not included in the EIS analysis for the reasons explained in section 2.3. This section as well as section 4.2.1.1 were revised in the FEIS to better explain the rationale for this decision and to provide updated information regarding the utilization of observer data in 2003 management. The updated information was not available before the DEIS was available for public review. Furthermore, The Ocean Conservancy recommends stronger regulatory language to more effectively control bycatch. Commenters object to the regulatory language of "take and retain, possess or land" that is used for groundfish management. NMFS continues to use the "take and retain, possess and land" language for species and in areas where fishing is allowed. This is an effective tool for controlling overall harvest. The bycatch monitoring and assessment process related to this management is explained at section 4.5. However, this regulatory language is not the only management tool being used. For 2003, NMFS is using additional management tools that address the concerns of the commenter, in particular by closing large areas to fishing by specific gear types as explained throughout the EIS.

3. *Better explain the effects of the different alternative on ecosystems and marine species not managed under an FMP.*

See response to EPA comment #6.

4. *Implement the mitigation measures outlined in Section 4.7.7*

The EIS must include a discussion of the “means to mitigate adverse environmental impacts” (40 CFR 1502.16(h)) if not already covered in the proposed action or alternatives (40 CFR 1502.14(f)). These mitigation measures are meant to address the impacts resulting from the proposed action, even those that by themselves are not significant. All relevant, reasonable mitigation measure must be identified, even if they are outside the agency's jurisdiction. However, NEPA does not require the agency to necessarily carry out mitigation measures identified in the EIS as part of the action analyzed by the EIS. The agency's Record of Decision (ROD) identifies which mitigation measures the agency will commit to implementing. Thus, in response to the comment that the agency should implement the mitigation measures identified in section 4.7.7 of the EIS, the agency will evaluate those mitigation measures and implement those necessary to reduce significant impacts that have been identified. It is important to note that the proposed action, as implemented through the preferred alternative identified in the EIS, is essentially mitigative in that it seeks to constrain fishing to levels that allow sustainable use of groundfish resources. The preferred alternative is not expected to result in significant impacts (particularly with respect to overfishing), and mitigation measures identified in the EIS are in part intended to further reduce uncertainty about resource status.

NRDC comment #4 advocates developing the mitigation measures as alternatives. However, this misconstrues the purpose of mitigation measures as distinct from alternatives. The range of alternatives reflect different sets of fishery management measures meant to constrain fishing to sustainable levels. The mitigation measures are intended to address those unavoidable impacts of the preferred alternative that result from the MSA-mandated need to meet both the conservation standard of preventing overfishing (National Standard 1) and provide for sustained participation by fishing communities while minimizing adverse impacts to them (National Standard 8).

It should also be noted that several of the possible mitigation measures listed in Section 4.7.7 are already underway.

For example, steps have already been taken to increase observer coverage. The initial observer coverage plan was designed to attain 10% coverage (in metric tons landed) of the limited entry trawl fishery, and pilot coverage of the limited entry fixed gear fishery. The actual coverage has exceeded these goals, by attaining 16% coverage of the total tonnage landed from the limited entry fishery by increasing the number of observers from 20 to 40. During the first year of the program, 80% of the limited entry trawl vessels (excluding the

Pacific whiting vessels) carried observers for at least one two-month cumulative limit period. This is significant because limited entry trawlers catch by far the most groundfish. In 2001, the limited entry trawl fleet took 98% of the total groundfish catch by weight (or 84% of the groundfish excluding Pacific whiting). In addition, NMFS has recently begun to place observers on the open access fleet.

Observer coverage and distribution during the first year of the observer program were designed to provide NMFS with the information and data necessary to determine what level and distribution of long-term observer coverage will be adequate to provide reliable information on bycatch in the groundfish fishery. Data obtained during the first year also provide a basis for making adjustments to the observer coverage strategy that will further improve the precision of observer bycatch and discard data in the future.

The issue of excess capacity is being addressed in part through the Council's Strategic Plan, which was adopted in October 2000, and is in now in the implementation phase. One purpose of the Strategic Plan is to reduce harvest capacity initially by 50% in each sector. Towards this goal, NMFS and the Council are currently preparing a programmatic EIS that evaluates a number of different alternatives for long-term management of the groundfish fishery, including additional limited access measures. The Draft Programmatic EIS is scheduled to be completed in August of 2003.

With respect to new gear designs, NMFS is in the process of issuing an Exempted Fishing Permit to the State of Oregon to conduct cooperative research with the NMFS Northwest Fisheries Science Center to evaluate a new trawl design for flatfish with a cutback headrope that reduces rockfish bycatch by allowing rockfish to swim upward and out of the trawl. If testing of this gear is successful it will may lead to a regulation as soon as 2004 that will require use of this type of trawl when fishing for flatfish.

Other mitigation efforts are also underway as described in Section 4.7.7.

