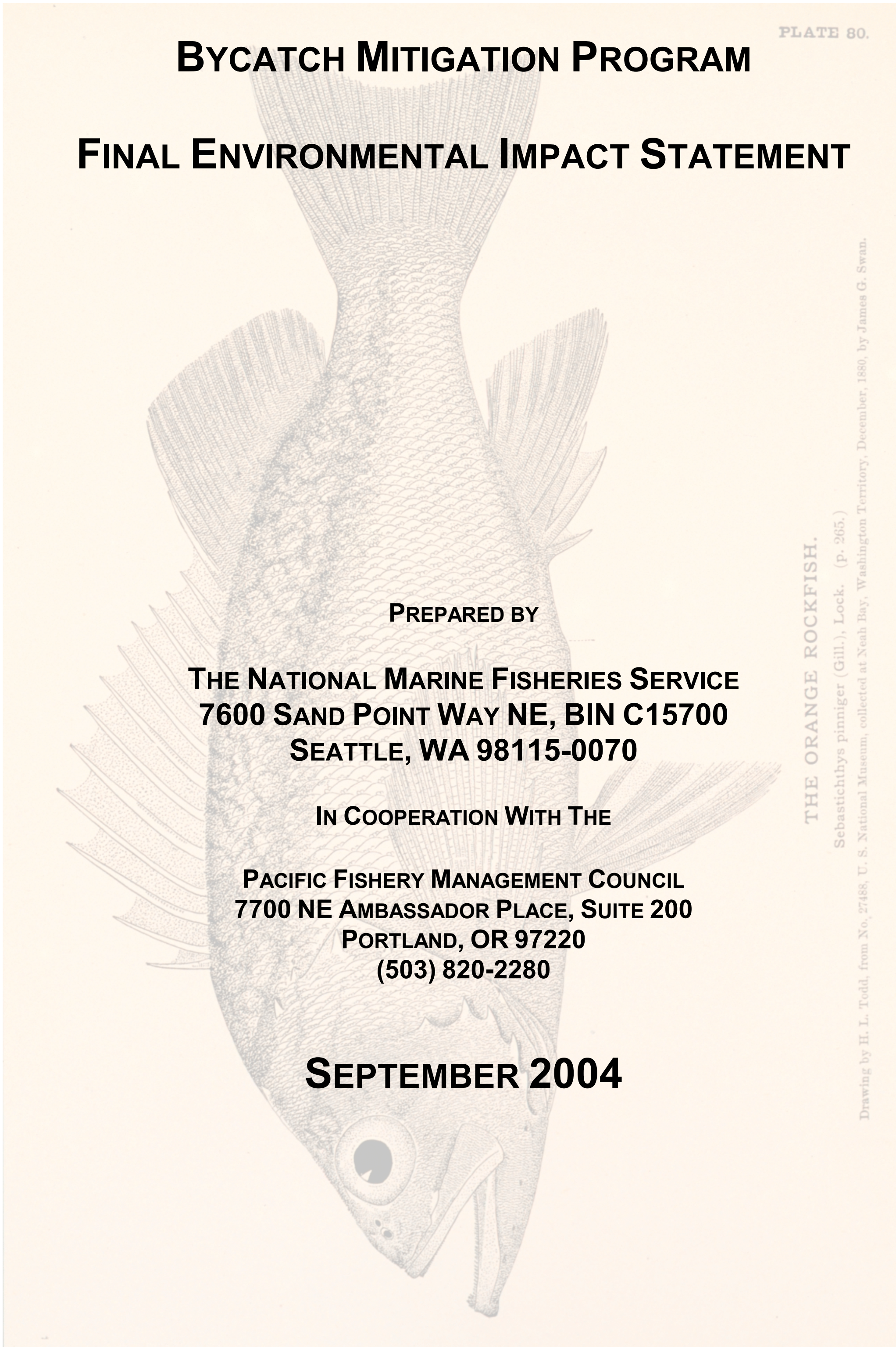
THE PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN



BYCATCH MITIGATION PROGRAM

FINAL ENVIRONMENTAL IMPACT STATEMENT

PREPARED BY

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COVER SHEET

Pacific Coast Groundfish Bycatch Management
FINAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Action: The Pacific Fishery Management Council and the National Marine Fisheries Service propose to establish the policies and program direction to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law.

Type of Statement: Final Environmental Impact Statement

Lead agency: NOAA Fisheries (National Marine Fisheries Service)

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Abstract: The 1996 Sustainable Fisheries Act requires that every federal fishery management plan (FMP) must be consistent with National Standard 9 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). National Standard 9 requires that "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Section 303(a)(11) of the Magnuson-Stevens Act requires each FMP to "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery."

The Pacific Fishery Management Council (Council) is responsible for developing FMPs that are consistent with the Magnuson-Stevens Act and other applicable law. The Council's Pacific Coast Groundfish FMP includes goals, objectives, and management measures addressing bycatch. This EIS analyzes the Council's objectives for its bycatch mitigation program and evaluates alternative programs to achieve those objectives. Various bycatch mitigation tools are evaluated for effectiveness in reducing unwanted catches of marine species, potential for mitigating other effects on the marine environment, social and economic effects, administrative costs, and other potential impacts. Some alternatives would require more comprehensive future scientific observations of catch and bycatch.

Errata Sheet for the Pacific Coast Groundfish Bycatch Final Programmatic Environmental Impact Statement

1. At the top of the Executive Summary the header should read Groundfish Final PEIS and not Draft Final PEIS.

2. The header for Section 4.8 Cumulative Effects of the Alternatives should read Groundfish Bycatch Final Programmatic EIS and not Draft Programmatic EIS.

3. In the Appendices, the header for Appendix B should read Groundfish Bycatch Programmatic FEIS and not DEIS.

Executive Summary

ES.1 The Proposed Action

The Pacific Fishery Management Council (Council) and National Marine Fisheries Service (NMFS, also called NOAA Fisheries - National Oceanic and Atmospheric Administration, U.S. Department of Commerce) propose to evaluate, at a broad scale, how to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law. The proposed action would establish the policies and program direction to achieve this purpose. Upon completion of this Final Programmatic Environmental Impact Statement (PEIS), the Council is expected to begin preparing a groundfish fishery management plan (FMP) amendment or series of amendments and/or regulatory actions that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This PEIS is intended to provide the analytical underpinnings for that effort.

ES.1.1 Why is Action Needed?

The 1996 Sustainable Fisheries Act established National Standard 9 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). National Standard 9 requires that "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Section 303(a)(11) of the Magnuson-Stevens Act requires each FMP to "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority –

(A) minimize bycatch; and
(B) minimize the mortality of bycatch which cannot be avoided."

The Council's Groundfish FMP includes provisions relating to bycatch mitigation. Some measures, such as gear definitions and restrictions, have been established as long-term regulations that remain in effect until the Council and NMFS amend them. Other measures are established through the biennial management process and expire at the end of each two-year fishing period. The current bycatch mitigation program is not clearly spelled out in a single place. Rather, elements are spread throughout the FMP, the regulations as recorded in the *Code of Federal Regulations*, various FMP amendments, and numerous *Federal Register* notices. The proposed action is needed to describe the elements of the groundfish bycatch program, to identify the various bycatch mitigation tools available to the Council, to evaluate the effects and effectiveness of those tools, and to evaluate potential improvements that might result from other combinations and applications of bycatch mitigation tools. A comprehensive program to minimize bycatch and bycatch mortality to the extent practicable in the groundfish fishery would (1) reduce waste, discard, and collateral damage to marine plants and animals by groundfish fishing activities on the Pacific coast, (2) collect and report appropriate and adequate information to support the groundfish fishery management program, and (3) balance these needs with environmental and social values.

ES.1.2 What is the Purpose of the Proposed Action?

The Council appointed an ad hoc Environmental Impact Statement Oversight Committee (Committee) to provide direction to drafters of this EIS. The Committee identified the following objectives for the groundfish bycatch mitigation program, which the Council subsequently adopted. These objectives define the purpose of the proposed action:

- account for total fishing mortality by species
- establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits
- reduce unwanted incidental catch and bycatch of groundfish and other species
- reduce the mortality of animals taken as bycatch
- provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods
- monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly
- reduce unobserved fishing-caused mortalities of all fish
- gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches.

This EIS has been prepared as a programmatic document to assist the Council and NOAA Fisheries in taking the next steps necessary to meet the bycatch requirements of the Magnuson-Stevens Act.

ES.1.3 Background

Since 1996, the Council has prepared two FMP amendments to bring the FMP into compliance with the Magnuson-Stevens Act bycatch minimization requirements. The first attempt was Amendment 11. NMFS disapproved the bycatch provisions of that amendment as inadequate and returned it to the Council for further consideration. The Council and NMFS worked together to prepare Amendment 13, which NMFS subsequently approved. However, the amendment was challenged in federal district court. The court disapproved Amendment 13 and its accompanying Environmental Assessment (EA) as inadequate in Pacific

Marine Conservation Council v. Evans, 200 F.Supp.2d 1194 (N.D. Calif. 2002). This court ruling is referred to as PMCC in this EIS.

In PMCC, the court made several rulings with respect to the adequacy of the Amendment 13 bycatch revisions and the EA. The court held that Amendment 13 failed to establish a standardized reporting methodology because it established neither a mandatory nor an adequate observer program. Further, the court held that the amendment did not minimize bycatch and bycatch mortality because it failed to include all practicable management measures in the FMP itself. The court also found a lack of reasoned decisionmaking, as the amendment rejected four specific bycatch reduction measures (fleet size reduction, marine reserves, vessel incentives, and discard caps) without consideration on their merits. With respect to NEPA, the EA prepared for Amendment 13 failed to address adequately the ten criteria for an action's significance set forth in the CEQ regulations at 40 CFR 1508.27(b), and also failed to analyze reasonable alternatives, particularly the immediate implementation of an adequate at-sea observer program and bycatch reduction measures.

This PEIS addresses the specific legal deficiencies identified by the court in the PMCC decision. Since the PMCC decision, Amendment 16-1 to the FMP has made the ongoing West Coast Groundfish Observer Program mandatory within the FMP. The Council is expected to prepare an FMP amendment that will include additional conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This PEIS is intended to provide the analytical underpinnings for that effort. In addition to other bycatch mitigation tools, it includes consideration of fleet size reduction, marine reserves, vessel incentives, and discard caps, as required by the PMCC decision.

Since the early 1990s, the FMP has required fishing vessels to carry observers at the request of NMFS. In August 2001, NMFS initiated a mandatory groundfish fishery observer program. The West Coast Groundfish Observer Program is conducted by the Fishery Resource Analysis and Monitoring Division of the NMFS Northwest Fisheries Science Center. Later, the Council and NMFS adopted a mandatory observer program into the FMP via Amendment 16-1. NMFS approved this amendment on November 14, 2003.

The Groundfish FMP covers more than 80 species of groundfish, many of which are caught together with a variety of fishing gears that are used to target groundfish. Groundfish are also caught incidentally in fisheries for non-groundfish species, such as pink shrimp and California halibut. As of July 2004, eight groundfish species are designated as overfished: darkblotched rockfish, canary rockfish, lingcod, yelloweye rockfish, bocaccio rockfish, cowcod (also a rockfish species), widow rockfish, and Pacific ocean perch (another rockfish).[1/] The Council has prepared (or is in the process of preparing) a plan to rebuild each of these species.

The groundfish fishery off the West Coast of the United States is executed from the Canadian to Mexican borders. Many types of vessels participate in this fishery. They range in size from 8 foot long kayaks to 120 foot trawlers, and vessels that fish in nearshore to offshore waters. These vessels use various types of gear including bottom trawls, midwater trawls, pots, longlines and other hook and line gear. Trawlers take the majority of commercially-harvested groundfish. The catch can be incredibly diverse in species and fish size and overall catch size can vary widely as well. In many cases, a portion of the catch is retained and another portion of the catch, that may be of the wrong size, species, or is over management retention limits, is discarded at sea. Discarded fish are called bycatch.

Figure ES.1 illustrates the meaning of bycatch and other catch-related terms as they are defined and used in the Magnuson-Stevens Act and Groundfish FMP. Some fish encounter fishing gear but escape alive. However, there will almost always be some unobserved mortality resulting from injury when fish encounter fishing gear, especially mass-contact types of gear, such as trawl gear. The latent or pass-through mortality of fish escaping from a trawl net may be quite high, depending on the design and manner in which the gear is fished as well as its mesh size. Additional delayed mortality may occur after fish escape gear. This type of mortality may be related to the stress of capture and physiological injuries which subsequently turn out to be fatal. There may also be mortality associated with gear that is lost or abandoned — the bycatch resulting from this is often called ghost fishing. NMFS considers this unobserved fishing-related mortality included in the definition of bycatch because it constitutes a harvest of fish that are not sold or kept for personal use (63 FR 24235, May 1, 1998).

ES.2 Measuring Environmental Consequences

Short-term effects are mortalities resulting from fisheries, including harvest and incidental mortality that occurs when fishers capture and then release groundfish and other species. Long-term effects are changes in the abundance of successive generations of the affected stock that may occur as a result of reductions in short-term impacts and the consequent increase in the species' populations. These effects are qualitatively described in this PEIS.

1 Pacific whiting, which had previously been designated as overfished, has recently been declared rebuilt.

Cumulative effects are changes to groundfish stocks and other marine animal populations that may result from a combination of short- and long-term effects of the actions in the groundfish fisheries, along with the effects of other past, present, or foreseeable future actions. Changes to the human environment stem from modifying management measures and the conduct of fisheries. These are described in terms of bycatch mitigation tools: changes in harvest specifications, season duration and structure, harvest, fishing effort, commercial fisheries, and angler benefits. Social and cultural effects are qualitatively described for the communities of commercial and recreational fishers and for coastal communities and tribes.

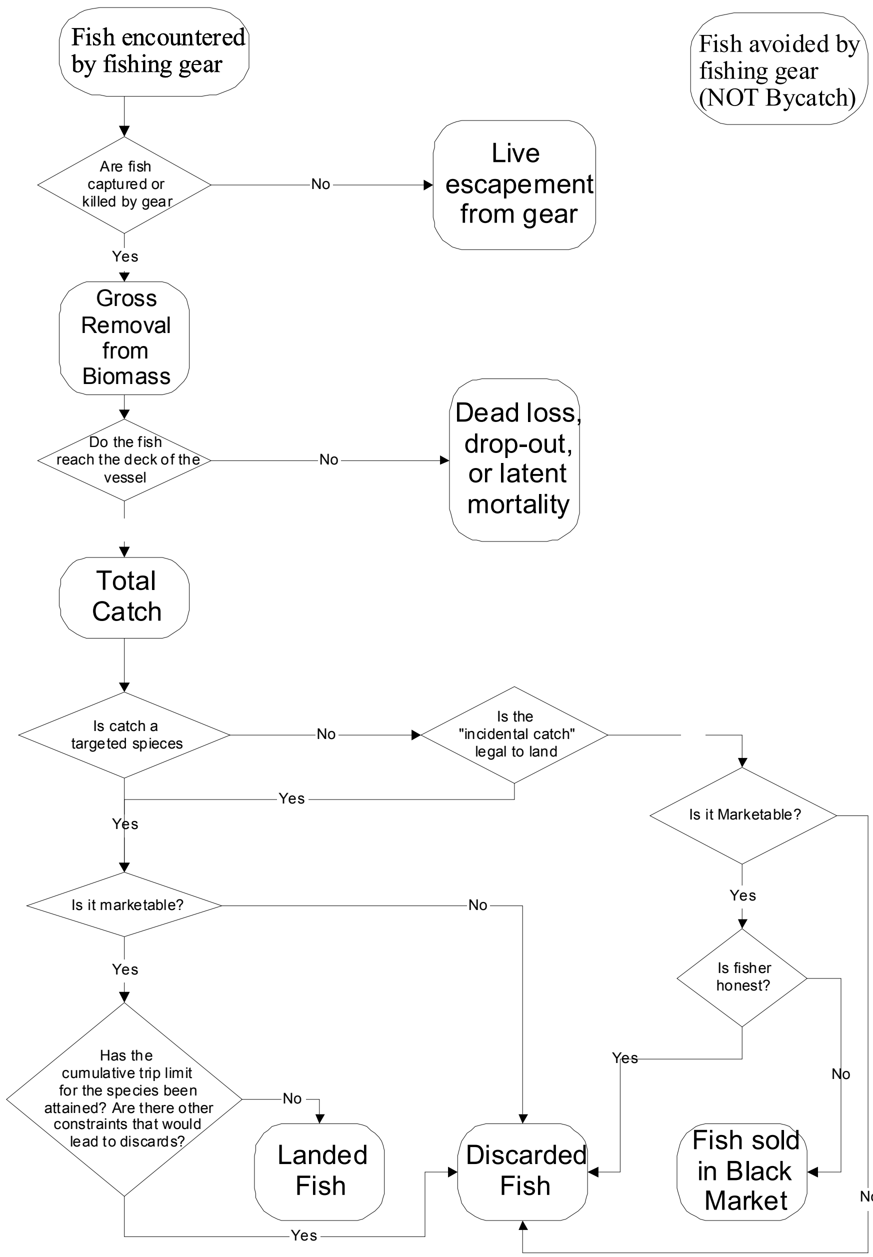

Figure ES.1: Diagrammatic representation of bycatch and other catch-related terms.

ES.3 The Alternatives

The Draft PEIS addressed five alternatives to the current bycatch management program. At its April 2004 meeting, the Council created and adopted a seventh alternative that combined elements of those alternatives (Table E.S.1). Each of the seven alternatives would use many of the current mitigation tools, but may use different combinations or may apply some differently. Alternative 1 is the no action/status quo. It describes the current bycatch program. Alternative 2 would emphasize capacity reduction, which means reducing the size of the commercial groundfish fleet. Specifically, it would reduce the trawl fleet by half (50%) from the number permitted to fish in 2002-2003. Since this alternative was proposed, a federal buyback program was approved and implemented, resulting in 91 trawl vessels being permanently eliminated and reducing the number of trawl fleet participants by 35%. That buyback program made the effects of Alternative 2 more similar to Alternative 1. Alternative 3 would reduce fishing effort by reducing the amount of groundfish fishing time for every commercial vessel. This reduction might be through shorter seasons, establishing fishing platoons, or other methods to limit fishing. Alternative 4 would allocate a portion of the available harvest to identified sectors and manage each of those sectors based on their catch and bycatch levels. These allocations would be fishing mortality limits for various species, and achievement of any sector limit would result in closure of that sector. In addition, Alternative 4 would use a combination of catch limits and trip limits. Any vessel reaching a catch limit would be required to stop fishing in that sector for the remainder of the period. Alternative 5 would replace trip limits with dedicated access privileges (individual fishing quotas or IFQs), which would be defined as catch or mortality limits. Quota holders would be allowed to buy and sell these quota shares. Discard caps for overfished species would also be established. Alternative 6 would focus on reducing bycatch to near zero by establishing no-take marine reserves, individual vessel catch quotas, and prohibiting discard of most groundfish. Alternative 7, the Council's preferred alternative, combines elements of Alternatives 1, 4 and 5. It would primarily use sector allocations and reward those sectors with the best bycatch minimization performance. It would encourage individual vessels to carry observers at the vessel's expense and provide larger trip limits for those vessels, in combination with catch limits for overfished species. Those vessels that participate would be exempted from the sectors and not be closed if a sector were closed. In the longer term, the Council will support development of IFQs (as proposed in Alternative 5) for appropriate sectors and vessels.

Table E.S.1 provides a brief summary of the bycatch mitigation tools used in each alternative, but does not portray many of the important details and intricacies. The details of these alternatives are spelled out in Chapter 2 and further described in Chapter 4.