5. *Clearly distinguish between bycatch and landings, and where estimates of total mortality are made, provide citations for this information.*

The tables in section 3.4 attempt to provide relevant landings and discard data by fishery or fishery sector. Landings are distinguished from discard in these table titles. One revision to the EIS that may make one of these tables more explicit is to change the Table 3.4-5 title to read. "Landings (mt) of target species and estimated <u>discard</u> mortality (mt) of overfished West Coast groundfish species ..." . This title has been revised accordingly. The EIS attempts to provide accurate catch accounting information to better understand where overfished species are being caught and to ground the analysis of effects of alternative management measures. Although the EIS provides historical data on catch and landings, the analysis focuses more strongly on recent fishery data. In recent years, groundfish fishery management has changed dramatically to accommodate a new management regime based on rebuilding overfished species. In analyzing how alternative management measures may affect total fishing mortality, the EIS focuses on effects within the context of the 1999-present rebuilding regime. Fisheries information from 1998 and prior years may not be as relevant to analyzing current fishery management proposals because it describes a pre-rebuilding management regime, when trip limits and other management measures were notably less restrictive. It is not clear from the comments where spot prawn information in the EIS contradicts that provided by CDFG. The CDFG reports where this information was obtained are cited. The EIS authors are not aware of other reports relevant to this issue.

6. *Correct any inaccuracies regarding bycatch in the spot prawn fishery.*

See response to comment #5 above.

7. *Include historical landings data and estimated discards for all groundfish fisheries and fisheries with significant impact to overfished groundfish, particularly exempted trawl fisheries, for the 1996-2000 period.*

Historical landings for all groundfish fisheries and for those fisheries with impacts on overfished species are provided in Table 3.3.1 going back to 1981. Historical information on discards has been provided where available; however, such information is very sparse. California had some logbook programs, which collected catch and bycatch information, and that information was requested and provided in Chapter 3. Oregon and Washington were asked for similar information however the information was unavailable.

8. *Identify the 2000-2001 fishing year as unsustainable and to provide notes in the document stating that socioeconomic benefits could not be sustained in the longer term, in accordance with the SFA, at the 2000-2001 levels.*

The purpose of the baseline is only to provide a standard comparison point between the alternatives and to provide the public with a sense of how the fishery will be changing relative to their experience of the fishery at some recent point in time. As such, the base period provides a standard against which the performance of the alternatives relative to one another can be measured. Base period harvest levels may not be sustainable, depending on the present and future status of stocks involved in the fishery and MSA policy regarding the management of overfished species. Section 4.3.1 of the FEIS has been revised to reflect that to reflect that under the current circumstances 2000-2001 fishing levels would not be sustainable.

9. *Acknowledge the failure of management measures to rebuild bocaccio in accordance with the National Standard Guidelines.*

See response to EPA comment #1.

10. *The Ocean Conservancy also commented generally on the adequacy of the bycatch projections for the 2003 fishery. They question the adequacy of the "Hastie" model because "it does not include discard information" and only applies to the trawl fishery. They also question whether the "best available scientific information" has been used to project bycatch mortality due to 2003 groundfish management measures and cite information from the EIS to demonstrate such potential underestimation. (See pages 3-6 of the comment letter.) Additional recommendations to improve bycatch monitoring include using federal groundfish observer data that will become available in early 2003 to refine the Hastie bycatch model and adjust management measures inseason in 2003; require fishers to document discards (bycatch) in logbooks (recognizing that there may be some under-reporting); implement an industry funded observer program for state managed fisheries operating in the CRCA; and request additional funds from Congress for the West Coast Groundfish Observer Program as part of 2003 appropriations legislation.*

It is acknowledged in the EIS that the Hastie bycatch model only pertains to the trawl fishery. Lack of available information regarding bycatch in the other sectors of the West Coast groundfish fishery compelled consideration of depth-based management to exclude other gears such as longline gears from the depth zones where overfished species reside. Although this has profound adverse socioeconomic impacts as described in the EIS, it was judged a reasonable strategy given the uncertainty in accounting for bycatch in the affected fishery sectors. In fact, even in the trawl fishery, where the Hastie model is informative to bycatch implications of different fishing strategies, depth-based restrictions are recommended as precautionary in the face of uncertainty. The bycatch implications of the Hastie model are also conservative due to the fact the model uses 1999 logbook data. The mitigating effect of small footrope restrictions that were first imposed on the fishery in 2000 are not factored into the model. Small footrope restrictions, where footropes less than 8 inches in diameter and no chafing gear on the net are required, prevent bottom trawls from fishing the rocky bottoms where most overfished rockfish species occur.

The comment that the Hastie model is inadequate because it is based on landings, not on discards, is also partially disputed. While logbook and landings data are the primary inputs to the Hastie model, discards of overfished species are estimated, not ignored. Discards are estimated in the Hastie model by estimating co-occurrence rates of overfished species relative to the trawl target species as indicated in 1999 logbooks and fish receiving tickets. Allowable landings in 1999 were less constrained than in the current management regime. The co-occurrence rate relative to current limits of both the target species and the overfished species predicts the discard rate of overfished species. This indirect method of determining discard and bycatch may be inferior to direct observations of the fishery, but it is reasonable and does represent the best available science for management application. Nevertheless, the Council and NMFS will convene a bycatch workshop in January 2003 to refine this bycatch model by incorporating observer data (see revised section 2.3). Eventually, the model will be supplanted by one based entirely on direct observations of the fishery.

Natural Resources Defense Council Comments

1. *The range of bocaccio OYs is inadequate.*

The commenter argues that the two bocaccio OYs—0 mt under the Low OY Alternative and #20 mt for all the other alternatives—is an inadequate range. In particular, they argue that the decision not to analyze a 5.8 mt, which was put forward and initially adopted by the Council at their June meeting, is "indefensible." The reason why this OY value was subsequently dropped in deference to the 20 mt harvest cap is explained in Section 4.2.1.1 of the EIS and the reader may also wish to refer to response to EPA comment #1 for a fuller explanation of the choice of bocaccio OYs. The 5.8 mt OY resulted from the rebuilding analysis program developed by Dr. Andre Punt of the University of Washington, which set the initial year of rebuilding to the current year. The Council recognized that this was not the correct basis for the analysis; rebuilding trajectories should be calculated from the year the species was declared overfished. In correcting the rebuilding program in this way the overharvests in 2000-2001 were accounted for in the analysis (see also NRDC comments #14 and #21). The 5.8 mt value thus does not reflect "the best available science," one of the National Standards in the Magnuson-Stevens Act.

As a result of the 2000-2001 overharvests and the new, more pessimistic stock assessment completed in 2002, on which the rebuilding analysis is based, it is projected that even in the absence of fishing the stock will not rebuild within the time frame mandated by National Standard Guidelines with a greater than 50% probability. Subsequently, a "sustainability analysis" was performed—similar to how the stock would be treated if listed under the ESA—to determine the probabilities of no further decline in the stock over the next 100 years for a range of harvest levels. The zero harvest level, which is part of the Low OY Alternative, represents one possible end of this range, and also represents the highest probability of no further decline (90%) and of recovery to B_{MSY} by T_{MAX} (49%) (see Table 4.2-2). The "#20 mt" OY value used in the other alternatives represents a cap, or limit, rather than a target . As such, it represents a range of possible total catch mortalities, which could vary depending on the actual management measures that would be implemented under the different alternatives. This cap comes with the admonition that management must be prosecuted so that total catch mortality is kept as close to zero as possible. This approach therefore allows analysis of a reasonable range of alternatives when evaluated in terms of projected harvests under each alternative's management measures. These management measures constrain actual bocaccio harvest (total fishing mortality) to a range of levels, with varying socioeconomic impacts, which are less severe than under the Low OY Alternative (with its 0 mt bocaccio OY). Estimates of bycatch in the limited entry trawl fishery, derived from the Hastie bycatch model and reproduced in the summary tables in Chapter 2, give an indication of this range (see Tables 2.1-9 through 2.1-1 and 2.1-15). Aside from the Low OY Alternative, in terms of limited entry trawl management measures, the Council-preferred Alternative results in the lowest projected bycatch in the limited entry trawl fishery, at 1.5 mt, while the Allocation Committee Alternative without depth restrictions results in the highest level, at 14 mt. Recognizing that there will be some bycatch in other fisheries, estimated bycatch under the different alternatives constitutes a range that is substantially below the 20 mt cap. Bycatch across all fisheries is estimated for the preferred alternative in Table 4.4-1 at 10.3 mt. The action alternatives adequately represent the range of overfished bycatch that are acceptable under the management framework. In addition, Table 4.4-1 also gives the reader the opportunity to consider how different fisheries contribute to total catch mortality and the sector-specific implications of further reducing bycatch to different levels below that projected for the preferred alternative in the table.

2 *The range of OYs for cowcod and other co-occurring species that do not have a new assessment (e.g., chilipepper and thornyhead) is inadequate.*

The Council and NMFS have a well-established policy for developing the range of OYs used to structure the alternatives in the annual management NEPA analysis, which is based on the use of the best available science standard in the MSA (National Standard 2). Stated simply, in the absence of new information about a stock the harvest policy from the preceding year is reapplied to calculate these values for the new calendar year (management cycle). In this case the acceptable biological catch (ABC) for a species or species group is usually derived by multiplying a harvest rate proxy by the biomass forecast to be available to the fishery. (The ABC represents a basic calculation of long-term average surplus production. Harvest rate proxies are developed for groups of species based on their biological characteristics and may be modified as new scientific information relevant to the stock becomes available. They are referred to as proxies because when applied to an individual stock they represent the best estimate of the harvest rate for that stock that will produce MSY.)