Table E.S.1. Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Harvest Levels							
ABC/OY	Y	Y	Y	Y	Y	Y	Y
Set **overfished groundfish catch caps**	N	N	N	Y	N	Y	Y
Use **trip limits**	Y	Y	Y	Y	N	N	Y
Use **catch limits**	N	N	N	Y	Y	Y	Y
Set individual	N	N	N	Y	Y	Y	Y
Set groundfish **discard caps**	N	N	N	N	Y	Y	Y
Establish **IQs**	N	N	N	N	Y	Y	Y
Establish bycatch **performance standards**	N	N	N	N	Y	Y	Y
Establish a reserve	N	N	N	Y	N/Y	Y	Y
Gear Restrictions							
Rely on **gear**	Y	Y	Y	Y	N	Y	Y
Time/Area Restrictions	Y	Y	Y	Y	Y	Y	Y
Establish **long term closures for all groundfish fishing**	N	N	N	N	N/Y	Y	N
Establish **long term closures for on-bottom fishing**	N	N	N	N	N/Y	Y	N
Capacity reduction (mandatory)	Y	Y(50%)	Y	Y	Y	Y	Y
Monitoring/Reporting							
Trawl logbooks	Y	Y	100%	Y	N	N	N
Fixed-gear logbooks	N	N	100%	Y	N	N	N
CPFV logbooks	N	N	N	Y	N	N	N
Commercial **port sampling**	Y	Y	Y	>Y	N/Y	Y	>Y
Recreational	Y	Y	Y	>Y	Y	>>x	>Y
Observer coverage (commercial)	10%	10%	10%+ logbook verification	increased, by sector (10-60%?)	100%	100%	increased, sector (10-60%
CPFV observers	N	N	N	Y	Y	100%	Y
VMS	Y	Y	Y	Y	Y	Y	Y
Post-season observer data OK	Y	Y	Y	N	N	N	N
Inseason observer data required	N	N	N	Y	Y	Y	Y

Table E.S.1. Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

Rely on fish tickets as the primary monitoring tool for groundfish landings inseason	Y	Y	Y	N	N	N	N

E.S. 4. The Affected Environment

Chapter 3 describes the physical and biological environment that may be affected by the proposed action and alternatives. In general, aspects of the environment that may be affected include: the groundfish species managed under the FMP, other fish that may be captured intentionally or unintentionally by commercial, recreational and tribal fishers, marine mammals and seabirds; the physical environment, including essential fish habitat; and, social and economic conditions for fishery participants, communities, and the general public that consumes fish products from the region.

ES.4.1 Environmental Impacts of the Alternatives

Chapter 4 describes numerous environmental impacts that may occur if no action is taken or if any of the alternatives is adopted. The results of the analyses of impacts are summarized in Tables ES.2 through ES.5 at the end of this section.

Each alternative substantially reduces bycatch compared to an unregulated groundfish fishery. The status quo minimizes bycatch by establishing large marine protected areas that greatly reduce the likelihood that fishers will catch any overfished species within the boundaries. Thus, these MPAs nearly eliminate encounter/bycatch of overfished species within the boundaries, and also bycatch of other fish. The use of trip (retention) limits outside the MPAs will continue to result in regulatory discard/bycatch of groundfish, both overfished and non-overfished species. Economic discard/bycatch of small or otherwise low-value groundfish will continue. The groundfish observer program will monitor a fraction of active commercial fishing vessels.

Alternative 2 would be expected to reduce regulatory bycatch of groundfish. The degree of reduction depends on how constraining current trip limits are; bycatch of species that are typically discarded for economic (non-regulatory) reasons would not be reduced significantly. Bycatch of non-groundfish would not be directly affected. However, reduced commercial trawl fishing effort would be expected to reduce fishing impacts. Because the groundfish trawl fleet has recently been reduced by 91 vessels, the amount of change from Alternative 2 would be substantially less than originally expected. The level of observer coverage would be increased, resulting in a larger fraction of active commercial fishing vessels being observed. This would improve catch and bycatch information.

Alternative 3 would be expected to reduce regulatory bycatch of groundfish to a similar degree as Alternative 2. Groundfish regulatory bycatch would be reduced as a result of larger trip limits. However, shorter fishing periods could result in different bycatch patterns, and could also increase a race for fish as fishers would fish harder at the beginning of the season to hedge against premature season closure. Predicting fishing effort, which is required for developing trip limits, would be severely compromised. While it may be possible to maintain some groundfish product flow to markets over much of the year, no individual vessels would be permitted to operate for more than a few months each year.

Alternative 4 would substantially reduce groundfish regulatory discard/bycatch (compared to the status quo) by assigning every commercial limited entry vessel to one or more sectors. Annual fishing mortality allocations for each overfished species would be established for each sector. All vessels in a sector would be required to stop fishing for the remainder of the year if any of its caps were reached. Trip limits would continue to be established and, in addition, individual vessel fishing mortality caps could be established to prevent premature closure due to a few participating vessels with high bycatch rates. These catch limits would be similar to trip limits, except that a vessel reaching any cap would have to stop fishing for the remainder of the cumulative period. The observer program would be restructured to monitor bycatch in each sector, with data available inseason. Vessels carrying observers would have larger trip limits for non-overfished groundfish; vessels could provide an observer at their expense to gain access to the larger limits. Non-regulatory bycatch of groundfish and other species would not be significantly affected by this alternative unless all trip limits were defined as catch limits. In that case, vessels would retain a larger proportion of groundfish because all catch would apply towards the vessel limits.

Alternative 5 would establish a rights-based program of individual fishing quotas. These would be annual catch limit shares that could be traded or sold. Reaching any quota would require the vessel to stop fishing until it obtained additional quota. The observer program would be expanded to cover all commercial vessels participating in the quota program. The value of restricted species quota (RSQ) shares (for overfished species) would increase; initial shares for some severely depleted species (such as canary and yelloweye rockfish) would be less than 100 pounds. All catch of overfished species would have to be retained. This alternative would substantially reduce groundfish both regulatory and economic bycatch; encounter/bycatch and discard/bycatch would be reduced. The pace of fishing would likely slow substantially, providing greater opportunity to avoid bycatch of other species also. Catch and bycatch data on all species would be improved substantially. Gear regulations would be relaxed to allow and encourage experimentation and development of gear and techniques that would eventually reduce bycatch as much as technically feasible. Administration costs related to the observer and quota monitoring programs would increase substantially. This would be partially offset by a reduced pre-season process for developing trip limits and other management measures; the process of inseason trip limit adjustments would no longer be needed. Adverse impacts to the marine biological environment would be significantly reduced compared to Alternatives 1, 2, 3 and 4. Social and economic conditions would be significantly affected;

some changes would be beneficial, some would be adverse, depending on the individual and the quota program design.

Alternative 6 would establish large no-take marine reserves that would eliminate encounter/ bycatch of all species (both groundfish and non-groundfish) within the boundaries. Individual catch quotas, similar to those of Alternative 5, would be established. Groundfish discard caps would nearly eliminate groundfish discard/bycatch. However, unless exceptions were established, these discard caps would increase the mortality of bycatch that could not be avoided. In addition, disposal of unusable fish on land would increase. Observers would monitor catch and bycatch of all commercial vessels (except those without adequate space or facilities). Monitoring of recreational fisheries would also be increased. Commercial vessels would be required to use only gears that had been certified as low bycatch gear. This would substantially reduce bycatch in the short term compared to all other alternatives. However, Alternative 5 would be expected to develop more effective bycatch avoidance gears and methods over time because innovation would be allowed. Adverse impacts to the marine biological environment would be significantly reduced compared to Alternatives 1, 2, 3 and 4. Adverse impacts may or may not be reduced compared to Alternative 5. Social and economic conditions would be significantly affected, especially short-term adverse impacts resulting from no-take reserves, gear restrictions and discard prohibitions. Long-term beneficial effects would be faster rebuilding of overfished groundfish stocks, fish habitat renewal and growth, larger and more numerous fish near reserve boundaries, and areas where relatively un-fished ecosystems can develop.

Alternative 7 would substantially reduce groundfish regulatory discard/bycatch (compared to the status quo) by assigning every commercial limited entry vessel to one or more sectors. Annual fishing mortality allocations for each overfished species would be established for each sector. All vessels in a sector would be required to stop fishing for the remainder of the designated period if any of its caps were reached. Trip limits would continue to be used for each sector. In addition, individual vessels could gain access to larger trip limits for non-overfished groundfish by paying for full observer coverage. These vessels would be assigned non-tradeable restricted species quotas for overfished species and would stop fishing for groundfish if any catch limit were reached. This would guarantee that their sector would not be closed by other vessels that fail to reduce their catch and/or bycatch of overfished species. These catch limits could be of similar duration to trip limits, and would be similar to individual, non-transferable quotas that would expire at the end of the period. The observer program would be restructured to monitor bycatch in each sector and to provide catch and bycatch data inseason. Regulatory bycatch of overfished species would be reduced, especially by vessels that volunteer for catch limits. These vessels would also be likely to reduce non-regulatory (economic) bycatch/discard of groundfish because they would want to maximize their revenues before reaching any catch limit. For vessels participating in sectors, regulatory and economic bycatch would be reduced over time as additional observer data became available. This would be especially true as observer data become available inseason. Bycatch of other groundfish species would not be significantly affected by this alternative unless all trip limits were defined as catch limits. In that case, vessels would retain a larger proportion of groundfish because all catch would apply towards the vessel limits.

ES.5 Practicability of Bycatch Minimization Methods

The Council determined that Alternative 7 minimizes bycatch to the extent practicable. The Council recognized that eliminating all groundfish bycatch is not practicable because it would require vessels to retain all fish caught or else not fish. By grouping vessels into sectors, and rewarding sectors that more effectively mitigate bycatch, vessels will be encouraged to develop methods and gears that better achieve the FMP's bycatch minimization objectives. Alternative 7 requires allocations to sectors and the subsequent monitoring and management by sector, both of which would increase management costs substantially. However, the Council believes the allocations are feasible and the observer program may be modified to achieve the desired results. Development of the monitoring infrastructure will take time, but will also lay important groundwork for development of dedicated access programs (individual fishing quotas). The Council found that Alternatives 5 and 6, which appear to be more environmentally preferred, are not practicable at this time for a variety of reasons. Information and analysis provided in Chapters 3 and 4 of this EIS contributed to that determination.

Table E.S.2. Summary of how well alternatives achieve the stated purposes for the proposed action.

Purpose of Proposed Action	Alt 1 (no action)	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Account for total fishing mortality by species	The current observer program provides statistically reliable estimations of groundfish mortalities.	I+	I+	S+	S+	S+	S+
Establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits	Trip and bag limits, application of the bycatch model and inseason tracking of landings are moderately effective but less than 100% successful.	I+	I+	S+	S+	S+	S+
Reduce unwanted incidental catch and bycatch of groundfish and other species	Area closures (Rockfish Conservation Areas), seasons and gear restrictions reduce unwanted catch. Trip limits create regulatory bycatch (discard).	I	I	S+	S+	S+	S+
Reduce the mortality of animals taken as bycatch	Prohibited species must be returned to the sea as quickly as possible with minimum of injury.	U	U	U	U	S-	U
Provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods	Trip limits reduce the race for fish and provide some minimal opportunity and incentives to avoid bycatch.	I+	I-	CS+	S+	CS+	S+
Monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly	The current program minimizes user and agency costs of monitoring catch and bycatch at the expense of precision and timeliness.	I	I	S+/ S-	S+/ S-	S+/ S-	S+/S-
Reduce unobserved fishing-caused mortalities of all fish	Area closures (RCAs), gear definitions and seasons mitigate potential mortalities.	I	I	CS+	S+	S+	CS+
Gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches.	Over a period of years, information on non-commercial and unassessed stocks will improve.	I	I	CS+	S+	S+	CS+

Performance Ratings, compared to status quo/no action alternative:

Substantial Beneficial (S+): Substantial improvement from status quo expected.
Substantially Adverse (S-): Substantially increased costs or reduced effectiveness expected.
Conditionally Substantial Beneficial (CS+): Substantial improvement expected if certain conditions are met or events occur, or the probability of improvement is unknown.
Conditionally Substantial Adverse (CS-): Substantially increased costs expected if certain conditions met, or the probability of occurrence is unknown.
Insubstantial Beneficial (I+)/Insubstantial Adverse (I-): Changes are anticipated but not expected to be major.

Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the direction or magnitude of the impacts.

Table ES.3. Significance of effects on the biological environment.

Resource	Alt 1 (no action)	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Groundfish	The current bycatch program provides statistically reliable estimations of groundfish bycatch and bycatch mortalities and mitigates many potential impacts. Trip and bag limits, application of the bycatch model and inseason tracking of landings are moderately effective but less than 100% successful in preventing overfishing. Trip limits create regulatory bycatch of groundfish.	I+	I+	S+	S+	S+	S+
Other Relevant Fish, Shellfish and Squid	Impacts on species such as Pacific halibut are reduced from recent years due to large area closures to protect overfished groundfish (primarily rockfish).	U	U	S+	S+	S+	S+
Protected Species	Area closures (Rockfish Conservation Areas), seasons and gear restrictions reduce potential catches. Protected species must be returned to the sea as quickly as possible with minimum of injury.	I+	I-	CS+	CS+	CS+	CS+
Salmon	Salmon bycatch in the Pacific whiting fisheries is closely monitored. Voluntary bycatch avoidance methods have proven effective, especially in the at-sea sectors	U	U	I+	I+	CS+	I+
Seabirds	Few seabird interactions have been documented; seasons and area closures could increase or decrease interactions.	I+	I-	CS+	CS+	CS+	CS+
Marine Mammals	Few marine mammal takings have been documented, and all are within current standards.	I+	I-	S+/S-	CS+	CS+	S+/S-
Sea Turtles	No sea turtle interactions have been observed in the groundfish fisheries.						
Miscellaneous Species	Area closures (RCAs), gear definitions and seasons mitigate potential mortalities. Little information is available.	U	U	CS+	CS+	S+	CS+
Biological Associations	Over a period of years, information on non-commercial and unassessed stocks will improve. Little information is available at this time.	U	U	CS+	S+	S+	CS+

Significance Ratings, compared to status quo/no action alternative:

Significant Beneficial (S+): Significant improvement from status quo expected.
Significant Adverse (S-): Significantly increased adverse impacts or reduced effectiveness expected.
Conditionally Significant Beneficial (CS+): Significant beneficial impacts expected if certain conditions are met or events occur (such as full observer coverage), or the probability of impacts is unknown.
Conditionally Significant Adverse (CS-): Significantly increased adverse impacts expected if certain conditions met, or the probability of occurrence is unknown.
Insignificant Beneficial (I+)/Insignificant Adverse (I-): Minor impacts, if any, are anticipated.
Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

Table E.S.4(a). Summary of effects of Alternatives 1 and 2 on the social and economic environment (Alternatives 3 - 7 in following tables).

	Alternative 1	Alternative 2
Incentives to Reduce Bycatch	Quota-induced discards may occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards are expected to increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely. However, in comparison to a race for fish allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards.	Reducing the level of effort in the groundfish fisheries and increasing trip limits would likely reduce the level of groundfish bycatch (discard).
Commercial Harvesters	By spreading out fishing more evenly over the year, the current management regime helps maintain traditional fishing patterns. However, landings of major target species (other than Pacific whiting) are expected to continue to decline as OYs are reduced to protect overfished species. Declining harvests lead to significant decreases in total groundfish ex-vessel value.	Further fleet reduction would be expected to reduce (but not eliminate) extra capacity in the fishery and to restore the fleet to some minimum level of profitability.
Recreational Fishery	Landings of major target species are not expected to increase and may decline further if OYs are reduced to protect overfished species. Decreased harvests lead to significant decreases in recreational value.	Changes in landings of major species targeted in the recreational fishery would be expected to be insignificant.
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1
Buyers and Processors	The current management regime reduces the likelihood that processing lines will be idle by fostering a regular flow of product to buyers and processors. However, decreased deliveries of groundfish to processors and buyers will result in significant decrease in groundfish product value.	No significant changes in the total amount of fish delivered to processors is expected. With fewer vessels in the fishery, processors would have fewer boats to schedule for landings. The related reductions in time spent unloading vessels is expected to result in cost savings. However, processors in ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources

Table E.S.4(a). Summary of effects of Alternatives 1 and 2 on the social and economic environment (Alternatives 3 - 7 in following tables).

	Alternative 1	Alternative 2
Communities	By maintaining year-round fishing and processing opportunities, the current management regime promotes year-round employment in communities. However, groundfish employment and labor income are expected to continue to decline, resulting in economic hardship for businesses involved in the groundfish fisheries. These businesses will likely continue to diversify to reduce dependence on groundfish fisheries.	The direction and magnitude of many of the economic effects on particular coastal communities are uncertain, as the distribution of the post-buyback fleet is uncertain. If further reduction in fleet capacity with higher trip limits were successful in increasing net revenues or profits to remaining commercial fishers, positive economic impacts on the communities where those fishers land their fish, home port and reside would be expected. On the other hand, some communities may experience a significant loss of vessels and a consequent decrease in income, jobs and taxes.
Consumers	The current management regime allows buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers. Consumers of fresh or live groundfish may be adversely affected by reduced commercial landings. However, changes in benefits to most consumers of groundfish products would be expected to be insignificant due to availability of substitute products.	Effects as described in Alternative 1
Fishing Vessel Safety	Some gains in fishing vessel safety are at least partially realized under the current management regime, as fishers are able to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. However, safety of human life at sea may decrease if reduced profits induce vessel owners to forgo maintenance, take higher risks or hire inexperienced crews.	Increases in net revenue to harvesters resulting from increases in trip limits may enhance their ability to take fewer risks and use their best judgment in times of uncertainty, thereby increasing vessel safety.
Management and Enforcement Costs	The management regime is expected to continue to be contentious, difficult and expensive. Technological developments such as VMS may mitigate the rate at which management costs escalate.	Costs are expected to decrease, as fewer vessels are generally easier and less expensive to monitor.

Table E.S.4(b). Summary of effects of Alternatives 3 and 4 on the social and economic environment (Alternatives 1 and 2 on preceding table; Alternatives 5, 6 and 7 in following table).

	Alternative 3	Alternative 4
Incentives to Reduce Bycatch	If trip limits increase, the level of groundfish bycatch (discard) would be expected to decline.	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, a race for fish could develop in which individual vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.
Commercial Harvesters	A combination of higher trip limits and a reduction in the length of the fishing season would be expected to lead to an overall reduction in variable fishing costs. With larger trip limits, revenues per trip are expected to increase. However, the overall impact of this alternative on costs and revenues would depend on when individual participants were allowed to fish. For example, fishers may be unable to fish for certain species at optimal times.	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. The allocation of catch limits to individual sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.
Recreational Fishery	Effects as described in Alternative 2	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by a CPFV observer program and expanded port/field sampling. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants. Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects.
Tribal Fishery	Effects as described in Alternative 1	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.

Table E.S.4(b). Summary of effects of Alternatives 3 and 4 on the social and economic environment (Alternatives 1 and 2 on preceding table; Alternatives 5, 6 and 7 in following table).

	Alternative 3	Alternative 4
Buyers and Processors	Larger trip limits would not be expected to affect the total amount of fish that harvesters deliver to processors. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, costs could increase if processors were unable to control the flow of product throughout the year and capital is idle during closed periods.	The economic effects on buyers and processing companies are unknown because of the uncertainty as to how well vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shut down, buyers and processors may experience significant shortages of fish.
Communities	The impacts are uncertain, as community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions. If larger trip limits resulted in increased net revenues or profits to fishers, positive economic impacts on the communities would be expected. On the other hand, seasonal closures could leave crew members at least temporarily unemployed.	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.
Consumers	Consumers of fresh or live groundfish could be unable to obtain fish from the same sources for half of the year unless the harvest sectors were split into two groups, with one group of vessels active at any given time.	If no early closures of major harvesting sectors occur, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.
Fishing Vessel Safety	The effects on vessel safety may be mixed. Increases in net revenue to harvesters resulting from increases in trip limits may lead to reductions in injury and loss of life because of harvesters incentives to take fewer risks and use their best judgment in times of uncertainty. However, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish.	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. If fishers within a sector perceive a greater likelihood of premature fishery closure, vessels would likely be more active early in the year (winter and early spring) when conditions may be more dangerous.