The OY represents a precautionary reduction from the ABC based on a range of factors. Most significant is the "40-10 precautionary policy," which applies a precautionary reduction from the ABC to stocks below the target biomass, which is generally at or above 40% of unfished biomass. The 40-10 policy is intended to reduce the chance that species will become overfished. According to the Council's OY policy, if the stock biomass is larger than the biomass needed to produce MSY (B_{MSY}), the OY may be set equal to or less than the ABC. The Council uses 40% as a default proxy for B_{MSY}, also referred to as $B_{40\%}$. The Council's default OY harvest policy reduces the fishing mortality rate when a stock is at or below Bmsy. A stock with a current biomass between 25% of the unfished level and B_{MSY} is said to be in the "precautionary zone." The further the stock is below the precautionary threshold (usually $B_{40\%}$), the greater the reduction in OY relative to the ABC, until at 10% of unfished biomass ($B_{10\%}$), the OY would be set at zero. This is, in effect, a default rebuilding policy that will foster quicker return to the B_{MSY} level than would fishing at the ABC level.

In the case of overfished species (defined as stocks below $B_{25\%}$), a rebuilding analysis is applied when a new stock assessment becomes available to determine harvest levels based on different estimated probabilities of the stock recovering within the time frame established by National Standard Guidelines. Fundamentally, then, the evaluation of harvest policies is driven by the availability of new stock assessments, and in the case of overfished species, updates to the rebuilding analyses. Because of uncertainties about stock characteristics and dynamics, stock assessments are not definitive; they typically present a range of possible interpretations of "the state of nature." This also feeds into rebuilding analyses, which can be influenced by new estimates of a stock's unfished biomass and additional recruitment time series data. Different OYs in the alternatives result from this range of possible interpretations. In the absence of new data there are only limited circumstances where an earlier assessment should be revisited to structure alternatives. The most salient circumstance is when the stock in question, because of its co-occurrence in fisheries, constrains harvests of other species. In fact, the alternatives are largely structured around the need to manage fisheries for these overfished, constraining stocks. All of the stocks specifically mentioned in the NRDC comments—chilipepper rockfish, thornyhead and cowcod—are projected to be harvested (total fishing mortality) below their OYs because of management measures implemented to keep total fishing mortality at or below OYs for the constraining stocks. For example, management measures for bocaccio are expected to constrain cowcod catch. Chilipepper rockfish also cooccur with bocaccio, and actual harvests are expected to be well below the OY under the proposed management measures. By the same token, management measures to constrain darkblotched rockfish total catch will prevent attainment of the thornyhead OY. As mentioned in response to the first NRDC comment, a distinction must be made between OYs—which represent a calculation based on the biology of the stock—and projected harvests, which result from the application of management measures. As described in the previous response, projected harvest for a given species, even with the same OY across the alternatives, does vary across the alternatives. The management measures proposed for constraining stocks are what produce this range of projected harvests for other stocks. As a result, despite the fact that the OY for a stock may be the same across alternatives, the alternatives do allow evaluation of a range of impacts, based on projected harvest.

In short, development of OY alternatives is driven by stock assessments, which are generally performed on a rotating three year basis for about 20 species. (See section 3.5.1 for a discussion of the stock assessment process.) OYs for overfished species are determined through both stock assessments and rebuilding analyses. Where there is neither a new stock assessment or a new rebuilding analysis, there is no scientific basis for developing new OY alternatives. However, as previously stated, a range of actual catch levels may result from the different management measures proposed across the range of alternatives.

3. *Discard caps, seasonal restrictions in the trawl fishery, and alternatives to the year round fishery are not considered as management measures.*

See response to The Ocean Conservancy comment #2.

4. *The mitigation measures should be developed as alternatives.*

See response to Ocean Conservancy comment #4.

5. *The effects that different management measures have on total fishing mortality are not adequately evaluated.*

NMFS and the Council are doing a reasonable job of evaluating the effects of different management measures based on the best available data. The first step in evaluating the effectiveness of management measures to control total fishing mortality is determining appropriate harvest levels. The supporting rebuilding analyses for overfished species adequately describe the uncertainty and risk of alternative harvest levels in rebuilding overfished species. Rebuilding probabilities are the key parameters that index this risk and uncertainty. Alternative harvest levels, which are total catch OYs (includes all sources of fishing-related mortality), are framed accordingly. The management measures designed to stay within these species' OYs include depth restrictions (which are area closures in the depth zones where these species most frequently occur), gear restrictions that have proven efficacy (i.e., finfish excluders and small footropes mandated in most exempt trawl fisheries), additional area closures in areas of known large density of overfished species (i.e., Cowcod and Yelloweye Conservation Areas), season and bag limits in recreational fisheries, no-retention regulations for the most critically depleted species, and reduced landing limits for species co-occurring with overfished species. Uncertainty in determining the bycatch in many groundfish fishery sectors is acknowledged throughout the EIS (see response to The Ocean Conservancy comment #9). Therefore, very restrictive and precautionary management measures are proposed, most notably the depth-based restrictions.

NMFS and the Council are obtaining more data for future use. There is a commitment to begin using observer data to better manage for total catch OYs as explained in section 2.3, EFPs (with 100% observer coverage) to test potentially more selective fishing gears and techniques have been recommended, precautionary measures are proposed for the stocks in areas where effort shifts are most likely to occur (i.e., precautionary reductions in nearshore species' OYs), and an aggressive stock assessment schedule for the overfished species. The Council has also recommended addressing one of the most serious problems in groundfish catch accounting by overhauling the current MRFSS Program. The Council and West Coast states are committed to more accurate recreational fishery sampling and increasing state observer programs to better manage total fishing mortality. Although not fully described in the EIS since many of these actions are ongoing and have evolved since publication of the DEIS, this initiative, coupled with the others described in this response and in the EIS, promise to greatly improve current management strategies.

6. *There is no discussion of the impacts of bycatch on overfished species.*

On page 4 of its letter, the commenter states that the DEIS “failed to include a complete, detailed discussion of the various issues involving bycatch” and that it is “wholly devoid of any discussion of the effects of current and alternative management techniques for constraining bycatch.” These statements are inaccurate. The DEIS provides a detailed evaluation of bycatch-related issues in section 4.4, and describes the bycatch implications of the alternatives for the major groundfish fishery sectors. The use of extensive closed areas, based on the depth-related occurrence of overfished species, represents a major change in the approach to management specifically intended to reduce bycatch of overfished species. Current management techniques are represented by the No Action Alternative. If this comment alludes to the elimination of other management measures from detailed consideration, the reasons for eliminating these measures from consideration are described in section 2.3.

The commenter also states that the DEIS does not analyze the impacts of depth-based restrictions on overfished species. However, the different closed area configurations in the alternatives were specifically developed in order to constrain overfished species bycatch to levels below the OYs for that alternative. Impacts are described by the associated estimated bycatch. The summary tables in Chapter 2 provide bycatch projections for the limited entry trawl fishery. To date, equivalent information is not available for other sectors; however, bycatch estimates for overfished species across all fisheries are presented in Table 4.4-1 for the preferred alternative. In addition, the Allocation Committee Alternative with no depth restrictions was included specifically to allow comparison of depth-based restrictions and “current” management measures across a common set of OYs. (The two Allocation Committee alternatives, with and without depth restrictions, and the Council-preferred alternative, use the same OYs for overfished species.)

7. *There is no discussion of alterative management techniques for constraining bycatch.*

The scoping process identified area closures, reducing limits for species co-occurring with overfished species, and using observer data and discard caps as alternative techniques for constraining bycatch, along with the small footrope requirement. The first two alternatives are analyzed in the EIS and are part of the Council-Preferred Alternative. The third alternative, which was recommended by The Ocean Conservancy and NRDC, may have conceptual merit as contemplated in the EIS (see section 2.3) and in draft rebuilding plans, but was rejected from detailed analysis in the EIS due to lack of availability of relevant data and analyses (see section 2.3 of the EIS and response to The Ocean Conservancy comment #2.

8. *The adequacy of bycatch data and the risk that bycatch is underestimated is not addressed.*

See response to The Ocean Conservancy comment #9.

9. *Bycatch in the pink shrimp and prawn fisheries is not addressed adequately.*

Table 4.4-1 provides the GMT's best estimate of total fishing mortality of overfished species under the Council-Preferred Alternative. Under this preferred alternative, finfish excluders will be required in the pink shrimp and ridgeback prawn trawl fisheries. The spot prawn trawl fishery will be phased out in Oregon and Washington and either phased out or displaced to waters deeper than 150 fm south of Cape Mendocino in California. These measures are considered adequately precautionary by the GMT and other experts that advised the Council. Data documentation supporting these analyses is considered complete for the spot prawn fishery (see Tables 3.4-8 and 3.4-8 in the EIS); however, it is acknowledged that the historical bycatch data for the pink shrimp fishery is not well documented in the EIS. This data was requested for the EIS analysis but was not provided. The GMT did consider that data when estimating the effect of mandatory finfish excluders in the pink shrimp fishery and the estimated mortality of overfished species in that fishery as described in Table 4.4-1 accounts for that effect.

10. *The impacts of different rebuilding periods for overfished species is not discussed, especially the effects of the much longer rebuilding period for bocaccio. These include ecological and short term versus long term economic effects.*

Impacts of alternative rebuilding periods for bocaccio will be addressed in environmental documents accompanying rebuilding plans to be adopted in the coming year.