Table E.S.4(b). Summary of effects of Alternatives 3 and 4 on the social and economic environment (Alternatives 1 and 2 on preceding table; Alternatives 5, 6 and 7 in following table).

	Alternative 3	Alternative 4
Management and Enforcement Costs	Effects will vary depending on the way the seasonal closure is structured. Costs are expected to decline if there is no fishing activity to monitor for 6 months of the year. However, there will be increased costs if permit holders are divided into groups.	Costs would be expected to increase as catch limits were allocated over an increasing number of sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.

Table E.S.4(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1- 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
Incentives to Reduce Bycatch	The amount of fish discarded by each vessel would be counted against the vessel's limit. This measure provides strong economic incentives to reduce the catch of unwanted fish because it internalizes the costs of discarding fish.	Marine reserves would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing groundfish bycatch (discard) outside of marine reserves. Prohibiting discard would produce a strong incentive to avoid unwanted catch because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. If vessel groundfish quotas are transferable, Alternative 6 would be similar to Alternative 5; if not transferable, negative effects would be much more significant and more similar to Alternative 4.	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, individual vessels may forgo fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.
Commercial Harvesters	Current vessel owners as a group would likely benefit from a system that allocates freely transferable quota shares to vessel owners on the basis of catch histories. Moreover, the total amount of fish available for harvest would increase, as bycatch would be measured more	Some measures would significantly increase fishing costs, while others would reduce them. For example, 100% groundfish retention, full observer coverage, and establishment of marine reserves would increase average costs, whereas the establishment of ITQs for groundfish	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch

Table E.S.4(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1- 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
	accurately through expanded observer coverage. Not all vessel owners would benefit equally, and the relative benefits would depend on the allocation formula. In addition, the economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage.	species would reduce costs.	would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. Establishment of allocations among sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.
Recreational Fishery	The creation of tradeable quota shares for the commercial fishing/processing sectors is not expected to apply to the recreational fishery. The possibility of creating ITQs for recreational fishers may exist, but any discussion of how such a allocation would be achieved or its effects on recreational fishers would be speculative.	Rights-based system effects would be as described in Alternative 5. Marine reserves could benefit recreational fishers over the long term if local catch rates and fish size increased due to spillage of adults out of the marine reserves. However, if marine reserves resulted in geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open could lead to localized stock depletion, reduced recreational catch per unit effort, and reduction in the quality of the fishing experience.	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by improved port/field sampling. Incentive programs are likely to be limited, as there are many and diverse participants. Dividing the recreational sector along geographical boundaries could mitigate some of the negative effects.
Tribal Fishery	Effects as described in Alternative 1	Effects as described in Alternative 1	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant. However, potential effects of overfished species allocations are significant
Buyers and Processors	Buyers and processors would be expected to benefit from the anticipated increases in fish landings. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating	The net economic effect on buyers and processors is uncertain. In general, buyers and processors would be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well vessel owners manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing

Table E.S.4(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1- 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
	quota shares. Arguments have been made that harvester-only ITQ programs may result in stranded capital in the processing sector and a shift in the balance of bargaining power toward harvesters. These potential adverse effects could be mitigated if processors were also allocated quota shares.	system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. Because of their lack of mobility, buyers and processors may be especially negatively affected by marine reserves. However, the effects of marine reserves on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations.	tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.
Communities	Consolidation of fishing and processing activities to fewer vessels and plants would likely result in reductions in the numbers of crew members and processing workers employed. Granting quota shares to community groups could help maintain existing harvesting and processing patterns and serve to meet concerns about employment in communities.	Effects of a right-based management system as described in Alternative 5. Marine reserves would be expected to help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, marine reserves resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of communities are experiencing under Alternative 1 (no action) would be exacerbated.	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.
Consumers	Consumers would be expected to benefit from the anticipated increases in fish landings. There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring would depend both	Consumers would benefit from the anticipated increased landings that result from a rights-based system. In addition, over the long term, marine reserves that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large marine reserves could substantially decrease seafood supply enough to make consumers	If supplies of fish remain consistent, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.

Table E.S.4(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1- 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
	on the level of consolidation that might occur and the elasticity of demand for particular products.	worse off, at least in the short term. Marine reserves could have a positive effect on those consumers who derive non-consumptive benefits from marine ecosystems, including non-market benefits (e.g., existence value).	
Fishing Vessel Safety	Possible increases in the profitability of harvesting operations would likely lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty.	The net effect of the various measures included in this alternative on fishing vessel safety is uncertain. The establishment of ITQs for groundfish species is expected to promote vessel safety by reducing the pressure to fish under dangerous conditions. On the other hand, the establishment of marine reserves may result in a reduction in fishing vessel safety if the closure of fishing grounds results in vessels fishing farther from port and possibly in more hazardous areas.	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. With individual vessel catch limits, some vessels will have more choice of when and where to fish. Winter and early spring fishing may increase if vessels in a sector anticipate premature closures.
Management and Enforcement Costs	The costs of monitoring, enforcement and administration would be expected to increase significantly. Cost recovery measures such as a fee on quota holders would be expected.	Full (100%) observer coverage would be required, which would facilitate enforcement of a full retention regulation. The enforcement costs of establishing marine reserves vary with several factors, including the location, number, size, and shape of the marine reserves and types of activities restricted and allowed.	Costs would be expected to increase with allocations to multiple sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.

Table E.S.5(a). Summary of direct, indirect and cumulative effects of Alternatives 1, 2 and 3.

Resource Issue or Category	Alternative 1	Alternative 2	Alternative 3
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish			
Direct/Indirect	Catch rates of overfished species such as canary and bocaccio rockfish may delay or prevent rebuilding. Discard/bycatch of other groundfish could remain high due to constraints for overfished species.	Reduced fishing effort expected to reduce bycatch and bycatch mortality of overfished and other groundfish. Latent capacity remains and could negate any savings.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Cumulative	Canary and bocaccio rockfish may not be sustainable.	Higher probability of rebuilding overfished species. Reduced bycatch and bycatch mortality of other groundfish may allow fuller resource utilization but not necessarily increased abundance.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.			
Direct/Indirect	No change from baseline	No change from baseline	Interactions are thought to be low, but may be completely absent during seasonal closures. Halibut bycatch depends on timing of seasonal closures.
Cumulative	No change from baseline	No change from baseline	Interactions with birds depend on timing of seasonal closures.
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.			
Direct/Indirect	Provides for statistically reliable measures of bycatch on an annual basis, but not inseason.	Marginal improvement in monitoring coverage of trips.	Marginal improvement in monitoring coverage of trips
Cumulative	Lack of timely inseason data may lead to unsustainable fisheries for some overfished species.	Similar to Alternative 1 - data cannot be used in-season.	Similar to Alternative 1 - data cannot be used in-season

Table E.S.5(b). Summary of direct, indirect and cumulative effects of Alternatives 4, 5, 6and 7 for West Coast groundfish fisheries.

Resource Issue or Category	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure				
Direct/Indirect	No change from baseline	Reduction in closed areas	Reduction in closed areas	No change from baseline
Cumulative	No change from baseline	Increased growth of living benthic habitat (sponges and corals) in closed areas.	Increased growth of living benthic habitat (sponges and corals) in closed areas.	No change from baseline
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.				
Direct/Indirect	No change from baseline	Increased growth and abundance of some species in closed areas	Increased growth and abundance of some species in closed areas	No change from baseline
Cumulative	No change from baseline	Increased biodiversity in closed areas	Increased biodiversity in closed areas	No change from baseline
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish				
Direct/Indirect	Reduces bycatch and bycatch mortality of overfished species in particular - due to RSQ caps for overfished species.	Reduces bycatch and bycatch mortality of overfished and other groundfish through use of MPAs, RSQs and IFQs for overfished and other groundfish.	Reduces bycatch and bycatch mortality of all groundfish through use of no-take reserves, RSQs, IFQs, and 100% groundfish retention requirement.	Reduces bycatch and bycatch mortality of overfished species in particular - due to RSQ caps for overfished species.
Cumulative	Higher likelihood and rate of rebuilding, with possible exception of bocaccio rockfish.	Higher likelihood and rate of rebuilding of overfished groundfish, possible increases in other groundfish populations.	Highest likelihood and rate of rebuilding of overfished groundfish. Increased size and diversity of groundfish within closed areas.	Higher likelihood and rate of rebuilding, with possible exception of bocaccio rockfish.
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.				
Direct/Indirect	No change from baseline.	Small reductions in bycatch and bycatch mortality within protected areas.	Small reductions in bycatch and bycatch mortality within protected areas.	No change from baseline.
Cumulative	No change from baseline.	No change from baseline.	No change from baseline.	No change from baseline.

Table E.S.5(b). Summary of direct, indirect and cumulative effects of Alternatives 4, 5, 6and 7 for West Coast groundfish fisheries.

Resource Issue or Category	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.				
Direct/Indirect	Significantly improved monitoring coverage. In-season data can be used to make in-season adjustments. Accurate in-season accounting of overfished stocks of groundfish.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of groundfish. Discard/ bycatch of overfished groundfish nearly eliminated in commercial fisheries.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of all groundfish catch. No groundfish discard/bycatch.	Significantly improved monitoring coverage. In-season data can be used to make in-season adjustments. Accurate in-season accounting of overfished stocks of groundfish.
Cumulative	Reduced risk and higher likelihood of rebuilding overfished stocks of groundfish.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.	Reduced risk and higher likelihood of rebuilding overfished stocks of groundfish.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

SEP 17 2004

Dear Reviewer:

In accordance with provisions of the National Environmental Policy Act of 1969, we enclose for your review the Final Programmatic Environmental Impact Statement (FPEIS) for a West Coast Groundfish Bycatch Mitigation Program

The Pacific Fishery Management Council (Council) is responsible for developing FMPs that are consistent with the Magnuson-Stevens Act and other applicable law. The Council's Pacific Coast Groundfish Fishery Management Plan includes goals, objectives, and management measures addressing bycatch. This FPEIS analyzes the Council's objectives for its bycatch mitigation program and evaluates alternative programs to achieve those objectives. Various bycatch mitigation tools are evaluated for effectiveness in reducing unwanted catches of marine species, potential for mitigating other effects on the marine environment, social and economic effects, administrative costs, and other potential impacts. Some alternatives would require more comprehensive future scientific observations of catch and bycatch. The Council and the National Marine Fisheries Service propose to establish the policies and program direction to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law.

Additional copies of the FPEIS may be obtained from the National Marine Fisheries Service, 7600 Sand Point Way, NE, Seattle, WA 98115. The document is also accessible through the Northwest Region's website: http://www.nwr.noaa.gov/1sustfsh/groundfish/eis_efh/pseis/.

Comments or questions on this document submitted during the 30-day review period for the FEIS must be received by October 25, 2004. Written comments should be submitted by mail to D. Robert Lohn, Regional Administrator, National Marine Fisheries Service Northwest Region, 7600 Sand Point Way NE, BIN C15700, Seattle, WA 98115-0070, telephone: (206) 526-6150. Comments may be submitted by facsimile (fax) to (206) 526-6736. Electronic comments may be submitted by e-mail to bycatcheis.nwr@noaa.gov; include in the comment subject line the following document identifier: Comment on Bycatch FPEIS. A copy of your comments should be submitted to me by mail to the NOAA Strategic Planning Office (PPI/SP), SSMC3, Room 15603, 1315 East-West Highway, Silver Spring, Maryland 20910; by fax to 301-713-0585; or by e-mail to nepa.comments@noaa.gov.

NMFS is not required to respond to comments received as a result of the issuance of the FPEIS However, comments received will be reviewed and considered for their impact on the issuance of a record of decision (ROD). The ROD will be made available publicly following final agency action.

Sincerely,

Susan A. Kennedy
Acting NEPA Coordinator

Enclosure

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1.0 Purpose and Need For Action

1.1 The Proposed Action

The *PACIFIC FISHERY MANAGEMENT COUNCIL* (*COUNCIL*) and *NATIONAL MARINE FISHERIES SERVICE* (*NMFS*, also called *NOAA FISHERIES* - National Oceanic and Atmospheric Administration, U.S. Department of Commerce) propose to evaluate, at a broad scale, how to minimize *BYCATCH* in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law. The proposed action would set groundfish bycatch mitigation policies and future program directions. The Council is expected to immediately undertake preparation of a new groundfish fishery management plan amendment that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This *PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT* (PEIS) is intended to provide the analytical underpinnings for that effort.

> Words printed in *TYPE LIKE THIS* are defined in the glossary at the end of this document.

1.2 Need for the Proposed Action

The 1996 *SUSTAINABLE FISHERIES ACT* requires that every federal *FISHERY MANAGEMENT PLAN* (*FMP*) must be consistent with *NATIONAL STANDARD* 9 of the *MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT* (*MAGNUSON-STEVENS ACT*). National Standard 9 requires that "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Section 303(a)(11) of the Magnuson-Stevens Act requires each FMP "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the *FISHERY*, and include conservation and management measures that, to the extent practicable and in the following priority –

(A) minimize bycatch; and
(B) minimize the mortality of bycatch which cannot be avoided."

The proposed action is needed to (1) reduce waste, discard, and collateral damage to marine animals and plants by groundfish fishing activities on the Pacific Coast, (2) collect and report appropriate and adequate information to support the groundfish fishery management program, and (3) balance these needs with environmental and social values (i.e., need to allow for fishing).

1.3 Purpose of the Proposed Action

As identified by the Council's ad hoc Environmental Impact Statement Oversight Committee (Committee), the purposes (objectives) of the proposed action include the following:

- **account for total fishing mortality by species**
- **establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits**
- **reduce unwanted incidental catch and bycatch of groundfish and other species**
- **reduce the mortality of animals taken as bycatch**
- **provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods**
- **monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly**
- **reduce unobserved fishing-caused mortalities of all fish**
- **gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches**.

1.4 How this Chapter Is Organized

Chapter 1 identifies the issue of bycatch reduction and reporting as the focus of the proposed action and describes why the action is needed. Section 1.5 further clarifies the legal mandates and defines the term bycatch as it is used throughout this EIS. Council and NOAA Fisheries actions relating to bycatch are described to help set the context for the proposed action. Section 1.6 describes the process used to identify the important environmental issues addressed by various alternatives. Previous Council and NOAA Fisheries actions to reduce bycatch are described in Section 1.7. Section 1.8 identifies the criteria that used in selecting the agency preferred alternative. Section 1.9 describes the organization of this EIS and the steps to determine and evaluate the anticipated environmental impacts.

1.5 Background

The Magnuson-Stevens Act (16 U.S.C. §§ 1801-1884) was first enacted by Congress in 1976 and has been amended several times since then. The Magnuson-Stevens Act established United States fisheries jurisdiction over the *EXCLUSIVE ECONOMIC ZONE* (*EEZ*) (waters 3-200 miles offshore). It also established eight regional fishery management councils charged with developing fishery management plans for the areas under their respective jurisdictions. Fishery management plans are approved, implemented, and enforced by NOAA Fisheries.

The Pacific Council is responsible for fisheries in the EEZ off Washington, Oregon, and California. The Pacific Council has developed several fishery management plans, including the *PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN* (Groundfish FMP). The Groundfish FMP was implemented in 1982. It covers more than 80 species of groundfish, many of which are caught together on a variety of fishing gears that are used to target groundfish. Groundfish are also caught incidentally in fisheries for non-groundfish species such as pink shrimp and California halibut. As of June 1, 2004, eight [1/] groundfish species are considered overfished. These are darkblotched rockfish, canary rockfish, lingcod, yelloweye rockfish, bocaccio rockfish, cowcod (also a rockfish species), widow rockfish, and Pacific ocean perch (another rockfish). Each of the overfished species is subject to a rebuilding strategy that constrains fishing for that species.

A 1996 amendment to the Magnuson-Stevens Act, the Sustainable Fisheries Act, created numerous new requirements for fishery management plans. Among the new requirements was a requirement that fishery management plans "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority – (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided." 16 U.S.C. § 1853(a)(11). The Magnuson-Stevens Act defines the term bycatch to mean "fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. Such term does not include fish released alive under a recreational catch and release fishery management program." 16 U.S.C. § 1802(2).

To meet the new requirements imposed by the Sustainable Fisheries Act, the Pacific Council prepared Amendment 11 to the Groundfish FMP. Amendment 11 included bycatch provisions, but these were disapproved by NOAA Fisheries as inadequate, and returned to the Pacific Council for further work. The Pacific Council subsequently prepared, and NOAA Fisheries approved, another bycatch amendment (Amendment 13) to the Groundfish FMP. Amendment 13 attempted to comply with the bycatch requirements by providing that NOAA Fisheries could implement an observer program to gather data on bycatch, and could also take a variety of listed measures to reduce bycatch. Amendment 13 and its accompanying Environmental Assessment (EA) were subsequently disapproved by the federal district court as inadequate in <u>Pacific Marine Conservation Council v. Evans</u>, 200 F.Supp.2d 1194 (N.D. Calif. 2002) [hereinafter <u>PMCC</u>].

1/ A recent stock assessment concluded the Pacific whiting stock has fully rebuilt, and NOAA Fisheries has declared the stock is no longer overfished.

In PMCC, the court made several rulings with respect to the adequacy of the Amendment 13 bycatch revisions and the EA. The court held that Amendment 13 failed to establish a standardized reporting methodology because it failed to establish either a mandatory or an adequate observer program. Further, it failed to minimize bycatch and bycatch mortality because it failed to include all practicable management measures in the FMP itself. The court also found a lack of reasoned decisionmaking because four specific bycatch reduction measures (fleet size reduction, marine reserves, vessel incentives, and discard caps) were rejected without consideration on their merits. With respect to NEPA, the EA prepared for Amendment 13 failed to address adequately the ten criteria for an action's significance set forth in the CEQ regulations at 40 CFR 1508.27(b), and also failed to analyze reasonable alternatives, particularly the immediate implementation of an adequate at-sea observer program and bycatch reduction measures.

This *ENVIRONMENTAL IMPACT STATEMENT* (EIS) has been prepared as a programmatic document to assist the Pacific Council and NOAA Fisheries in taking the next steps necessary to meet the bycatch requirements of the Magnuson-Stevens Act and to address the specific legal deficiencies identified by the court in the PMCC decision. When the EIS is final, the Council is expected to immediately undertake preparation of a new FMP amendment that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This EIS is intended to provide the analytical underpinnings for that effort. In addition to other bycatch mitigation tools, it includes consideration of fleet size reduction, marine reserves, vessel incentives, and discard caps, as required by the PMCC decision.

With respect to the requirement for a standardized reporting methodology, the Council and NOAA Fisheries adopted a mandatory observer program in Amendment 16-1 to the Groundfish FMP. Amendment 16-1 was approved by NOAA Fisheries on November 14, 2003. Pre-existing regulations implementing the FMP already required fishing vessels to carry observers at the request of NOAA Fisheries. A mandatory observer program was begun under these regulations in August 2001 under the auspices of the Fishery Resource Analysis and Monitoring Division, Northwest Fisheries Science Center, NMFS, Seattle, Washington. This program has continued and has been expanded since that time. The Science Center has reported the data gathered during the first two years of the observer program. The most recent information obtained through the observer program is contained in the observer program's "Initial Data Report and Summary Analyses" dated January 2004, details of which are included in this FEIS. The full report is provided as Appendix A.

1.5.1 Defining Bycatch

The Magnuson-Stevens Act generally defines "bycatch" as fish that are discarded for regulatory or economic reasons The term "fish" is defined to include nearly all types of marine life except marine mammals and seabirds. However, most fishery managers also use the term in a broader sense. The broader meaning sometimes includes fish, marine mammals and seabirds that are caught incidentally while fishing for a different species. It can also include fish of the same species that are small or inferior quality, or fish that simply co-occur in a particular fishing location and are caught together. Fish caught under these circumstances may either be kept or discarded. Problems presented by the overfished groundfish species, which frequently co-occur with other species, or are caught incidentally, are particularly difficult to solve. Consideration of these problems is also included in this EIS.

The Proposed Action is to establish bycatch management policies and program direction consistent with the Magnuson-Stevens Act. Certain bycatch mitigation measures have been established; additional measures may be established based on decisions related to this PEIS. New bycatch mitigation measures may require additional NEPA analysis.

The bycatch management policies, reporting methodologies, and reduction measures make up a bycatch management program. "Bycatch," as the term is defined in the Magnuson-Stevens Act, refers specifically to fish. "*FISH*" is defined broadly to include nearly all species of marine organisms except seabirds and marine mammals; however, these non-target marine animals may also be affected by federally-managed fisheries, and impacts on them must also be considered in order to be consistent with other federal laws. Therefore, for the purposes of this *ENVIRONMENTAL IMPACT STATEMENT* (EIS), the term bycatch will mean discarded catch of any living marine resource, plus any unobserved mortality that results from a direct encounter with fishing gear.

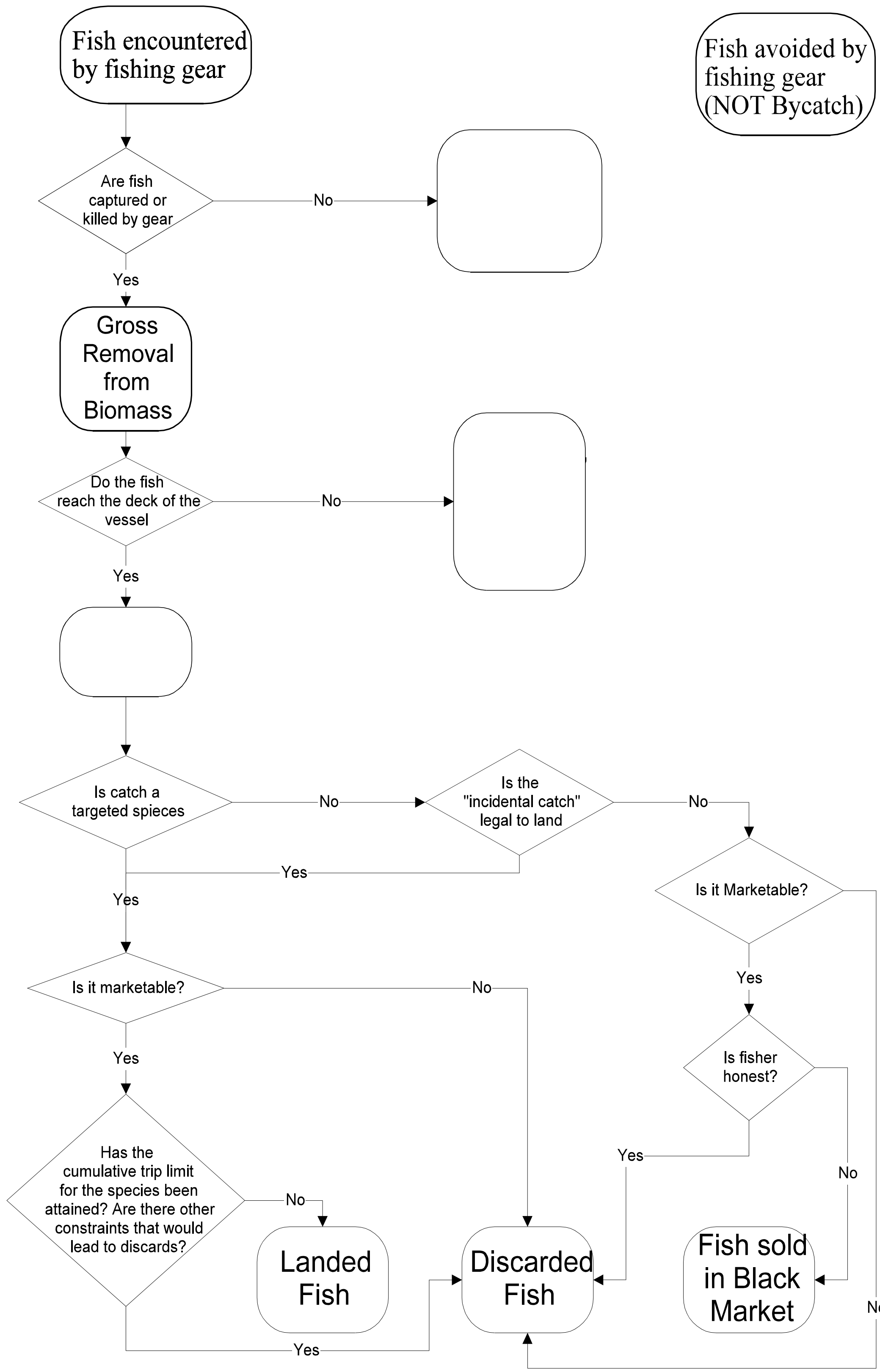
The groundfish fishery off the West Coast of the United States is executed from the Canadian to Mexican borders. Multiple vessel types participate in this fishery. They range in size from 8' kayaks to 120' trawlers and fish in nearshore to offshore waters. The vessels use various types of gear, including bottom trawls, midwater trawls, pots (traps), longlines, and other hook and line gear to catch over 80 species of marketable fish. Trawlers take the majority of groundfish. The catch can be incredibly diverse in species and fish size, and overall catch size can vary widely as well. In many cases, a portion of the catch is retained and another portion of the catch, that may be of the wrong size, species, or is over management quota limits, is discarded at sea.[2/]

2/ In addition, some fish may be rejected as sub-quality by a fish buyer/processor when a commercial vessel delivers its load. Such

Figure 1.1 illustrates the meaning of bycatch and other catch-related terms as they are defined and used in the Magnuson-Stevens Act and Pacific Coast Groundfish FMP. Some fish encounter fishing gear but escape alive. However, there will almost always be some unobserved mortality resulting from injury when fish encounter fishing gear, especially mass-contact types of gear, such as trawl gear. The latent or pass-through mortality of fish escaping from a trawl net may be quite high, depending on the design and manner in which the gear is fished as well as its mesh size (Henry 1990). Additional delayed mortality may occur after fish escape gear. This type of mortality may be related to the stress of capture and physiological injuries which subsequently turn out to be fatal (Davis and Ryer 2003). There may also be mortality associated with gear that is lost or abandoned — the bycatch resulting from this *GHOST FISHING*. NOAA Fisheries considers this unobserved fishing-related mortality included in the definition of bycatch because it constitutes a harvest of fish that are not sold or kept for personal use (63 FR 24235 May 1, 1998).

fish, called weigh backs, are disposed of on land or returned to the vessel for disposal at sea. These fish fall outside most definitions of bycatch but are still considered to be wasted.

Figure 1.1. Diagrammatic representation of bycatch and other catch-related terms.



TOTAL CATCH is that harvest taken by the fishing gear and which reaches the deck of the fishing vessel. It is sometimes useful to subdivide total catch into "targeted catch" and "non-targeted catch" (also referred to as *INCIDENTAL CATCH*), bearing in mind that a species can move from one category to another depending on size, market demand, season or other criteria.[3/]

A fish captured by a commercial fisher can be retained and sold or discarded; a fish captured by a recreational fisher can be retained or discarded, but may not be sold. In both cases, discards are that portion of total catch thrown away at sea (for one reason or another). The remainder is the *LANDED CATCH* or *RETAINED CATCH* (i.e., that which is brought ashore).

There are circumstances in which fishermen will discard fish even though they are marketable or desirable. Discarding these fish may be the result of *FISHERIES MANAGEMENT MEASURES* directly, such as *PROHIBITED SPECIES* regulations or incentives created by management measures (e.g., a cumulative trip limit or quota constraint). Discarding may also occur for economic reasons (e.g., to make room in the vessel hold for more valuable catch) or for other non-regulatory reasons (e.g., recreational fisher doesn't like it). In most cases, fish that are not marketable because they are an undesirable species, size, sex, or poor quality are discarded. Fish that are illegal to land (due to restrictions imposed by fisheries management) are in most cases discarded, although some of this fish may be retained by a recreational fisher or retained and sold on the black market by commercial fishers (or recreational fishers), if these fishers are dishonest.

U.S. fishery policy in the 1970s and 1980s focused primarily on development of American fishing and processing capacity so the entire harvest could be used by U.S. citizens. Bycatch was considered to be mainly a social and economic issue; the main concerns were bycatch of *SALMON*, Pacific halibut, and high value groundfish taken by foreign *TRAWL* fishing operations targeting Pacific whiting,

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3/ The definition of bycatch in NOAA Fisheries' "*Managing the Nation's Bycatch*" includes "retained incidental catch." The term "incidental catch" is often used as a synonym for "non-target species." The groundfish FMP allows capture and retention of all species of groundfish; thus, all groundfish species up to the specified limits may be considered target species. However, because strict limits are placed on overfished groundfish, some people believe they should be considered non-target. This creates conflicting definitions. If overfished species are to be considered as retained incidental catch, the FMP and regulations should be amended to define them as such. However, it is appropriate to consider <u>non-groundfish</u> species as incidental or non-target species, and therefore bycatch, whether or not those fish are retained.

and catch of salmon and halibut taken by American trawl fishers. Foreign catch of Pacific ocean perch was considered a conservation issue because this species had been severely depleted by earlier foreign fishing. Bycatch of salmon and Pacific halibut by U.S. trawl fishers was also considered a problem because it could reduce the target fishery quotas for these species. (The International Pacific Halibut Convention prohibits the use of trawls to harvest halibut; harvest of salmon with trawls is also prohibited in U.S. and Canadian waters. Dungeness crab is another prohibited species in most *COMMERCIAL* groundfish fishing operations.)

When certain salmon populations were listed as *THREATENED* or *ENDANGERED* under the *ENDANGERED SPECIES ACT* (ESA), NOAA Fisheries evaluated the impact of groundfish fisheries on these populations and prepared a series of *BIOLOGICAL OPINIONS*. Amendment 7 to the groundfish FMP acknowledged that groundfish fishing may directly impact non-groundfish species and authorized implementation of measures to control groundfish fishing to share conservation burdens to protect those stocks.

1.5.2 Groundfish Management and NEPA

The groundfish resource includes over 80 species of *FINFISH* that inhabit a wide variety of marine habitats. Many of these species occupy the same *HABITATS* and are caught together, either intentionally or unintentionally. While some species may be more desirable from a commercial or *RECREATIONAL* standpoint, fishing methods are rarely selective enough to catch only the most desirable species. Other *GROUNDFISH* species are typically caught incidentally, and many are considered valuable for human consumption, bait or other uses. This *INCIDENTAL CATCH* has always been considered a part of fishing, and fishers typically keep what they can use; bycatch (*DISCARD*) of groundfish is the portion of the catch that cannot be used, whether due to regulations, markets, or edibility (or palatability). Incidental catch and bycatch in the groundfish fishery were initially considered an unavoidable cost of doing business. The main concerns were the cost of sorting the catch, damage to more valuable fish, lack of storage space, or lack of markets. In fact, the original FMP defined the *OPTIMUM YIELD* (*OY*) to exclude all groundfish discarded by U.S. fishermen and fishing vessels. A single OY was established for the entire groundfish resource, defined as "all the groundfish that can be taken under the regulations, specifications, and management measures authorized by the FMP and promulgated by the *SECRETARY* (of Commerce)." This OY was not a predetermined or specified numerical amount, but rather whatever harvest (landed catch) resulted under the regulatory program and economic conditions. As U.S. harvesting capacity grew and exceeded sustainable harvest levels, retention limits were established for commercial fishing vessels to prevent excessive harvest of certain groundfish species. These vessel limits, called *TRIP LIMITS*, initially limited the amount of fish a vessel could catch and retain during a single fishing trip. Later, trip limits were applied to a period of time such as a week or two-week period; more recently the time periods were extended to monthly or two-month periods. Much of the management process each year is focused on monitoring the rate of commercial landings and adjusting trip limits to maintain a relatively consistent product flow throughout the year. This system requires commercial vessel operators to cull (discard) any catches that exceed specified limits. The system worked relatively well as long as trip limits were so large (tens or hundreds of thousands of pounds) that few vessels reached those limits. However, as various species biomasses were fished down, trip limits were reduced correspondingly to the point where many vessels frequently reached the limits. Trawl gear designed to catch large amounts of fish often captures too much, especially late in a period when the vessel is trying to catch just enough to fill its limit. This problem became more acute as trip limits were established for more species, and as trip limits became smaller (for example, a few thousand pounds). Since 1999, with development of *REBUILDING PLANS* for *OVERFISHED* groundfish species, some trip limits have been reduced to a few hundred pounds. Fishers must now avoid these species as much as possible, although they may be allowed to keep some overfished species up to their limits.

> NEPA stands for the National Environmental Policy Act. This federal law requires every federal agency to prepare an analysis of environmental effects before it takes a major action that may affect the environment. The agency must "specify the alternative or alternatives ... considered to be environmentally preferable" and "whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not."

Federal agencies are required to comply with the *NATIONAL ENVIRONMENTAL POLICY ACT* (*NEPA*) when a major federal action may be taken by an agency. Federal decision-makers are to use NEPA to assist them with making the appropriate decision for a *PROPOSED ACTION*, including fishery management plans and regulations. NEPA requires agencies, in this case the Council and NOAA Fisheries, to consider reasonable alternatives to achieve the identified purpose and need, to evaluate the environmental consequences of the alternatives, and to provide for public participation in the decision-making process.

The proposed action is to amend the FMP and its implementing regulations to comply with section 303(a)(11) of the Magnuson-Stevens Act. Changes to the bycatch program may require revisions to the catch and bycatch reporting and monitoring systems and/or to conservation and management measures. In considering this action, the Council and NOAA Fisheries will evaluate the effects of bycatch on other non-target species to ensure that fishery management does not result in conflicts with other legal mandates. This action is being undertaken to ensure the FMP complies with the conservation and management requirements of the Magnuson-Stevens Act, *MARINE MAMMAL PROTECTION ACT* (*MMPA*), *MIGRATORY BIRD ACT*, Endangered Species Act (ESA) and other applicable federal laws.

This PEIS addresses the issue of bycatch and other incidental catch in the Pacific Coast groundfish fishery. Specifically, this EIS analyzes the expected environmental *IMPACTS* of various alternative methods to reduce bycatch taken by commercial and recreational fishers fishing for groundfish and associated species and methods of collecting bycatch information.

Effective fishery management programs include several smaller programs, such as stock assessment, policy and regulation development, decision-making, monitoring, information collection, and enforcement. These sub-programs must be designed, matched, and integrated to achieve the overall program goals and objectives. The fishery management program established by the groundfish FMP is one of the most complex and complicated in the Nation, covering over 80 species over the entire West Coast of the U.S. Thousands of commercial fishing vessels harvest groundfish each year, and many more thousands of recreational fishers fish for many of the same species. The catching capacity (fishing power) of each of these sectors far exceeds the capacity of many species to sustain themselves under that fishing pressure. Thus, regulations to limit catch have become more stringent and complex.

Eight groundfish stocks are classified as overfished, and efforts to rebuild them require that harvest be minimized to the extent practicable. Along with this, it is critical that rebuilding efforts be closely monitored to ensure the regulations are effective and catches are reduced as intended. In addition, effects of fishing on other fish, birds and marine mammals should be monitored and mitigated as appropriate.

Groundfish species are important components of the marine *ECOSYSTEM* off the Pacific Coast of North America, and fishing for groundfish affects other components of the marine environment. Non-groundfish species may be captured and/or killed directly by groundfish fishing gears or fishing methods. Even some groundfish species may be subjected to additional mortality, such as being captured and released. Groundfish fishing may reduce food sources (*FORAGE*) for other marine animals. In some cases, groundfish species may be the forage. In other cases, the forage may be other species that are affected by groundfish fishing.

HARVEST includes all fish that are captured, whether intentionally or not, and all fish that are killed, whether retained by the fisher. Fish that are captured and released or discarded are called bycatch. Bycatch also includes fish that are injured or killed but not captured (for example, dropouts and fish that become unhooked) and fish killed by lost and discarded gear (ghost fishing). In addition, groundfish fishing could directly or indirectly affect other marine animals such as marine mammals, seabirds and turtles. The EIS evaluates certain potential effects and could indicate the need for management measures to *MITIGATE* such impacts.

The current bycatch program includes a mix of indirect measures to control bycatch and a combination of methods to report and assess catch and bycatch amounts. Some management policies and measures tend to increase regulatory bycatch. Overall, the current bycatch program provides little individual bycatch accountability or opportunity or incentives for individuals to reduce bycatch.

1.6 Scoping: Key Issues and Development of Alternatives

NEPA mandates that "[t]here shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." This process, termed scoping, allows the public to comment on what the EIS should cover in order to help determine possible alternatives, issues and impacts to be analyzed. The overall purpose of the scoping process is to identify the affected public, identify public and agency concerns, define issues that will be examined, and assign EIS preparation tasks.

Pacific Coast Groundfish EIS Scoping Hearings

2001	
CITY	**DATE**
Newport, OR	May 22
Astoria, OR	May 23
Eureka, CA	May 29
Los Alamitos, CA	May 30
Seattle, WA	June 5
Burlingame, CA *(at Council meeting)*	June 12
2003	
Foster City, CA *(at Council meeting)*	June 16

The scope of this EIS has been refined since NOAA Fisheries initially identified a need for action, and NOAA Fisheries conducted two scoping processes relating to this EIS. The first scoping process, from April 10, 2001 through June 12, 2001, focused on the need for a Programmatic EIS (PEIS) on the entire Pacific Coast groundfish fishery management program. NOAA Fisheries published an initial scoping report in August 2001, which provided a summary of all comments received and key issues identified during the scoping process. Bycatch was a major issue identified during scoping, along with protection of essential fish habitat (EFH) and several other issues. NOAA Fisheries immediately began working with the Council to develop alternatives to address the purpose and need for the PEIS. In February 2002, NOAA Fisheries determined there was a need to address EFH issues independently and began preparation of a separate EIS focusing specifically on designation of essential fish habitat (EFH) and associated management measures, including measures to reduce effects of fishing on EFH. This separation was intended to improve public understanding and participation in the NEPA process, to make each EIS more useful in future management decisions, and to more clearly distinguish between programmatic groundfish fishery management and specific EFH issues. On May 16, 2003, NOAA Fisheries published a notice of its intent to further revise the scope of the PEIS; the intent was to focus more specifically on issues relating to bycatch reduction and monitoring.

The Council established an ad hoc Groundfish EIS Oversight Committee (Committee) to advise the drafting team and help develop a range of programmatic alternatives for managing the Pacific Coast groundfish fishery.

The Committee, at its third meeting (April 22-23, 2003), reviewed the status of the PEIS, the alternatives under consideration, and events subsequent to the initial scoping period. Based on its perception that conditions and needs had changed and on NOAA Fisheries comments, the Committee recommended the scope of the EIS be focused more narrowly on the more pressing issue of bycatch reduction and reporting. The Committee prepared a revised set of alternatives to encompass the range of approaches to reduce bycatch and to address incidental catch monitoring and reporting issues. NOAA Fisheries reopened scoping and conducted an additional scoping meeting on June 16, 2003 in conjunction with the Council meeting in Foster City, California. These alternative were presented to the Council at its meeting, along with a summary of comments received during the second scoping period. The Council provided comments in concurrence with the revised scope and suggested improvements to the alternatives its committee had prepared. NOAA Fisheries has adopted those alternatives in this PEIS.