While taking into account and analyzing cumulative impacts, the current EIS addresses regulations for only one year of fishing. At all levels being considered, the incremental effects of one year of fishing on stocks and the ecosystem are not significant because the fisheyr is constrained by rebuilding analyses that are already in place and which were considered in developing the 2003 regulations.

11. *The impacts of increasing fishing harvest limits on darkblotched and yelloweye rockfish is not adequately analyzed.*

NMFS disagrees. Harvest levels are analyzed throughout Chapter 4 in the EIS and in the supporting rebuilding analyses cited in the relevant sections. Biomass trends for these species indicate growing abundance as indicated in stock assessments and rebuilding analyses. This comment infers that the increased harvest limits are based on a decision to increase the harvest rate. However, increasing biomass of darkblotched is the largest factor in specifying a larger OY in 2003. In fact, the basis for the Council-Preferred Alternative is more conservative than the basis for the 2002 OY in that the effective harvest rate is reduced to conform to a rebuilding probability trajectory of 80% rather than 70% as in 2002. Additionally, trawl bycatch of darkblotched (this is the only fishery sector with bycatch of darkblotched) is estimated to be 87 mt under the Council-Preferred Alternative (see Table 2.1-15 in the EIS) which is 13 mt less than the 100 mt Low OY alternative for darkblotched analyzed in the EIS (see Table 2.1-1 in the EIS). The darkblotched rockfish stock assessment will be updated in 2003 and will provide more information about the effects of overall groundfish management on darkblotched rockfish rebuilding.

The increased yelloweye OY under the Council-Preferred Alternative (22 mt) relative to the No Action Alternative (13.5 mt) is due to the more optimistic outlook for yelloweye as determined in the latest assessment done this summer by Methot et al. (2002). The inclusion of Washington CPUE and length data in the assessment led to this more optimistic outlook. This is not surprising given that the greatest distribution of yelloweye on the West Coast is off Washington. Explanation of these relative impacts are analyzed throughout the EIS.

12. *The environmental impacts of harvest levels for co-occurring species (chilipepper and thornyhead) are not adequately analyzed.*

The EIS analyzes the overall effects of the specifications and management measures, including the harvest levels set for more abundant species in Chapter 4. This comment assumes that the specified total catch OYs for thornyheads and chilipepper, as indicated in Table 2.1-1 in the EIS, will be attained in 2003. In fact, most of the total catch OYs for species and stock complexes that co-occur with overfished species are not attained annually due to the constraints imposed by the need to rebuild overfished stocks. While the new management regime of depth-based restrictions may enable fisheries to come closer to specified OYs for species like longspine thornyheads that don't co-occur with overfished species (they tend to reside in waters much deeper than the depths where overfished species occur), OYs for species such as chilipepper, which co-occur with bocaccio will not come close to attainment due to the depth restrictions imposed to protect bocaccio and other co-occurring overfished groundfish species. This effect is addressed in section 4.2 of the EIS.

13. *The discussion of management measures is inadequate.*

Chapter 2, including the accompanying tables adequately describe the alternatives. Chapter 2 text provides an overview of each alternative, including a summary of salient management measures. Tables 2.1-2 through 2.1-5 detail commercial, recreational, tribal and nongroundfish commercial fishery management measures. Tables 2.1-6 through 2.1-15 provide detailed information on trip limits for each alternative, projected landings in the limited entry trawl fishery, and the extent of closed areas. The commenter cites as an example the failure to clearly explain what fishing is allowed in the CRCA (see page 5 of the attached letter). However, section 2.2.5 is devoted to a description of the CRCA, including detailed lists of which gear types would be allowed under specific exemptions.

14. *The impacts of exceeding OYs for overfished species in 2000-2002 are not analyzed.*

In its comments (see page 5 of the attached letter) the commenter recommends that the EIS include catch data from 2000-2002, discuss environmental consequences of past overharvests, explain how management measures proposed for 2003 will constrain harvests below OYs, and explain the environmental consequences of exceeding OYs for overfished species. This comment is somewhat misleading in that it is only bocaccio catch that we know with certainty exceeded its OY. Having said this, it must be conceded that precisely determining total catch of overfished species has been extremely difficult given available data sources. This is particularly true in recreational fisheries where current monitoring programs often do not result in very accurate catch estimates. The EIS does discuss the implications of past overharvest of bocaccio in section 4.6.2.3. The most relevant and specifiable consequence of past harvests is on the stock itself and its potential for recovery to target biomass. (Stock depletion may have other ecological effects, as discussed in response to EPA comment #6. Although it is possible to describe these potential effects, the current state of science does not allow us to quantify or specify these effects.) The effect of past overharvest on stock status and rebuilding potential is captured in stock assessments and rebuilding analyses. For bocaccio, the one overfished species where there is good evidence that OYs were exceeded in 2000 and 2001, the effect is reflected in the most recent stock assessment and sustainability analysis as discussed in response to EPA comment #1. As to including "comprehensive actual catch data" from 2000-2002, as possible, the preparers made a good faith effort to include as much data on catches in a variety of different fisheries. Since this EIS was prepared during 2002, it is not possible to include data from this year. Information on catches is reproduced in tables for chapter 3 and discussed in section 3.3.1 (describing fisheries) and 3.4 (describing bycatch). In particular, see Tables 3.4-1 through 3.4-11. Admittedly, these data are incomplete. That underscores the difficulty of determining actual total catch.