1.6.1 Key Issues Identified During Initial Scoping Period

Time/Area Management

- Year-round fishery policy versus partial year fishery
- Traditional single-species management versus an ecosystem-based approach

Fleet Capacity

- Capacity reduction consistent with number of fish available
- Geographic distribution of vessels under capacity reduction
- Active reduction of the fleet versus establishing methods for the industry to reduce itself
- Overcapacity is too narrow an issue for an option in EIS analysis
- Effects of capacity reduction on the value and need for MPAs

Resource Allocation

- Promote IFQs/ITQs
- Consider whether flexibility of ITQs will harm coastal communities
- Keep effort/people spread along coast
- Consider port quotas, like CDQs and Cooperatives, for West Coast communities
- Allow permit transfers between gear types in the limited entry program
- Allocate resource equitably between recreational and commercial sectors
- Coordinate inshore species allocation for recreational and commercial sectors with States
- Consider gear impacts and efficiency during allocation (favor low impact, less efficient gear)
- Allocate catch to particular vessels rather than gear types based on clean fishing practices (low bycatch, minimal habitat disturbance by gear)

Bycatch/Discards

- Bycatch and discards created by regulations
- Analyze year-round fishery for bycatch/discards
- Verify effectiveness of time/area management as a bycatch reduction measure
- Higher limits would reduce discards
- Standardize a reporting method for bycatch by having fishers provide bycatch information in logbooks
- Lack of data on discards (number, type, mortality)
- Lack of research on bycatch-friendly gear; hook-and-line fishery has no bycatch
- Create incentives to reduce bycatch
- Reduce waste: use bycatch/discard overages instead of throwing them away
- Recreational fishery should increase efforts to help discarded fish survive, especially undersized fish
- Reevaluate bycatch estimates for fisheries
- Use bycatch caps to close target fishery
- If it's legal for you to sell, it's not bycatch
- Ocean ecosystem linked tighter than land ecosystem, therefore if protein taken out, effects felt elsewhere

Gear

- Lack of data on relative selectivity of gear
- Favor more selective gear types
- Evaluate gear performance standards vs. design standards

Gear restrictions:

- Create incentives/penalties rather than mandating gear changes/restrictions
- Do not ban gear
- There must be a better way to protect red rockfish than requiring small footropes
- Prohibit rockhopper gear
- Evaluate effectiveness of small footrope requirement

1.6.2 Key Issues and Comments During Second Scoping Period

The second scoping period focused primarily on whether to refine the scope to focus more narrowly on bycatch or to continue with the broad scope of the entire groundfish fishery management program. Support for the broad scope was expressed, along with need for specific bycatch reduction measures at the end of this NEPA process. Methods to improve bycatch avoidance were stressed, along with development of incentive-based measures. While increased observer coverage was widely endorsed, concerns about cost and cost-effectiveness were also expressed. No new issues were identified beyond those identified in the initial scoping process.

1.7 The Groundfish Fishery Management and Bycatch Mitigation Program

Active management of the domestic groundfish fishery began in the early 1980s with the establishment of numerical Optimal Yields (OYs) for several managed species and trip limits for widow rockfish, the *SEBASTES COMPLEX*, and sablefish. The objective of trip limits was to slow the pace of landings to maintain year-round fishing, processing, and marketing opportunities. Since the 1980s, management regulations generally have evolved to the use of cumulative 2-month catch limits.

Under the original groundfish FMP, most groundfish were included in a non-numerical OY that excluded bycatch. The non-numerical OY was defined as "all the fish that can be taken under the regulations, specifications, and management measures authorized by the FMP and promulgated by the U.S. Secretary of Commerce. This non-numerical OY is not a predetermined numerical value, but rather the harvest that results from regulations..." In short, OY included all groundfish legally caught and landed. This definition was based on the understanding the groundfish fishery is a multi-species fishery, with multiple fishing strategies and target strategies. Almost all domestic groundfish bycatch in the early years of groundfish management was market-induced discards, where fishers were throwing away unmarketable species or unmarketable sizes of targeted species. Domestic fisheries management did not account for these groundfish discards; targets for landed catch were set equal to the *ACCEPTABLE BIOLOGICAL CATCH* (*ABC*). For the foreign and joint venture fisheries, the Council set incidental catch limits for non-target species.

Over time, foreign and joint venture fisheries dwindled, and the Council introduced trip limits for a greater number of species taken in the domestic fisheries. *EFFORT* increased in the domestic fishery, and trip limits became more restrictive to control harvest rates. The Council realized that managing a variety of species under trip limits could lead to increased rates of discards for some species. Bycatch and discards can result from a regime of multiple trip limits because a fisher might target gear on a complex of species, and then find that in order to catch the full limit on one species, he has to exceed the limit on other species, and then discard that excess. To address this issue, the Council shifted away from per trip limits for most species and towards monthly cumulative limits. Cumulative limits were preferable to per trip limits because a fisher could accumulate species at different rates over different trips, without having to discard fish each trip because of exceeding per trip limits. Once the Council had seen that monthly landings limits would continue to allow a year-round fishery, it introduced two-month cumulative limits to again reduce the likelihood that fishermen would have to discard overages of particular species within a multi-species complex fishery.

In addition to modifying the use of trip limits to reduce discards, the Council used other regulatory measures to reduce incidental catch of *JUVENILE* fish that would be discarded as unmarketable, and to reduce bycatch of protected salmon species. During the mid-late 1980s, the Council endorsed two research projects that addressed bycatch in the groundfish trawl fishery and potential mesh changes that might reduce bycatch of certain groundfish.[4/] The research included voluntary observer programs, primarily on trawl vessels fishing off Oregon. In the early 1990s, the Council began responding to the preliminary results by requiring larger (4½ inch minimum) trawl mesh in net *CODENDS* and then requiring the larger mesh throughout *TRAWL* nets. By 1995, all bottom trawl nets were required to have a minimum of 4½ inch mesh, the use of chafing gear was restricted, and double-walled (lined) codends were prohibited (60 FR 13377, March 13, 1995, codified at 50 CFR 660.322). All of these measures were intended to give smaller-size fish the opportunity to escape from the trawl net, reducing the likelihood that those fish would be caught and discarded.

Reducing bycatch of threatened and endangered salmon species was particularly important to the Council as American fishers replaced the foreign whiting fishery in the late 1980s. The Council brought salmon and whiting fishers together to address salmon bycatch in the whiting fishery. In 1993, the Council established Klamath River and Columbia River salmon conservation zones and Eureka area trip limit restrictions to prohibit or reduce whiting fishing in areas of high salmon interception rates (58 FR 21261, codified at 50 CFR 660.323). The whiting fleets now also work to keep their chinook salmon interception below a voluntary threshold of 0.05 chinook salmon per metric ton of whiting.

Growth of the West Coast groundfish fisheries and inadequate scientific information combined to frustrate efforts to stabilize the management program and maintain stocks near MSY levels. While the Council was experimenting with these methods to reduce bycatch, domestic fishing capacity in the groundfish fleet was growing and outstripping resource productivity. We now also know that stock assessment information in the 1980s and early 1990s was not adequate to draw a clear picture of West Coast rockfish productivity. Harvest rates based on scientific information available at the time are now considered too aggressive to sustain harvest of the low productivity West Coast rockfish stocks (Myers, et al., 1999; Ralston et al., PFMC, 2000). The combination of increasing fishing capacity and decreasing OYs led to ever more restrictive cumulative landings limits. The Council's *GROUNDFISH MANAGEMENT TEAM* (*GMT*) became concerned about the effects of a restrictive cumulative landings limit regime on rates of bycatch and discard, and announced in April 1990 its plans to begin to factor

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4/ Pikitch et al., 1988; Pikitch 1990; Bergh et al., 1990: Two voluntary observer programs (1985-1990) assessed discard causes and the impact of potential changes in codend mesh-size and shape.

discards into setting ABCs for the 1991 fishing year (PFMC GMT, 1990). In August 1990, the Council finalized Amendment 4 to the FMP, which introduced the practice of distinguishing between ABCs and *HARVEST GUIDELINES* to, among other things, account for fishing mortality beyond landed catch numbers (PFMC, August 1990.)

Amendment 4 set the Council's bycatch policies for the early-mid 1990s, accounting for discards by setting landed catch limits below ABC levels. Initially, only sablefish and Dover sole were managed with reduced landed catch limits. Over time, however, the Council treated a suite of rockfish and roundfish in a similar fashion by assuming a certain level of discard and subtracting that discard off allowable total harvest levels for each species. For rockfish species, discards were assumed to be 16% of the ABC. This assumption was based on a 1988 study (Pikitch, et al., "An evaluation of the effectiveness of trip limits as a management tool") that observed a 16% discard of widow rockfish in the trawl groundfish fishery (57 FR1654, January 15, 1992).

From 1995 to 1998, Oregon Department of Fish and Wildlife (ODFW) administered the Enhanced Data Collection Project (EDCP) in cooperation with the states of Washington and California. The primary goal of the EDCP was to collect data on discard rates for groundfish species and to determine bycatch rates for prohibited species (salmon and Pacific halibut). Trawl catcher vessels participated in this program on a voluntary basis, carrying observers and/or logbooks. Trawlers used the logbooks to record discard and landed catch data, while observers additionally monitored quantities and rates of discards, species composition of discards, halibut viability information, and conducted some biological sampling.

NOAA Fisheries declared three species overfished in 1999 – bocaccio, lingcod, and Pacific ocean perch (POP.) The first groundfish rebuilding measures were implemented as part of the 2000 harvest specifications and management measures. These measures included: time/area closures to protect lingcod during their spawning/nesting season; limiting directed fishing effort on healthy species that co-occurred with overfished species to times and areas when the healthy stocks were most concentrated, or when bycatch of other species was expected to be low; setting cumulative landings limits to move fishing effort away from the deeper continental shelf, the primary habitat of several overfished species; and, setting differential landings limits for trawlers operating with different trawl gear configurations (bottom trawling with *FOOTROPES* greater than 8 inches in diameter, bottom trawling with footropes smaller than 8 inches in diameter, and *MIDWATER* or *PELAGIC TRAWLING*.) Trawling with footropes that have roller gear or other devices designed to bounce over rough rock piles affords those vessels greater access to prime rockfish and lingcod habitat. Therefore, landings of *SHELF* rockfish were prohibited if large footrope trawls (roller gear) were used. Small amounts of shelf rockfish bycatch were allowed to be landed if small footrope trawls were used, and targeting healthy shelf rockfish stocks was encouraged only if midwater trawls were used.

In addition to these initial measures to reduce bycatch of overfished species, the Council began to incorporate information from analyses of the EDCP data into its management program for deepwater species. Methot et al. (2000) had used the data to estimate discard of sablefish, Dover sole, and thornyheads. Wallace and Methot (2002) also applied the data to estimate Pacific halibut bycatch mortality in IPHC Area 2A. Sampson (2002) applied the data to estimate average discard rates for the major species and determine the factors contributing to variability of discard rates. These analyses were used to set trawl cumulative landings limits for the *DTS COMPLEX,* which were based on catch ratios between the four species in the complex–Dover sole, thornyheads (shortspine and longspine), and sablefish.

Over 2000-2002, NOAA Fisheries declared six additional species as overfished – canary rockfish and cowcod (2000), darkblotched and widow rockfish (2001), Pacific whiting,[5/] and yelloweye rockfish (2002). West Coast groundfish management has been radically changed by the need to manage a group of multi-species fisheries to protect eight overfished groundfish species. Reducing incidental take of overfished species has been one of the major goals of the rebuilding programs for overfished species. The Council's current bycatch mitigation program is separable into three major objectives: improving the monitoring of bycatch, improving the models used to quantify bycatch, and implementing management measures to reduce bycatch.

> Three major objectives of the current bycatch mitigation program are: (1) improving the monitoring of bycatch, (2) improving the models used to quantify bycatch, and (3) implementing management measures to reduce bycatch.

To improve bycatch monitoring, NOAA Fisheries began placing observers onboard vessels participating in the shore-delivery groundfish fisheries in August 2001. This observer program, the West Coast Groundfish Observer Program (WCGOP,) is distinct from the observer program for at-sea whiting fisheries, but both are managed out of the NOAA Fisheries Northwest Fisheries Science Center. The focus of WCGOP is to collect total catch and discard data (including protected resources and seabirds) from commercial groundfish trawl and non-trawl gear (longline, pot, hook-and-line, net gear) vessels. Observers in this program sample species composition of the discard, and data on target fisheries interactions with species of concern. This observer program initially targeted the trawl and non-trawl limited entry fleets for observer coverage. The program plans to expand its data collection efforts to assess catch and bycatch in the open access fisheries that target groundfish. The

5/ As of May 2004, whiting is no longer considered overfished.

WCGOP is described more fully later in this document; Appendix A of this PEIS provides the results of the first two years of the program: ***Northwest Fisheries Science Center West Coast Groundfish Observer Program - Data Report and Summary Analyses***, January 2004.

To better quantify bycatch, the Council needed updates to historical bycatch models. In late 2001, NOAA Fisheries developed a model for estimating incidental catch rates and amounts of several overfished stocks taken in the trawl fishery. Because data from the new observer program was not yet assembled and available for use in the bycatch model, the initial bycatch model relied upon trawl logbooks and data from the EDCP program to estimate co-occurrence ratios between overfished and more abundant stocks. In 2002, NOAA Fisheries expanded its bycatch model to facilitate Council consideration of depth-based management restrictions. The first year of WCGOP data (August 2001 - August 2002) was available by January 2003 and the bycatch model underwent a formal review by the Council's Scientific and Statistical Committee. During 2003, NOAA Fisheries revised the bycatch model to address the SSC's concerns and presented the updated model to the Council in June 2003 for use in developing its 2004 harvest specifications and management measures. This latest version of the bycatch model estimates discards of both overfished and more abundant stocks. NOAA Fisheries expects to further refine the model during 2004 to incorporate the second year of observer program data (September 2002 - August 2003), which had a greater focus on the limited entry non-trawl fisheries than the first year of the program.

NOAA Fisheries has implemented numerous management measures to reduce bycatch since 2000, most of which have been intended to protect and rebuild overfished species. NOAA Fisheries and the Council have supported full retention or full utilization Exempted Fishing Permit (EFP) programs for the Washington arrowtooth flounder trawl, yellowtail rockfish trawl and longline dogfish fisheries, and for the California flatfish trawl fishery. Shorter-than-year-round fishing seasons have been set for various species and sectors of the groundfish fleet in order to protect different overfished groundfish species. Amendment 14 to the FMP implemented a permit stacking program for the limited entry fixed gear fleet that reduced the number of vessels participating in the primary sablefish fishery by about 40%. In 2003, NOAA Fisheries implemented a buyback of limited entry trawl vessels and their permits, reducing the groundfish trawl fleet by about 35%. As discussed above, NOAA Fisheries has implemented gear modification requirements that restrict the use of trawl gear in rockier habitat and other requirements to constrain the catching capacity of recreational fishing gear. Higher groundfish landings limits have been made available for trawl vessels using gear or operating in areas where overfished species are less likely to be taken. And, since late 2002, the Council's bycatch mitigation program has included a series of marine protected areas known collectively as groundfish conservation areas or rockfish conservation areas (RCAs). These large time/area closures affect the entire West Coast and are specifically designed to reduce the incidental catch of overfished groundfish species in fisheries targeting more abundant stocks. (RCAs). These were initially described in detail in the ***Final Environmental Impact Statement for the Proposed Groundfish Acceptable Biological Catch and Optimum Yield Specifications and Management Measures: 2003 Pacific Coast Groundfish Fishery***.

1.8 The Council Preferred Alternative

The Council reviewed a preliminary draft of this PEIS at its November 2003 meeting. The Council reviewed the Draft PEIS during the comment period and identified its preferred alternative at its April 2004 meeting. At that meeting, the Council considered how each alternative addresses the purpose and need for action (see sections 1.1, 1.2 and 1.3). The Council evaluated the expected or potential benefits and costs of each alternative. They determined that by combining elements of three alternatives, they would achieve a better balance than any of the original six alternatives. Analysis shows that the preferred alternative, Alternative 7, will reduce bycatch to the extent practicable and, for bycatch that cannot be avoided, will reduce bycatch mortality to the extent practicable. The Council additionally believes that Alternative 7 will better mitigate anticipated negative effects of implementing new bycatch monitoring and reduction measures.

1.9 Contents of this Document

This EIS follows the standard organization established by the CEQ regulations. Chapter 1 has identified the issue of bycatch reduction and reporting as the focus of the proposed action and describes why action is needed. Previous Council and NOAA Fisheries actions relating to bycatch are described to help set the context for the proposed action.

Chapter 2 presents the seven alternatives to reduce bycatch and bycatch mortality, and to establish a standardized reporting methodology. It describes how the alternatives were developed, and provides a summary of the anticipated environmental impacts of the each alternative. It briefly describes the management tools available to the Council and NOAA Fisheries for reducing bycatch and for monitoring the effects and effectiveness of the various tools, and how the alternatives apply the tools. It identifies the direct, indirect and cumulative impacts so the decision-makers can make a reasoned and informed decision, and the public can understand the conclusions and how they were reached.

Chapter 3 describes the affected environment as it pertains to incidental catch, bycatch, bycatch mortality, and catch reporting/monitoring. The following factors related to bycatch are identified and described: co-occurrence in time and space; species behavior; fish body size and shape; and types of fishing gears and methods used. Chapter 3 describes the current human environment as it relates to incidental catch, bycatch and bycatch mortality. The current condition of particularly important groundfish and other species of marine animals are described, and how they are directly affected (that is, bycaught) in groundfish fisheries. The social and economic conditions relating to bycatch, bycatch reduction methods, and bycatch monitoring are also described.

Chapter 4 presents the analysis of environmental impacts. This chapter describes the capture methods of the various fishing gears, including selectivity features and placement factors (that is, where and in what conditions they can be used). Potential mitigation tools are analyzed, that is, the available management measures and adjustments to control incidental catch and bycatch and to achieve other objectives. Regulations not related to fishing gears are identified and described: harvest specifications, allocation, retention limits, catch/ mortality limits, time/area management, limiting access (reducing fleet size), and data reporting/monitoring requirements. Collectively, these management measures are identified as the bycatch mitigation toolbox. Potential effects of each tool are analyzed and the effects and effectiveness of each tool are ranked. Next, the particular application of each tool, as it is used in each alternative, is ranked. This stepwise process provides the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes. Effects of each alternative on groundfish, other important fish, seabirds and mammals are analyzed.

Chapter 5 reviews the consistency of the alternatives with the goals and objectives of the groundfish FMP and the National Standards of the Magnuson-Stevens Act.

Chapter 6 describes the relationship between the proposed action and other federal laws and policies.

2.0 Alternatives, Including the Status Quo

2.1 Introduction

2.1.1 How this Chapter is Organized

Chapter 2 presents the alternatives that have been developed to resolve bycatch issues and to ensure the FMP complies with the bycatch reduction mandates of the *MAGNUSON-STEVENS ACT*. Each *ALTERNATIVE* describes a *BYCATCH* management program and includes all the parts of the program: the overall objectives, the methods to achieve the objectives, and the reporting and monitoring requirements that would be required. The seven alternatives represent a variety of policies, approaches, and methods to reduce bycatch. The alternatives range from the current methods of reducing bycatch (Alternative 1, the status quo) to more aggressive and comprehensive bycatch reduction policies and methods.

Section 2.1.2 describes the structure of the alternatives, so that they can be compared and understood more clearly. Sections 2.2.1-2.2.7 describe each alternative in detail. Section 2.3 summarizes the anticipated effects or impacts of each alternative in comparison to current conditions.

2.1.2 Structure of the Alternatives

Each alternative includes general goals and/or objectives and the management tools to achieve them. Six alternatives to the *STATUS QUO* have been developed, which provide a range of approaches to reducing bycatch and incidental catch. Some alternatives are more

Table 2.1. Bycatch Mitigation Tools

Harvest Levels	
	ABC/OY
	sector allocations
	trip (landing) limits
	catch limits
	individual quotas
Discard Caps (limits and prohibitions)	
Gear Restrictions	
Trawl	mesh size
	footrope diameter/length
	net height
	codend mesh and dimensions
	design: on-bottom or pelagic
	bycatch reduction devices (BRDs)
Line	number of hooks
	hook size
	line length
	retrieval requirements
Pot/trap	number of pots
	pot size
	escape panel in net/pot
	retrieval requirements
Other	setnets (gill and trammel nets)
Time/Area Restrictions	
	seasons
	area closures
	depth closures
	marine reserves
Capacity (number of participants)	
	permits/licenses/endorsements
	limited entry
Capacity (Vessel Restrictions)	
	vessel size
	engine power
	vessel type
Monitoring/Reporting Requirements	
	permits/licenses
	registrations
	Fish tickets (commercial landings/ sales receipts)
	Vessel logbooks
	Surveys
	Punch cards/tags (recreational)
	Port sampling/on-shore observers
	On-board observers
	Vessel monitoring systems (VMS)
	Onboard video recording devices
	Enforcement

comprehensive than others, representing a different balance between regulatory burden, costs and other considerations. Some mandate more data collection than others, thus reducing some of the uncertainty about status of groundfish stocks, *ECOSYSTEM* condition, and management program effectiveness. Some alternatives are more costly and less practicable than others, both to fishers and to the management agencies (both state and federal). The alternatives have been structured to clearly show the *IMPACTS* (effects) of different management approaches and combinations of management tools.

2.2 The Alternatives

Table 2.2 at the end of this section provides an abbreviated overview of the generic bycatch mitigation tools included in each alternative. This table does not portray all the details and subtleties of the alternatives, and readers are cautioned to review the text for the full description of the alternatives.

2.2.1 Alternative 1: No Action (The Status Quo)

> Alternative 1 is the current bycatch management program. It reduces incidental catch and bycatch through a combination of indirect measures: Optimum Yield (OY) specifications, area closures, gear restrictions, trawl fleet reduction, variable trip limits and bag limits, seasons and other measures. High priority is given to minimize cost of catch monitoring. Vessel trip limits are calculated using a computer model and incidental catch ratios from past years.

Under the status quo alternative, the current bycatch management program would not be modified. The current program minimizes bycatch through a combination of Optimum Yield (OY) specifications, gear restrictions, area closures, variable trip limits and bag limits, seasons and other measures, while minimizing the cost of bycatch monitoring. The primary focus of this bycatch program is groundfish species. Disincentives include requirements to sort groundfish catches into established categories (species or species group), discard *PROHIBITED SPECIES* (salmon, halibut, Dungeness crab), and discard all groundfish that exceed the trip (retention) limits. In addition, estimated bycatch mortalities are deducted from the annual allowable catch levels. Positive incentives include larger trip limits in areas where encounters with overfished species are expected to be low. In addition, a sablefish species endorsement has been established for limited entry fixed-gear vessels, along with permit stacking, individual permit sablefish catch allowances, and a longer season, which greatly reduces the race for fish that occurred in past years. In the Pacific whiting fishery, OY is allocated among four sectors and vessels voluntarily practice bycatch reduction methods that focus on salmon as well as incidental catch of certain groundfish species.

The current bycatch management program uses indirect measures, such as setting an overall OY (catch limit) for various groundfish species and, in some cases, sub-limits or allocations for fishery sectors. A variety of measures, such as area closures, seasons, and gear modifications are established to ensure groundfish catches do not exceed the specified limits.

Since 1998, groundfish management measures have been shaped by the need to rebuild overfished groundfish stocks. There are more than 80 species in the West Coast groundfish complex managed under the FMP, and many of these species co-occur to different degrees in different areas. Each species has its own habitat affinity associated with depth, substrate, temperature, and portion of the water column. Some have fairly restricted distributions, while others are widespread. Over the past several years, groundfish management measures have been more carefully crafted to recognize the tendencies of overfished species to co-occur with healthy stocks in certain times and areas.

In 2000, the Council refined the management program on the understanding that certain types of *TRAWL* gear cannot be effectively fished in areas where the seafloor is rocky or uneven. Specifically, only *BOTTOM TRAWLS* with large diameter *FOOTROPES* can pass along this type of seafloor without snagging or hanging up on the multitude of obstructions. Use of large footrope trawls was not prohibited, but trip limits were set at such small levels that the economic incentives favored small footrope gear. Allowances were made for use of large footrope gear for deepwater stocks found primarily outside the range of most overfished species. In 2002 the Council introduced a new bycatch analysis model that allowed managers to set trip limits so that more abundant stocks were strongly *TARGETED* in times when they were less likely to co-occur with overfished stocks. The 2002 management measures primarily varied by time (two-month period) and by north-south management area (north of Cape Mendocino, between Cape Mendocino and Point Conception, south of Point Conception, etc.). Beginning in late 2002, the Council began using depth-based area restrictions. These area restrictions are intended to prevent vessels from fishing in depths where overfished species commonly occur, while still allowing some fishing for more abundant stocks in the open areas. The inner and outer boundaries of these closed areas may be adjusted seasonally; the enclosed area may be expanded during periods when overfished stocks are distributed more widely. Conversely, the boundaries may be narrowed when the overfished species are more concentrated or to allow access to other stocks that are more available at certain times. Different closed areas have been established for different gear types, because not all gear types encounter each overfished species at the same rate or in similar areas.

Participation in the *COMMERCIAL* groundfish fisheries is limited by a federal permit system established in 1994. This program limited the number of trawl, *LONGLINE* and *POT* (fish trap) permits and established a number of conditions and requirements. Each permit specifies the type of gear the vessel may use to participate in the limited entry fishery, and the vessel length associated with the permit. A vessel may only participate in the fishery with the gear designated on its permit(s) and may only be registered to a permit appropriate to the vessel's length. Since 1994, the Council has modified license restrictions for the *LIMITED ENTRY* fixed gear (longline and fish pot gear) to allow vessels to accumulate (stack) and use as many as three sablefish-endorsed permits during the primary sablefish fishery.

The number of trawl permits was reduced in the mid-1990s when seven large *FACTORY-TRAWLER* vessels purchased and consolidated a number of permits in order to participate in the Pacific whiting fishery. A federally-supported trawl *ET AL.,* program in late 2003 retired an additional 92 trawl permits and associated vessels, 35% of all of the groundfish trawl permits in existence at that time. These 92 vessels accounted for 36.5% of the trawl-caught groundfish, including whiting, during the 1998 - 2001 base years. They accounted for about 46% of all the non-whiting groundfish during that period. In addition to eliminating groundfish trawl permits, the program required the retirement of Dungeness crab and pink shrimp permits as well. Vessels remaining in the fishery will pay the costs of the reduction program.

Certain gear types and fisheries are exempted from the limited entry program and remain *OPEN ACCESS*. Trip limits for these vessels are set to allow retention of incidentally-caught groundfish and limited intentional groundfish harvest.

Recreational fisheries off Washington, Oregon, and California are managed by a combination of bag limits, gear requirements, size limits, seasons and area closures. In 2003, most *RECREATIONAL FISHING* was restricted to relatively shallow waters (generally less than 20-27 fathoms).

To reduce fishing in rocky areas of the *CONTINENTAL SHELF*, trip limits for vessels using trawls configured with large footropes (those with footrope diameter greater than 8 inches) are typically set at minimal levels. This creates strong incentives for vessels using bottom trawl gear to avoid prime *ROCKFISH* habitat areas, while not prohibiting the use of such trawls or closing specific areas. Two large areas off southern California are closed to most fishing activities as part of the plan to rebuild overfished cowcod, a species of rockfish . The closed areas (referred to as the Cowcod Conservation Areas or CCAs) encompass the primary habitat of cowcod and are intended to reduce possible encounters with this species.

Trip limits and area closures are currently based on incidental catch rates and fishing patterns through the use of a NOAA Fisheries *BYCATCH MODEL*. The model estimates the total amounts of overfished species that would be caught coincidentally with available target species. The Council uses this information to set the amount and timing of trip limits for target species. The objective is to prevent catches of both target and overfished groundfish species from exceeding their allowable annual harvests. NOAA Fisheries believes this new approach better accounts for the total mortality fishing of the overfished stocks than previous methods.

The bycatch model calculates the co-occurrence of each of five overfished species with healthy targeted stocks. To make these calculations, several trawl fishery target strategies are evaluated (for example, the *DTS COMPLEX* or arrowtooth flounder). Each target strategy has been evaluated in two-month periods to set a baseline of co-occurrence rates of overfished stocks throughout an entire calendar year. The analysis identified seasonal variations in these co-occurrence rates, which have been used to calibrated the model. Trip limits and seasons are intended to allow targeting on healthy stocks during times when incidental catches of overfished species are expected to be lowest (based on recent years' data). Management measures are adjusted as necessary during the season.

The No Action alternative includes continuation of Rockfish Conservation Areas (RCAs) where fishing is greatly restricted. By preventing fishing in times and areas where overfished species are most commonly encountered, the likelihood of catching them is greatly reduced. Outside the RCAs, more liberal fishing opportunities can be provided because co-occurance rates are lower for overfished species taken with target species. This approach increases the complexity of the regulations and certain monitoring requirements, but avoids the need for an expanded on-board observer program.

The bycatch model uses expected catch amounts for each major fishing sector, calculated before the season opens. Groundfish trip limits for commercial sectors are set based on previously observed ratios with various other species; these trip limits may vary by season if previously observed ratios show seasonal patterns. State fishery management and enforcement personnel monitor commercial *LANDINGS* throughout the year by tabulating state fish landings receipts (*FISH TICKETS*). Although landings of many species are monitored inseason, the landings data for overfished species may not be used for inseason management. Due to the strong economic incentives to avoid reaching an overfished groundfish species OY or cap, coupled with the opportunity to discard fish prior to their being counted, managers assume fish tickets tend to underestimate the actual catches. There is currently no way to verify this inseason. However, onboard *OBSERVERS* ride selected vessels and collect information on amounts and rates of fish discarded at sea. Observer data are not tabulated during the season but are compiled in annual summaries after being matched with fish ticket and trawl *LOGBOOK* records. The new observed groundfish catch ratios are compared to the previous rates that were used to set the current trip limits. If the trip limit ratios differ substantially from the new observations, subsequent trip limits would be adjusted and other management measures may also require adjustments.

2.2.2 Alternative 2 (Larger Trip Limits and Trawl Fleet Reduction)

Alternative 2 would continue most of the current bycatch reduction measures and would further reduce the number of commercial fishing vessels. Further reduction in the number of commercial vessels would be expected to enable NOAA Fisheries to increase groundfish trip limit sizes while maintaining as long a fishing season as practicable. Previous analyses have concluded that larger trip limits are associated with less groundfish *REGULATORY DISCARD* (that is, groundfish that vessels must discard to avoid penalty), and particularly the rate of discard. This type of bycatch increases as trip limits become smaller. If Alternative 2 were adopted, the FMP would be amended to specify the maximum number of commercial groundfish permits and a schedule for reducing the fleet to that size. Further analysis of specific options would be necessary to determine the method of reducing the number of commercial fishing permits. A few examples are briefly described below.

This alternative differs from the status quo in that the number of commercial groundfish trawl vessels would be reduced by 50% from the number that were permitted to land groundfish during 2002-2003. Trip limits would be larger because the total allowable catch would be shared among fewer participants.

The preferred method of fleet reduction is an industry-sponsored et al., program. The et al., program reduced the trawl fleet by about 35%, and thus failed to achieve the full 50% reduction in the number of trawl permits. Under Alternative 2, the number of trawl permits would be reduced to the 50% level by other means. The Council has limited alternatives to achieve the additional reduction: eliminate permits by establishing eligibility criteria (for example, a minimum amount of groundfish landed in previous years, a minimum number of years of participation in the fishery, etc), require vessels to hold more than one trawl permit, or allow trawl permits to be converted to fixed-gear permits.

In establishing the current vessel license limitation program, the Council established minimum landing requirements for eligibility. Vessels that met the minimum requirements received licenses (permits). Only the most recent entrants and vessels with the smallest catch histories did not receive permits. It is likely that in reducing the number of eligible vessels, criteria based on amounts of groundfish landed would tend to eliminate those trawl vessels that have caught the fewest groundfish in recent years or participated less than other vessels. This reduction method could result in reducing effective fishing power of the trawl fleet by less than 50%.

Approval of the trawl et al., program in late 2003 has had a substantial effect on this analysis: the status quo (no action alternative) has become very similar to Alternative 2.

2.2.3 Alternative 3 (Larger Trip Limits - Shorter Fishing Season)

Alternative 3 would continue most of the current bycatch reduction programs, but would eliminate the goal of maintaining a year-round fishing season. This alternative would reduce groundfish regulatory discard by increasing groundfish trip limit size and reducing fishing time (shortening seasons), without further reducing the number of trawl vessels. As with Alternative 2, this is based on the understanding that regulatory bycatch of groundfish, and particularly the rate of discard, increases as trip limits become smaller. The specific method(s) of reducing fishing time are not specified in this alternative but are critical to the effects. If this alternative were adopted, further analysis of specific options would be required. Examples are described below.

In contrast to Alternative 2, the number of commercial fishery participants would not be further reduced under Alternative 3. Instead, the commercial fishing season would be shortened in order to allow larger trip limits.

The fishing seasons could be shortened in a variety of ways, and effects on individual commercial fishers would vary. For example, if the current two-month periods were reduced to one month, larger vessels would not be much affected. Such trip limits might not be much larger than the current ones, because actual fishing time per vessel for each two-month period is already less than one month. Another approach would be to allow indidual commercial vessels to fish only three of the six two-month periods.

A different way of reducing commercial fishery fishing time to six months would be to allow limited entry sector fishing for six months and open access fishing for six months while the limited entry sector is closed. For example, the limited entry fishery (except the whiting fishery) could operate during two 3-month periods, one in the spring (some period between February and June) and one in the fall (perhaps September, October and November). These open seasons fall mainly outside the shrimp and crab seasons. Open access fisheries might fill in between, i.e., summer and winter.

2.2.4 Alternative 4 (Sector and Vessel Catch Caps)

Alternative 4 would define fishery sectors and establish specific annual limits on the amounts of overfished groundfish that could be caught by each sector. When a sector reaches an annual catch limit for an overfished species, further fishing by that sector would be prohibited for the remainder of the year. Alternative 4 would modify the definition of *TRIP LIMIT* to include *CATCH LIMITS* for *OVERFISHED* stocks. Like Alternative 1, trip retention limits would continue to be used for non-overfished groundfish stocks. If a vessel reaches a catch limit for any overfished groundfish species, that vessel would be required to stop fishing for all groundfish for the remainder of that period. If a vessel reaches a trip (retention) limit for non-overfished species, the vessel could continue to fish for other species.

Each sector would be monitored separately and would be responsible and accountable for all overfished (or otherwise restricted) groundfish caught. Seven commercial fishing sectors are identified under the current regulations: *LIMITED ENTRY TRAWL*; limited entry *LONGLINE*; limited entry *POT*; three whiting sectors (*CATCHER/PROCESSOR*, *MOTHERSHIP,* and *SHORE-BASED*); and *OPEN ACCESS.* In addition, the tribal fishery and recreational groundfish fisheries are fishery sectors. Additional sectors could be established by subdividing any of these sectors. Under this alternative, each sector would be monitored separately with stratified, partial observer coverage. Catch rates and closure dates for each sector would be projected based on observer reports. If individual commercial vessel caps were adopted, every vessel would need to be monitored.

The inseason catch monitoring or verification program would be upgraded to ensure sector catch limits are not exceeded. Larger retention limits for non-overfished groundfish would be made available to vessels carrying an approved monitoring system (observer or other method).

In order to prevent sector catch limits from becoming a series of derby fisheries, methods to restrict individual vessels would be necessary. The most effective way to do this without increasing groundfish (discard) bycatch would be to establish individual vessel catch limits in addition to the sector caps. Any vessel reaching any catch limit would be required to stop fishing for all groundfish species. These vessel caps would not be transferable between vessels and would expire at the end of each period. Alternatively, vessel trip limits could be continued, and landings of target species would be monitored throughout the season as they are now. Catch of overfished species by each sector would be estimated during the season, based on assumed co-occurrence rates for each sector. Those rates would be adjusted from year to year based on updated observer data. (Another approach would be to set seasons for each target fishery, although this approach could also be taken under the status quo alternative.)

The NOAA Fisheries West Coast Groundfish Observer Program would monitor each sector by placing observers on a portion of the vessels in each sector. Catch rates of overfished/restricted species would be projected to all unobserved vessels operating in the sector. Vessels not carrying a NOAA Fisheries-funded observer could carry an observer at their own expense in order to be eligible for the larger trip limits and to gain exemption from the sector caps. An electronic monitoring (video) option may be available if NOAA Fisheries determines such a program would provide the necessary catch/mortality information. This program might require increased retention of certain species to be effective.

Economic (that is, non-regulatory) bycatch/discard could also be addressed under this alternative by prohibiting discard or limiting the amount of groundfish that may be discarded. If allowed, discard would be measured by onboard observers (or electronic monitoring). If discard were prohibited, economic (non-regulatory) bycatch of groundfish would be greatly reduced.

The option of creating more sectors could reduce the need for other controls to limit fishing activities. To accomplish this, vessels would be assigned to one or more sectors, perhaps through an endorsement attached to the limited entry permit. When a sector limit is reached, further fishing by those vessels would be prohibited or severely curtailed. Alternatively, sectors might be defined by target fisheries that would be closed when a catch limit is reached. Bycatch under such an approach could be controlled by requiring *FULL RETENTION* or placing limits on discards. The primary differences between Alternative 4 and the previous three alternatives are: (1) Alternative 4 would assign every vessel to one (or more) sectors; (2) each sector would have a set of annual catch caps for overfished (or other restricted) groundfish species; (3) all vessels in a sector would have to stop fishing when any cap for the sector is reached, while vessels in other sectors would continue fishing; and (4) groundfish mortality caps would be set for overfished groundfish species in addition to retention limits for other groundfish. In addition, if individual vessel caps were established, each vessel would be required to stop fishing when it reached any catch limit during a period. Catches by each sector would be monitored inseason, with actual catch statistics available quickly (either inseason or before the next season) so that adjustments could be made. Total catch OYs and discard caps would be set for overfished *STOCKS*, and sub caps would be set for each sector. Initial trip (retention) limits for vessels without observers would be calculated based on previously observed joint catch ratios of various groundfish species (the same as under status quo). Onboard observers would monitor a subset of vessels in each sector, recording and compiling catch and discard of overfished groundfish species (and other specified species) inseason. This catch data would be expanded to the entire sector. Each sector would be managed to its groundfish caps based on this expanded real time information, rather than based on ratios from previous years. This process would occur weekly, biweekly, or at some other appropriate frequency.

Under Alternative 4, a *RESERVE* could be set aside as a buffer to ensure any species OY or allocation is not exceeded; this reserve could be made available for vessels and/or sectors observed to have low incidental catch and/or bycatch rates. This would provide incentives for individual vessels to fish more selectively and to carry an observer if one is not provided by NOAA Fisheries. In order to ensure their access to the reserve, vessels may need to carry an observer (or observers) at the vessel's expense so the vessel's catch and bycatch could be monitored accurately.

2.2.5 Alternative 5 (Individual Fishing (Catch) Quotas and Increased Retention)

Alternative 5 would reduce bycatch by assigning annual *CATCH LIMITS,* or *INDIVIDUAL QUOTAS,* or *DEDICATED ACCESS PRIVILEGES*.[1/] to each limited entry commercial fisher, vessel, or other qualified entity. These catch limits would primarily apply to overfished groundfish stocks, but quotas would also be established for other groundfish stocks. Certain gear restrictions and other regulations would be relaxed to allow fishers/vessels to develop their own best practices to catch healthy groundfish stocks while avoiding the catch of overfished groundfish stocks.

Under Alternative 5, it may or may not be useful to distinguish between IQs for overfished groundfish stocks and IQs for other groundfish. In the event that such distinction is appropriate, catch allowances for overfished stocks might be referred to as *RESTRICTED SPECIES CATCH QUOTAS* (RSQS). In the long term, catch limits for other marine life could also be established (which might be referred to as prohibited species catch limits), which could not be retained unless specifically authorized or required.

An IQ or dedicated access privilege would be considered an authorization to catch a specified share or amount of the OY for a specified groundfish stock. A portion of some or all overfished stock OYs would be reserved for vessels with the best bycatch performance. (The Council would define *BEST PERFORMANCE* or *PERFORMANCE STANDARDS* at a later date. For example, it could be based on low catch or catch rates of overfished species, low bycatch of non-groundfish species, or other factors.) A robust monitoring or catch verification program would be established to ensure catch caps are not exceeded.