15. How management measures will successfully constrain bycatch is not explained.

See section 2.3 of the EIS and responses to The Ocean Conservancy comment #2 and NRDC comment #7.

16. *The probability of achieving rebuilding of overfished species within the target rebuilding periods is not described and the environmental consequences of failing to rebuild in these time periods is not discussed.*

All of the overfished species OYs are analyzed in terms of the probability of rebuilding these stocks within T_{MAX} (the maximum allowable time to rebuild under the NMFS National Standard Guidelines). Evaluations of rebuilding analyses are completed every 2 years, with new assessments and rebuilding analyses for overfished species completed at least every 3-4 years. Stock assessments with the most uncertainty and where the stock has extremely low OYs may be done more frequently (i.e., bocaccio will be reassessed next year). Annual management measures are specified accordingly. See revised sections 3.1 and 4.1 in the EIS and response to EPA comment #6 for discussion on the analysis of the environmental consequences of the rebuilding measures and harvest levels.

17. *The overlap in fishing quotas between the US and Canada (e.g., canary rockfish and Pacific whiting) is not adequately discussed.*

The OYs analyzed in the EIS are based on the relative distribution of the exploitable biomass of these stocks in U.S. waters. It is acknowledged that the distribution of canary and yelloweye on the U.S. West Coast is highest near the U.S.-Canada border and there could be a benefit from a joint research and management effort with Canada where fisheries are less constrained. However, these species are relatively sedentary and basing the OY on their relative biomass in U.S. waters should be adequately precautionary. Catch sharing of Pacific whiting is perhaps more influential in rebuilding this stock since it is a more dynamic species with variable distribution annually in waters off both countries. The situation is also more problematic in that the U.S. OY is based on 80% of the combined U.S.-Canada OY and there is disagreement between the two countries on how to allocate the allowable harvest and manage the whiting fisheries in the respective countries. However, despite the management differences of this dynamic transboundary stock, there is little doubt that the potential productivity of whiting is high enough that, at the considered harvest levels analyzed in the EIS, the stock will rebuild within ten years. Negotiations have occurred since publication of the DEIS and all of these issues are discussed in the EIS.

18. *The canary rockfish catch sharing scenarios are not adequately described.*

There has been confusion regarding canary rockfish catch sharing scenarios and how allocation decisions affect the OY. In section 4.2, it describes the effect of the recreational fishery taking smaller fish than the commercial fishery and therefore having a greater "per ton" impact on rebuilding. Perhaps the wording in the EIS could be more explicit explaining when more fish are taken to harvest 1 mt of canary, then the total catch OY is reduced to have the same long-term rebuilding outcome. That is, all catch sharing scenarios presented in Table 2.1-1 in the EIS under each alternative have the same estimated rebuilding effect (i.e., same rebuilding probability trajectory, the same year of predicted rebuilding, etc.). Therefore, the Council was challenged to first decide how much risk they were willing to take to rebuild canary rockfish within T_{MAX} (i.e., which rebuilding probability is most appropriate) and then make the recreational:commercial allocation decisions before deciding on the target total catch OY for canary rockfish. The decision on rebuilding probabilities for canary rockfish and the allocation decision is described and analyzed in section 4.2.

19. *VMS-related issues are not adequately discussed.*

See response to EPA comment #3.

20. *The cumulative effects on ecosystem, habitat and biodiversity are not adequately described and the statement that the effects of the different alternatives are indistinguishable is incorrect.*

See response to EPA comment #6.