To increase the effectiveness of IQs/access privileges as a bycatch management

1/ In its draft report, the U.S. Commission on Ocean Policy recommends the term dedicated access privileges to highlight the fact that fishing is a privilege, not a right. Also, it is an umbrella term that includes access privileges assigned to individuals (ITQs; IFQs; individual gear quotas), as well as to groups or communities (community development quotas; cooperatives; area-based quotas, community-based quotas). Finally, it reflects the fact that the dedicated privilege being granted is *access* to the fish, rather than the fish themselves.

program, certain regulations would be relaxed to allow fishers to modify their fishing operations and/or gear to better utilize their quotas. For example, gear endorsements could be modified to allow trawl vessels to use nontrawl gear, or to convert their trawl endorsement to a new category of longline, pot, or generic gear endorsement. Quota holders would be allowed to buy and sell incidental catch allowances (RSQs) and individual transferable fishing quotas (IQs/IFQs) for other (non-overfished) groundfish.

There are several potential methods and criteria for initial allocation of quota shares, as well as ownership requirements, and transfer methods. There are also different possible definitions of "individual." For example, "individual" could refer to or include the vessel, vessel owner, fisherman, person, firm, cooperative, community or other entity. These issues would have to be debated in developing an effective IQ/bycatch management program and are not analyzed in this EIS.

Alternative 5 would use direct incidental catch and bycatch controls at the level of the individual vessel. To reduce economic (non-regulatory) bycatch, discard of groundfish could be prohibited or restricted; if discarding were allowed, it would be measured as accurately as possible. All groundfish catch, whether retained or discarded, would be charged against the appropriate RSQ/IQ. Fewer controls would be needed to limit fishing activities, except that when a vessel reaches any catch limit it would have to stop all fishing until it acquired additional IQ or RSQ. Also, if a groundfish OY were reached, further fishing by all vessels would be prohibited or severely curtailed. Bycatch under this approach could be controlled by requiring *INCREASED RETENTION* or placing limits on discards.

Alternative 5 is similar to Alternative 4 except that each commercial limited entry permit would be assigned annual individual caps (RSQs) for overfished groundfish stocks and IQs/IFQs for other groundfish species, and these would be transferable.

Initially, RSQs would be set for all limited entry commercial vessels. Catch limits for other species would be calculated based on previously observed joint catch ratios of various groundfish species. Onboard observers would monitor catch and discard of overfished groundfish species (and other specified species) inseason. Each vessel would be managed to its caps based on its own performance, using real time catch information rather than relying on ratios from previous years.

A reserve of various groundfish species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Also, any unused OYs of non-overfished groundfish would be made available to those vessels that had not taken their overfished species allowances.

Alternative 5 would require that every commercial groundfish vessel be closely monitored so that all catch of overfished species would be observed and recorded.

This close scrutiny would likely require placing fishery observers on every vessel. Alternative monitoring methods could be allowed if they resulted in the same level of data accuracy and completeness. For example, some vessels might be able to meet the standard by retaining all groundfish in conjunction with a video system to verify that no discard occurred.

2.2.6 Alternative 6 (No-take Reserves, Individual Catch Quotas, and Full Retention)

Alternative 6 would reduce bycatch of all species to very low levels by establishing long-term closed areas where overfished groundfish and other sensitive species are most likely to be encountered, establishing incidental catch limits for individual vessels, prohibiting or severely restricting discard of groundfish species (and perhaps other species), and accurately accounting for all catch. The alternative would emphasize the identification and use of alternative fishing gears and methods that avoid capture of restricted species.

This alternative would use both indirect controls (no-take marine reserves) and direct bycatch controls of each individual vessel. The areas encompassing most of the distribution of all overfished groundfish stocks would be established as long-term marine protected areas to reduce the possibility that those fish could be caught.

Alternative 6 is similar to Alternative 5, except the focus would be on reducing bycatch of overfished groundfish and other identified species to near zero by closing areas where encounters of those species are most likely. These areas could be reopened only through a deliberative process based on the best scientific information available. In addition, individual commercial groundfish vessels would be assigned a catch allowance of overfished groundfish species. These would be mortality limits or caps. Certain regulations would be relaxed to allow fishers to modify their fishing operations and/or gear to keep from exceeding their individual vessel caps.

A portion of the total allowable groundfish catch could be held in reserve for access by vessels with the lowest catch (or catch rates) of overfished species or bycatch rates of non-groundfish species. Initial groundfish catch limits for other species would be calculated based on previously observed joint catch ratios of various groundfish species. Discarding of groundfish would be prohibited or greatly restricted. Discarding of other species could be prohibited or restricted also. Onboard observers would monitor all vessels' catches of all species.

2.2.7 Alternative 7 (The Preferred Alternative)

The Council approved the following motion at its April 2004 meeting as its preferred alternative:

> *Create a new Alternative 7 that includes elements of Alternatives 1, 4, and 5. Elements from Alternative 1 that would be included in Alternative 7 would be all current programs for bycatch minimization and management, including but not limited to: setting optimum yield specifications, gear restrictions, area closures, variable trip and bag limits, season closures, establishing landings limits for target species based on co-occurrence ratios with overfished stocks, etc. The FMP would be amended to more fully describe our standardized reporting methodology program and to require the use of bycatch management measures indicated under Alternative 1 for the protection of overfished and depleted groundfish stocks and to reduce bycatch and bycatch mortality to the extent practicable. These would be used until replaced by better tools as they are developed.*
>
> *Elements from Alternative 4 that would be included in Alternative 7 would be the development and adoption of sector-specific caps for overfished and depleted groundfish species where practicable. We anticipate phasing in sector bycatch caps that would include: monitoring standards, full retention programs, and individual vessel incentives for exemption from caps.*
>
> *Elements of Alternative 5 that would be included in Alternative 7 would be the support of future use of Individual Fishing Quota programs for appropriate sectors of the fishery. The FMP would incorporate the Strategic Plan's goal of reducing overcapacity in all commercial fisheries.*
>
> *Additionally, baseline accounting of bycatch by sector shall be established for the purpose of establishing future bycatch program goals*.

Alternative 7 would continue most of the current bycatch reduction measures and would reduce bycatch by expanding the defining catch or mortality limits for overfished species. *CATCH LIMITS* or caps for overfished groundfish species would be established for each fishing sector. All vessels in a sector would be required to stop fishing when a catch limit for that sector is reached. The inseason catch monitoring or verification program would be upgraded to ensure sector catch limits are not exceeded. Larger retention limits for non-overfished groundfish would be made available to vessels carrying an approved monitoring system (observer or other method).

In order to prevent sector catch limits from becoming a series of derby fisheries, methods to restrict individual vessels will continue to be necessary. The most effective way to do this without increasing groundfish (discard) bycatch would be to establish individual vessel catch limits in addition to the sector caps. However, in the short term this will not be feasible with the current monitoring and catch verification system. Until greatly expanded monitoring is available, the primary means of slowing the rate of fishing will continue to be trip (retention) limits. However, individual vessels may take an observer at their own expense in order to gain exemption from their sector catch limits. Such vessels could be assigned individual catch limits for designated species, and they would agree to stop fishing for all groundfish upon reaching any catch limit. These vessel caps would not be transferable between vessels and would expire at the end of the specified period.

In the short term, vessel trip limits for each sector would be continued, and landings of target species would be monitored throughout the season as they are now. Catch of overfished species by each sector would be estimated during the season based on assumed co-occurrence rates for each sector. Those rates would be adjusted from year to year based on updated observer data. In the longer term, the observer program will be upgraded to provide inseason catch data on overfished species. At that time, catch of overfished species will no longer have to be estimated based on target species landings, and each sector will be managed based on current information.

Eight commercial fishery sectors are identified under the current regulations: limited entry trawl; limited entry longline; limited entry pot; three whiting sectors (catcher/processor, mothership and shore-based); open access; and tribal. The recreational fishery is also a recognized sector. Additional sectors could be established by subdividing any of these sectors. Under this alternative, each sector would be monitored separately with stratified, partial observer coverage. Catch rates and closure dates for each sector would be projected based on observer reports. If individual commercial vessel caps were adopted, every vessel would need to be monitored.

This alternative would modify the definition of trip limits to include catch (mortality) limits and would also establish catch (mortality) caps for each sector. Vessels would no longer be required to discard overfished groundfish species, although they could choose to discard them. Non-overfished groundfish would be managed the same as under the status quo (no action) alternative, except that vessels carrying an observer (or other approved monitoring system, if any) would be eligible for larger trip (retention) limits for non-overfished species. However, they would still be required to stop fishing upon reaching a catch limit. The NOAA Fisheries West Coast Groundfish Observer Program would monitor each sector by placing observers on a portion of the vessels in each sector. Catch rates of overfished/restricted species would be projected to all unobserved vessels operating in the sector. Vessels not carrying a NOAA Fisheries-funded observer could carry an observer at their own expense in order to be eligible for the larger trip limits and to gain exemption from the sector caps. An electronic monitoring (video) option may be available if NOAA Fisheries determines such a program would provide the necessary catch/mortality information. This could require increased retention of certain species.

Economic bycatch could also be addressed under this alternative by prohibiting discard or limiting the amount of groundfish that may be discarded. If allowed, discard would be measured by onboard observers (or electronic monitoring). If discard were prohibited, economic (non-regulatory) bycatch of groundfish would be greatly reduced.

The option of creating more sectors could reduce the need for other controls to limit fishing activities. To accomplish this, vessels would be assigned to one or more sectors, perhaps through an endorsement attached to the limited entry permit. When a sector limit is reached, further fishing by those vessels would be prohibited or severely curtailed. Alternatively, sectors might be defined by target fisheries that would be closed when a catch limit is reached. Bycatch (discard) under such an approach could be controlled by requiring *FULL RETENTION* or placing limits on discards.

2.3 Summary of Environmental Impacts

The following series of tables summarizes the results of the analysis, following with Table 2.2 that identifies the bycatch mitigation and monitoring tools included in each alternative.

Table 2.3.1 summarizes how well each alternative achieves the stated purpose for the action, that is, how well they achieve the goals and objectives the Council has initially set for the bycatch management program.

Impacts on the biological environment are summarized in Table 2.3.2. Tables 2.3.3(a - c) summarize the social and economic impacts. The significance of those economic impacts is described in Table 2.3.4. These tables are also provided in Chapter 4 where the results are discussed in greater detail.

Table 2.2. Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**	**Alternative 6**	**Alternative 7**
Goals and Objectives	Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	Reduce effort in order to create larger or more flexible trip limits (reduce commercial trawl fleet)	Shorten commercial season in order to create larger or more flexible trip limits	Establish sector catch/ mortality caps	Establish individual groundfish catch limits (individual quotas) for the commercial fishery	Close large area closures, tighten gear restrictions, establish individual bycatch caps, and increase	Establish sector catch/mortality caps as appropriate, support individual catch limits (IQs)
FISHERY MANAGEMENT TOOLS							
Harvest Levels							
ABC/OY	Y	Y	Y	Y	Y	Y	Y
Set **overfished groundfish catch caps**	N	N	N	Y	N	Y	Y
Use **trip limits**	Y	Y	Y	Y	N	N	Y
Use **catch limits**	N	N	N	Y	Y	Y	Y
Set individual	N	N	N	Y	Y	Y	Y
Set groundfish **discard caps**	N	N	N	N	Y	Y	Y
Establish **IQs**	N	N	N	N	Y	Y	Y
Establish bycatch **performance standards**	N	N	N	N	Y	Y	Y
Establish a reserve	N	N	N	Y	N/Y	Y	
Gear Restrictions							
Rely on **gear**	Y	Y	Y	Y	N	Y	Y

Time/Area Restrictions	Y	Y	Y	Y	Y	Y	Y

Table 2.2 (continued). Bycatch reduction methods (bycatch mitigation tools) included in the

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**	**Alternative 6**	**Alternative 7**
Establish **long term closures for all groundfish fishing**	N	N	N	N	N/Y	Y	N
Establish **long term closures for on-bottom fishing**	N	N	N	N	N/Y	Y	N
Capacity reduction (mandatory)	Y	Y(50%)	Y	Y	Y	Y	Y
Monitoring/Reportin							
Trawl logbooks	Y	Y	Y	Y	N	Y	N
Fixed-gear logbooks	N	N	Y(100%)	Y	N	N	N
CPFV logbooks	N	N	N	Y	N	N	N
Commercial **port sampling**	Y	Y	Y	>Y	N/Y	Y	>Y
Recreational	Y	Y	Y	>Y	Y	>>x	>Y
Observer coverage (commercial)	10%	10%	10%+logbook verification	increased, by sector	100%	100%	increased, by sector
CPFV observers	N	N	N	Y	Y	100%	Y
VMS	Y	Y	Y	Y	Y	Y	Y
Post-season observer data OK	Y	Y	Y	N	N	N	N

Inseason observer data required	N	N	N	Y	Y	Y	Y
Rely on fish tickets as the primary monitoring tool for groundfish	Y	Y	Y	N	N	N	N

Table 2.3.1. Summary of how well alternatives achieve the stated purposes for the proposed action.

Purpose of Proposed Action	Alt 1 (no action)	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Account for total fishing mortality by species	The current observer program provides statistically reliable estimations of groundfish mortalities.	I+	I+	S+	S+	S+	S+
Establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits	Trip and bag limits, application of the bycatch model and inseason tracking of landings are moderately effective but less than 100% successful.	I+	I+	S+	S+	S+	S+
Reduce unwanted incidental catch and bycatch of groundfish and other species	Area closures (Rockfish Conservation Areas), seasons and gear restrictions, reduce unwanted catch. Trip limits create regulatory bycatch (discard).	I	I	S+	S+	S+	S+
Reduce the mortality of animals taken as bycatch	Prohibited species must be returned to the sea as quickly as possible with minimum of injury.	U	U	U	U	S-	U
Provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods	Trip limits reduce the race for fish and provide some minimal opportunity and incentives to avoid bycatch.	I+	I-	CS+	S+	CS+	S+
Monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly	The current program minimizes user and agency costs of monitoring catch and bycatch at the expense of precision and timeliness.	I	I	S+/S-	S+/S-	S+/S-	S+/S-
Reduce unobserved fishing-caused mortalities of all fish	Area closures (RCAs), gear definitions and seasons mitigate potential mortalities.	I	I	CS+	S+	S+	CS+
Gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches.	Over a period of years, information on non-commercial and unassessed stocks will improve.	I	I	CS+	S+	S+	CS+

Performance Ratings, compared to status quo/no action alternative:

Substantial Beneficial (S+): Substantial improvement from status quo expected.

Substantially Adverse (S-): Substantially increased costs or reduced effectiveness expected.

Conditionally Substantial Beneficial (CS+): Substantial improvement expected if certain conditions are met or events occur, or the probability of improvement is unknown.

Conditionally Substantial Adverse (CS-): Substantially increased costs expected if certain conditions met, or the probability of occurrence is unknown.
Insubstantial Beneficial (I+)/Insubstantial Adverse (I-): Changes are anticipated but not expected to be major.
Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the direction or magnitude of the impacts.

Table 2.3.2(a). Summary of effects of Alternatives 1 and 2 on the social and economic environment (Alternatives 3 - 7 in following tables).

	Alternative 1	Alternative 2
Incentives to Reduce Bycatch	Quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards are expected to increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely. However, in comparison to a race for fish allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards.	Reducing the level of effort in the groundfish fisheries and increasing trip limits would likely reduce the level of groundfish bycatch (discard).
Commercial Harvesters	By spreading out fishing more evenly over the year, the current management regime helps maintain traditional fishing patterns. However, landings of major target species (other than Pacific whiting) are expected to continue to decline as OYs are reduced to protect overfished species. Declining harvests lead to significant decreases in total groundfish ex-vessel value.	Further fleet reduction would be expected to reduce (but not eliminate) extra capacity in the fishery and to restore the fleet to some minimum level of profitability.
Recreational Fishery	Landings of major target species are not expected to increase and may decline further if OYs are reduced to protect overfished species. Decreased harvests lead to significant decreases in recreational value.	Changes in landings of major species targeted in the recreational fishery would be expected to be insignificant.
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1
Buyers and Processors	The current management regime reduces the likelihood that processing lines will be idle by fostering a regular flow of product to buyers and processors. However, decreased deliveries of groundfish to processors and buyers will result in significant decrease in groundfish product value.	No significant changes in the total amount of fish delivered to processors is expected. With fewer vessels in the fishery, processors would have fewer boats to schedule for landings. The related reductions in time spent unloading vessels is expected to result in cost savings. However, processors in ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources

Table 2.3.2(a). Summary of effects of Alternatives 1 and 2 on the social and economic environment (Alternatives 3 - 7 in following tables).

	Alternative 1	Alternative 2
Communities	By maintaining year-round fishing and processing opportunities, the current management regime promotes year-round employment in communities. However, groundfish employment and labor income are expected to continue to decline, resulting in economic hardship for businesses involved in the groundfish fisheries. These businesses are expected continue to diversify to reduce dependence on groundfish fisheries.	The direction and magnitude of many of the economic effects on particular coastal communities are uncertain, as the distribution of the post-buyback fleet is uncertain. If further reduction in fleet capacity with higher trip limits were successful in increasing net revenues or profits to remaining commercial fishers, positive economic impacts on the communities where those fishers land their fish, home port and reside would be expected. On the other hand, some communities may experience a significant loss of vessels and a consequent decrease in income, jobs and taxes.
Consumers	The current management regime allows buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers. Consumers of fresh or live groundfish may be adversely affected by reduced commercial landings. However, changes in benefits to most consumers of groundfish products would be expected to be insignificant due to availability of substitute products.	Effects as described in Alternative 1
Fishing Vessel Safety	Some gains in fishing vessel safety are at least partially realized under the current management regime, as fishers are able to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. However, safety of human life at sea may decrease if reduced profits induce vessel owners to forgo maintenance, take higher risks or hire inexperienced crews.	Increases in net revenue to harvesters resulting from increases in trip limits may enhance their ability to take fewer risks and use their best judgment in times of uncertainty, thereby increasing vessel safety.
Management and Enforcement Costs	The management regime is expected to continue to be contentious, difficult and expensive. Technological developments such as VMS may mitigate the rate at which management costs escalate.	Costs are expected to decrease, as fewer vessels are generally easier and less expensive to monitor.

Table 2.3.2(b). Summary of effects of Alternatives 3 and 4 on the social and economic environment (Alternatives 1 and 2 on preceding table; Alternatives 5, 6 and 7 in following table).

	Alternative 3	Alternative 4
Incentives to Reduce Bycatch	If trip limits increase, the level of groundfish bycatch (discard) would be expected to decline.	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, a race for fish could develop in which individual vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.
Commercial Harvesters	A combination of higher trip limits and a reduction in the length of the fishing season would be expected to lead to an overall reduction in variable fishing costs. With larger trip limits, revenues per trip are expected to increase. However, the overall impact of this alternative on costs and revenues would depend on when individual participants were allowed to fish. For example, fishers may be unable to fish for certain species at optimal times.	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. The allocation of catch limits to individual sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.
Recreational Fishery	Effects as described in Alternative 2	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by a CPFV observer program and expanded port/field sampling. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants. Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects.
Tribal Fishery	Effects as described in Alternative 1	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.

Table 2.3.2(b). Summary of effects of Alternatives 3 and 4 on the social and economic environment (Alternatives 1 and 2 on preceding table; Alternatives 5, 6 and 7 in following table).