21. *The cumulative effects of past under-conservative OYs are not analyzed.*

This comment is related to NRDC comment #14, above. Although this commenter found the explanation that stock assessments and rebuilding analyses actually incorporate an evaluation of direct, indirect and cumulative effects "perplexing," the preparers stand by this explanation. The concept that different types of impacts—direct, indirect, and cumulative—described in NEPA regulations can be correlated with the fishery management framework, which must consider the total effect to dynamic fish populations over a long time period. The direct effect of the proposed action is equivalent to the total fishing mortality that occurs during the year as a consequence of management measures. Indirect effects include changes in future stock productivity that result from changes in spawning biomass due to fishing mortality. Past, present and future fishing mortality also contribute to cumulative impacts to a given fish stock. Cumulative effects must also be evaluated in terms of external factors that when combined with the proposed action produce some greater effect. (See section 4.6 for a description of these external factors.) However, all of these external factors act on the fish population and must be accounted for, at least in sum, when modeling population dynamics. For example, factors influencing the ecosystem (including habitat impacts and fishing-induced changes to population structure) are a component of natural mortality, or alternatively affect recruitment. Admittedly, these types of model parameters are not derived by summing all the components—the cumulative effects—contributing to a parameter value such as natural mortality. More often they are inferred from population structure, which can be used to estimate year-to-year total mortality rates, and an estimate of fishing mortality, which is then deducted from year-specific total mortality estimates. Evaluating the different types of effects identified in NEPA regulations separately is not very useful when evaluating impacts of management measures to fish populations. The direct effect of the action, if defined as total fishing mortality in a given year, is almost meaningless unless it is evaluated in the broader context of ongoing fishing mortality in past, current and future years. The management framework and rebuilding analyses for overfished species are based on long-term stock rebuilding targets; current year OYs are based both on estimates of how past fishing mortality has affected the population and an assumption that the current harvest policy will be used over the course of the rebuilding period. In this sense a rebuilding analysis is a cumulative effects analysis of "past, present, and reasonably foreseeable future actions."

22. *The cumulative effects of depth-based restrictions, especially in terms of changes in the pattern of fishing effort (concentration) are not analyzed.*

Section 4.5.2 contains a lengthy discussion of the effect of potential shifts of fishing effort to inshore fishery management. Given that the implementation of extensive closed areas on the continental shelf represents a new and as yet untested management technique with respect to the groundfish fishery, it is very difficult to predict how fishermen will respond. However, it should be noted that the Hastie bycatch model, as restructured to analyze depth-based management, does attempt to account for possible effort shifts when projecting limited entry trawl impacts. These effects are also considered in section 4.3.8, evaluating impacts of the management measures on vessel safety.

10.2 Summary of Revisions to the Draft EIS

The following is a descriptive list of revisions to the draft EIS. Some of these revisions were based on comments received from reviewers (see sections 10.1 and 10.3) and other revisions were independently developed by the EIS authors. The following list of revisions does not include the format and editorial changes that were made to correct obvious mistakes in the draft EIS. Revisions do not substantively change results of analyses of alternatives (except perhaps the socioeconomic implications of the *Low OY Alternative*), nor are the alternatives substantively re-structured.

- A Glossary was added to the List of Acronyms and Abbreviations
- Section 1.5 (scoping) revised:
    - Added written comments for June Council meeting to scoping summary table
    - Added oral comments from June and September Council meetings to scoping summary table
    - Clarified the option references in the California hearing summary
    - Added table summarizing sources of scoping material

Added theme numbers to table
Added references to other relevant parts of EIS

- A clearer explanation of depth-based management was added in Chapter 2
- A few minor revisions to exemptions to the California Rockfish Conservation Area restrictions as specified by the Council at its November meeting were made in section 2.2.5
- Revisions were made to section 2.3 including a clearer explanation of the anticipated use of observer data in 2003 management
- The following changes were made to the *Council-Preferred Alternative* as specified by the Council at its November 2002 meeting: 1) incidental catch allowances for some flatfish species were proposed for the California halibut fishery, 2) 12 instead of 5 #2 or smaller hooks are specified for directed fixed gear sanddab fisheries in California, 3) 32 oz. instead of 16 oz. of weight specified for the recreational sanddab fishery in California, and 4) a more restrictive Yelloweye Rockfish Conservation Area is proposed. These changes were made in the relevant Chapter 2 and 4 text and tables
- Added additional description of Table 2.4-1 in section 2.4 as well as revisions to Table 2.4-1
- Added Section 3.1.4 describing current research on the fishery ecosystem
- Revised section 3.5.3 describing enforcement issues
- Added section 3.5.4 describing federal, state and tribal roles and responsibilities for fisheries management
- The estimated recreational effort for the *Low OY Alternative* was changed (increased) in response to problems identified witht he RecFIN algorithms used to generate these estimates from MRFSS data (see Section 4.3.4.1)
- Revised the estimated economic impacts of the *Allocation Committee Alternative* (without depth restrictions) to reflect restrictions that would be imposed on non-groundfish fisheries (see Section 4.3.2.1)
- Added additional impacts discussion in Section 4.1 and 4.2.1.1 including a clearer discussion of the analysis of estimated effects to bocaccio rebuilding under the *Council-Preferred Alternative*
- Moved material from section 4.6.3 describing cumulative impacts to impacts discussions in sections 4.1 through 4.5
- Revised section 4.5.1 discussing enforcement impacts including adding a more comprehensive discussion of Vessel Monitoring Systems
- Table nomenclature was simplified
- A discussion regarding impacts on small entities was added to section 6.6
- A paragraph was added to section 6.7 regarding Environmental Justice implications
- A discussion regarding coordination with Indian tribes was added to section 6.9

10.3 Comment Letters