	Alternative 3	Alternative 4
Buyers and Processors	Larger trip limits would not be expected to affect the total amount of fish that harvesters deliver to processors. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, costs could increase if processors were unable to control the flow of product throughout the year and capital is idle during closed periods.	The economic effects on buyers and processing companies are unknown because of the uncertainty as to how well vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shut down, buyers and processors may experience significant shortages of fish.
Communities	The impacts are uncertain, as community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions. If larger trip limits resulted in increased net revenues or profits to fishers, positive economic impacts on the communities would be expected. On the other hand, seasonal closures could leave crew members at least temporarily unemployed.	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.
Consumers	Consumers of fresh or live groundfish could be unable to obtain fish from the same sources for half of the year unless the harvest sectors were split into two groups, with one group of vessels active at any given time.	If no early closures of major harvesting sectors occur, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.
Fishing Vessel Safety	The effects on vessel safety may be mixed. Increases in net revenue to harvesters resulting from increases in trip limits may lead to reductions in injury and loss of life because of harvesters' incentives to take fewer risks and use their best judgment in times of uncertainty. However, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish.	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. If fishers within a sector perceive a greater likelihood of premature fisheryclosure, vessels would likely be more active early in the year (winter and early spring) when conditions may be more dangerous.
Management and	Effects will vary depending on the way the seasonal	Costs would be expected to increase as catch limits were

Table 2.3.2(b). Summary of effects of Alternatives 3 and 4 on the social and economic environment (Alternatives 1 and 2 on preceding table, Alternatives 5, 6 and 7 in following table).

	Alternative 3	Alternative 4
Enforcement Costs	closure is structured. Costs are expected to decline if there is no fishing activity to monitor for 6 months of the year. However, there will be increased costs if permit holders are divided into groups.	allocated over an increasing number of sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.

Table 2.3.2(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1 - 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
Incentives to Reduce Bycatch	The amount of fish discarded by each vessel would be counted against the vessel's limit. This measure provides strong economic incentives to reduce the catch of unwanted fish because it internalizes the costs of discarding fish.	Marine reserves would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing groundfish bycatch (discard) outside of marine reserves. Prohibiting discard would produce a strong incentive to avoid unwanted catch because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. If vessel groundfish quotas are transferable, Alternative 6 would be similar to Alternative 5; if not transferable, negative effects would be much more significant and more similar to Alternative 4.	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, individual vessels may forgo fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.
Commercial Harvesters	Current vessel owners as a group would likely benefit from a system that allocates freely transferable quota shares to vessel owners on the basis of catch histories. Moreover, the total amount of fish available for harvest would increase, as bycatch would be measured more accurately through expanded observer coverage. Not all vessel owners would	Some measures would significantly increase fishing costs, while others would reduce them. For example, 100% groundfish retention, full observer coverage, and establishment of marine reserves would increase average costs, whereas the establishment of ITQs for groundfish species would reduce costs.	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer

Table 2.3.2(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1 - 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
	benefit equally, and the relative benefits would depend on the allocation formula. In addition, the economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage.		coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. Establishment of allocations among sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.
Recreational Fishery	The creation of tradeable quota shares for the commercial fishing/processing sectors is not expected to apply to the recreational fishery. The possibility of creating ITQs for recreational fishers may exist, but any discussion of how such a allocation would be achieved or its effects on recreational fishers would be speculative.	Rights-based system effects would be as described in Alternative 5. Marine reserves could benefit recreational fishers over the long term if local catch rates and fish size increased due to spillage of adults out of the marine reserves. On the other hand, if marine reserves resulted in geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open could lead to localized stock depletion, reduced recreational catch per unit effort, and reduction in the quality of the fishing experience.	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by improved port/field sampling. Incentive programs are likely to be limited, as there are many and diverse participants. Dividing the recreational sector along geographical boundaries could mitigate some of the negative effects.
Tribal Fishery	Effects as described in Alternative 1	Effects as described in Alternative 1	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant. However, potential effects of overfished species allocations are significant
Buyers and Processors	Buyers and processors would be expected to benefit from the anticipated increases in fish landings. The overall level of	The net economic effect on buyers and processors is uncertain. In general, buyers and processors would be expected to	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well

Table 2.3.2(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1 - 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
	benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Arguments have been made that harvester-only ITQ programs may result in stranded capital in the processing sector and a shift in the balance of bargaining power toward harvesters. These potential adverse effects could be mitigated if processors were also allocated quota shares.	benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. Because of their lack of mobility, buyers and processors may be especially negatively affected by marine reserves. However, the effects of marine reserves on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations.	vessel owners manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.
Communities	Consolidation of fishing and processing activities to fewer vessels and plants would likely result in reductions in the numbers of crew members and processing workers employed. Granting quota shares to community groups could help maintain existing harvesting and processing patterns and serve to meet concerns about employment in communities.	Effects of a right-based management system as described in Alternative 5. Marine reserves would be expected to help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, marine reserves resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of communities are experiencing under Alternative 1 (no action) would be exacerbated.	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.
Consumers	Consumers would be expected to benefit from the anticipated increases in fish landings. There is some chance that consumers could be negatively affected,	Consumers would benefit from the anticipated increased landings that result from a rights-based system. In addition, over the long term, marine reserves that	If supplies of fish remain consistent, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of

Table 2.3.2(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1 - 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
	if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring would depend both on the level of consolidation that might occur and the elasticity of demand for particular products.	effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large marine reserves could substantially decrease seafood supply enough to make consumers worse off, at least in the short term. Marine reserves could have a positive effect on those consumers who derive non-consumptive benefits from marine ecosystems, including non-market benefits (e.g., existence value).	fresh or live groundfish could be adversely affected.

Table 2.3.2(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1 - 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
Fishing Vessel Safety	Possible increases in the profitability of harvesting operations would likely lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty.	The net effect of the various measures included in this alternative on fishing vessel safety is uncertain. The establishment of ITQs for groundfish species is expected to promote vessel safety by reducing the pressure to fish under dangerous conditions. On the other hand, the establishment of marine reserves may result in a reduction in fishing vessel safety if the closure of fishing grounds results in vessels fishing farther from port and possibly in more hazardous areas.	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. With individual vessel catch limits, some vessels will have more choice of when and where to fish. Winter and early spring fishing may increase if vessels in a sector anticipate premature closures.

Table 2.3.2(c). Summary of effects of Alternatives 5, 6 and 7 on the social and economic environment. (Alternatives 1 - 4 in preceding tables).

	Alternative 5	Alternative 6	Alternative 7
Management and Enforcement Costs	The costs of monitoring, enforcement and administration would be expected to increase significantly. Cost recovery measures such as a fee on quota holders would be expected.	Full (100%) observer coverage would be required, which would facilitate enforcement of a full retention regulation. The enforcement costs of establishing marine reserves vary with several factors, including the location, number, size, and shape of the marine reserves and types of activities restricted and allowed.	Costs would be expected to increase with allocations to multiple sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.

Table 2.3.3. Significance of effects on the biological environment.

Resource	Alt 1 (no action)	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Groundfish	The current bycatch program provides statistically reliable estimations of groundfish bycatch and bycatch mortalities and mitigates many potential impacts. Trip and bag limits, application of the bycatch model and inseason tracking of landings are moderately effective but less than 100% successful in preventing overfishing. Trip limits create regulatory bycatch of groundfish.	I+	I+	S+	S+	S+	S+
Other Relevant Fish, Shellfish and Squid	Impacts on species such as Pacific halibut are reduced from recent years due to large area closures to protect overfished groundfish (primarily rockfish).	U	U	S+	S+	S+	S+
Protected Species	Area closures (Rockfish Conservation Areas), seasons and gear restrictions reduce potential catches. Protected species must be returned to the sea as quickly as possible with minimum of injury.	I+	I-	CS+	CS+	CS+	CS+
Salmon	Salmon bycatch in the Pacific whiting fisheries is closely monitored. Voluntary bycatch avoidance methods have proven effective, especially in the at-sea sectors	U	U	I+	I+	CS+	I+
Seabirds	Few seabird interactions have been documented; seasons and area closures could increase or decrease interactions.	I+	I-	CS+	CS+	CS+	CS+
Marine Mammals	Few marine mammal takings have been documented, and all are within current standards.	I+	I-	S+/S-	CS+	CS+	S+/S-
Sea Turtles	No sea turtle interactions have been observed in the groundfish fisheries.						
Miscellaneous Species	Area closures (RCAs), gear definitions and seasons mitigate potential mortalities. Little information is available.	U	U	CS+	CS+	S+	CS+
Biological Associations	Over a period of years, information on non-commercial and unassessed stocks will improve. Little information is available at this time.	U	U	CS+	S+	S+	CS+

Significance Ratings, compared to status quo/no action alternative:

Significant Beneficial (S+): Significant improvement from status quo expected.

Significant Adverse (S-): Significantly increased adverse impacts or reduced effectiveness expected.

Conditionally Significant Beneficial (CS+): Significant beneficial impacts expected if certain conditions are met or events occur (such as full observer coverage), or the probability of impacts is unknown.

Conditionally Significant Adverse (CS-): Significantly increased adverse impacts expected if certain conditions met, or the probability of occurrence is unknown.
Insignificant Beneficial (I+)/Insignificant Adverse (I-): Minor impacts, if any, are anticipated.
Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

Table 2.3.4. Significance of effects on the social and economic environment.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Incentives to Reduce Bycatch	CS+/CS-	CS+	CS+	S+	S+	S+	S+
Commercial Harvesters	S+	S+	CS+	CS+/CS-	S+/S-	S+/S-	CS+/CS-
Recreational Fishery	S-	I	I	CS-	I	S+/S-	CS-
Tribal Fishery	I	I	I	CS-	I	CS-	CS-
Buyers and Processors	S+/S-	I/CS-	I/CS-	CS+/CS-	CS+	CS+/CS-	CS+/CS-
Communities	S+/S-	CS+/CS-	CS+/CS-	CS-	CS+	CS+/CS-	CS-
Consumers	S+/S-	I	CS-	CS-	CS+	CS+/CS-	CS-
Fishing Vessel Safety	S+/S-	S+	S+/S-	CS-	S+	S+/S-	CS-
Management and Enforcement Costs	S-	S+	CS+/CS-	S-	S-	S-	S-

Significance Ratings:

Significantly Adverse (S-): Significant adverse impact based on ample information and the professional judgment of the analysts.

Conditionally Significant Beneficial (CS+)/Conditionally Significant Adverse (CS-): Conditionally significant is assigned when there is some information that significant impacts could occur, but the intensity of the impacts and the probability of occurrence are unknown.

Insignificant Impact (I): No significant change based on information and the professional judgment of the analysts..

Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

3.0 The Affected Environment

3.1 Introduction

Groundfish *BYCATCH* and its characteristics (e.g., species, extent of harm, quantity, distribution in time and space) result from the dynamic and complex interaction of attributes of the species, the fisheries, and the affected *ENVIRONMENT*, both physical and biological. Life history strategies can influence vulnerability to bycatch at the level of an individual, a population, or group of species. For example, fish morphology (e.g., size, shape, presence of spines, large gill cover), distribution (e.g., preferred temperature, in deepwater, along cliffs) and behavior (e.g., schooling, inhabiting crevices, fast-swimming) affect how vulnerable a fish or species is to capture or harm by a particular gear. Fishers continuously adjust their gears, fishing practices and areas, to the extent allowed by regulation, to take advantage of these attributes in order to efficiently maximize the harvest of targeted species, as well as to reduce the harvest of unwanted species. The physical and biological environment also influences the distribution and abundance of species, largely through the availability and abundance of suitable habitat, prey, predators, competitors, and reproductive opportunities.

Chapter 3 describes various components of the coastal marine *ECOSYSTEM* and how people and communities use and rely on the groundfish resources of this region. The groundfish FMP and management regime covers groundfish stocks off Cape Flattery, Washington to the California border with Mexico. Hundreds of plant and animal species occur along the West Coast and groundfish-related bycatch may affect many of them. To make this chapter easier to read and understand, much of the detail on the biology of species and associated literature citations, have been placed in an appendix (See Appendix B).

This chapter describes the affected environment as it is today, 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 status quo environmental condition is the result of millions of years of natural events and changes, and at least 150 years of human-caused events and changes. Humans have affected the downstream sediment transport from freshwater streams, which has affected the amount and characteristics of sediment entering the marine environment. Tree harvesting, on the other hand, sometimes results in increased erosion and sediment transport, especially in watersheds with few or no dams. Oil and mineral exploration and extraction have undoubtedly affected the ocean physical environment, at least in the immediate vicinity of those activities. Fishing activities have also contributed to changes in the physical environment.

The biological environment has also been directly affected by fishing and other marine harvesting activities. For example, several recent studies have suggested that historical (and pre-historical) removal of whales and other marine mammals has created cascading effects[1/] throughout marine *FOOD WEBS*. More recently, fishing has contributed to reduced abundance of several groundfish species, resulting in NOAA Fisheries designating nine species as overfished.

3.1.1 How Chapter 3 Is Organized

Chapter 3 describes the human environment as it exists today. To help set the context for the analysis of impacts, Section 3.2 provides a brief description of the physical environment, including marine geology, climate and currents. Section 3.3 describes the biological environment, including the biology of selected species: important groundfish species, protected species, and other relevant fish and shellfish species. Several species or species groups are given special emphasis in this chapter because of concerns regarding their population status and relevancy to bycatch issues. These include eight *OVERFISHED* groundfish species and protected marine species including Pacific salmon, marine birds, marine mammals and sea turtles. Other important species include those with substantive bycatch of groundfish in a non-groundfish fishery such as for pink shrimp; with substantive bycatch of the species in a groundfish fishery, such as Pacific halibut; especially vulnerable species such as Dungeness crab in softshell condition and long-lived and slowly reproducing species such as sharks and rays. Known *TROPHIC* relationships are identified, as are species that may be directly affected by groundfish fishing operations (for example, accidentally captured and/or killed by groundfish operations). This section summarizes the information in Appendix B and arranges it within the context of bycatch issues. Citations for Section 3.3 discussion appear within the more comprehensive Appendix B.

Section 3.4 describes the social and economic environment; that is, the human uses of West Coast groundfish stocks, and how these activities relate to other fishing activities in the region. Section 3.4.1 identifies incentives and disincentives relating to bycatch. Sections 3.4.2-3.4.8 describe the commercial, recreational and tribal fisheries, commercial fish buyers and processors, and coastal communities where groundfish-related activities occur are described. Section 3.8 discusses vessel safety issues, and Section 3.9 describes management

1. For example, some species may be considered keystones because they are the primary predator on another species. Reducing or eliminating such a keystone predator could result in a population explosion of the prey species, which would in turn affect the populations of other species that occupy that trophic level. Likewise, a keystone prey species' population can be reduced, resulting in a crash of species that rely on that prey for reproduction or survival. In either case, removal of a keystone species can cause significant (and unpredictable) changes in other populations.

and enforcement activities and costs. Section 3.10 describes other fisheries that take groundfish incidentally (open access, non-groundfish fisheries) to provide a broader view of catch and bycatch on the West Coast.

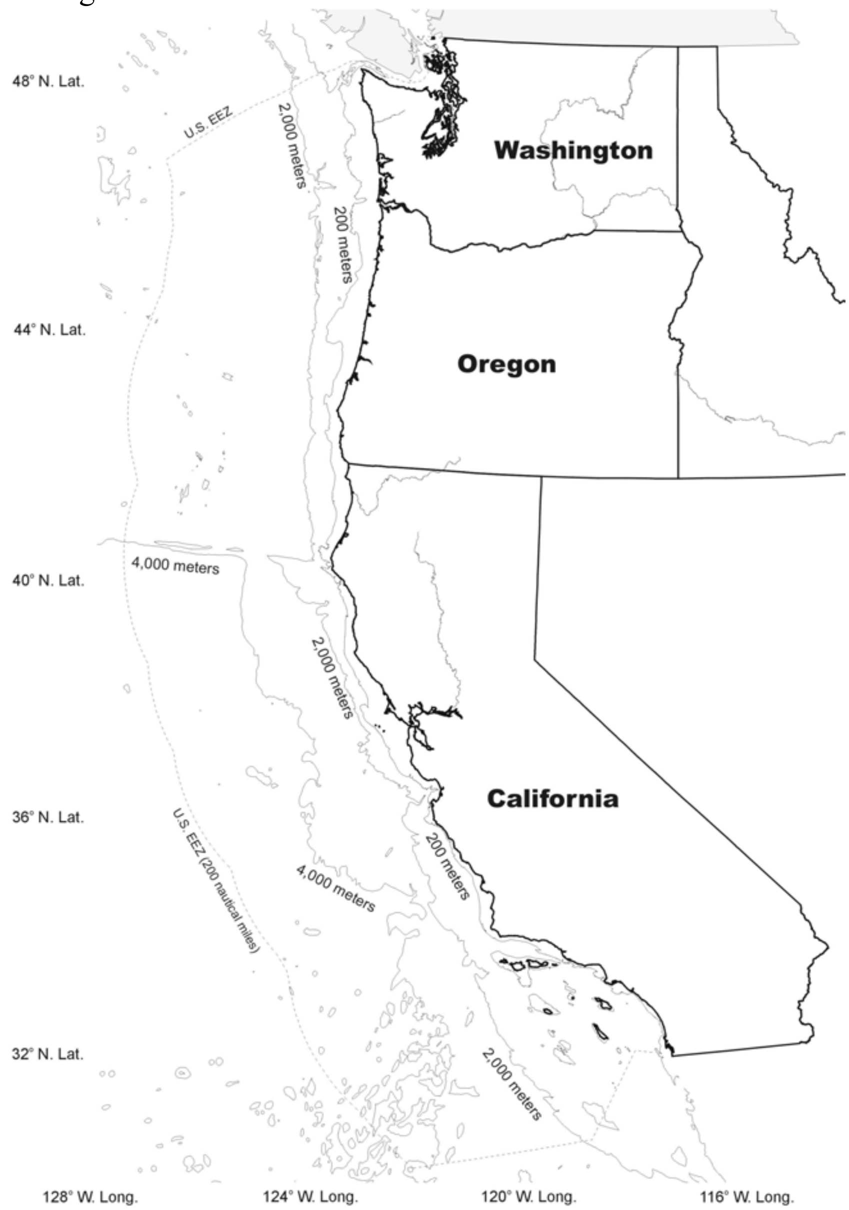
3.2 The Physical Environment

Essential Fish Habitat (EFH) for groundfish is defined as the aquatic *HABITAT* necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. This approach focuses on ecological relationships among groundfish species and between the species and their habitat. These habitat types are described primarily by physical features with the caveat that EFH also includes the associated biological communities. EFH for groundfish is identified by seven major habitat types: rocky *SHELF*, non-rocky shelf, continental slope/basin, canyon, *NERITIC* zone, oceanic zone and *ESTUARINE*. EFH descriptions have been incorporated in the FMP in both section 11.10 and in a detailed appendix (available online at http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html. Groundfish EFH is currently being re-evaluated in a separate EIS.

3.2.1 Geology Bathymetry and physical topography help determine habitat by influencing its physical structure and also the *CO-OCCURRENCE* of other species. Groundfish species are harvested in the *PELAGIC* zone, close to the bottom, or on the bottom, mostly within 50 miles of the shoreline where maturing and adult stages are found. Mud, sand, gravel, and exposed rocky areas, along with associated biological *COMMUNITIES*, make up the varied benthic habitats for groundfish on the continental margin.

The continental margin and waters out to 200 miles, the seaward boundary of the EEZ, are important habitat for groundfish and other marine species affected by groundfish fishing. The continental margin is composed of the *CONTINENTAL SHELF* and *CONTINENTAL SLOPE* - the steeper, deeper part of the continental margin (Figure 3.1). The U.S. West Coast is characterized by a relatively narrow continental shelf. The 200 m depth contour shows a shelf break closest to the shoreline off Cape Mendocino, Point Sur, and in the Southern California Bight; and widest from central Oregon north to the Canadian border, as well as off Monterey Bay. Deep submarine canyons pocket the EEZ, with depths greater than 4,000 m south of Cape Mendocino. Major estuaries along the coast include San Francisco Bay, Columbia River, Willapa Bay, Grays Harbor, and the Strait of Juan de Fuca. A number of small estuaries occur all along the West Coast.

Table 3.4.4 Bathymetry of the West Coast groundfish fishery management area.



3.2.2 California Current System Biological characteristics of species, combined with physiographic features, are important determinants of changes in distribution. More mobile and schooling species, such as Pacific whiting, may vary in location *en masse* as they move in response to environmental conditions and prey availability. Current regimes may also control the distribution of larvae, helping to determine the location of adult populations. As mentioned earlier, fish distribution is an influential factor in determining bycatch, and thus, currents and their variability can affect bycatch.

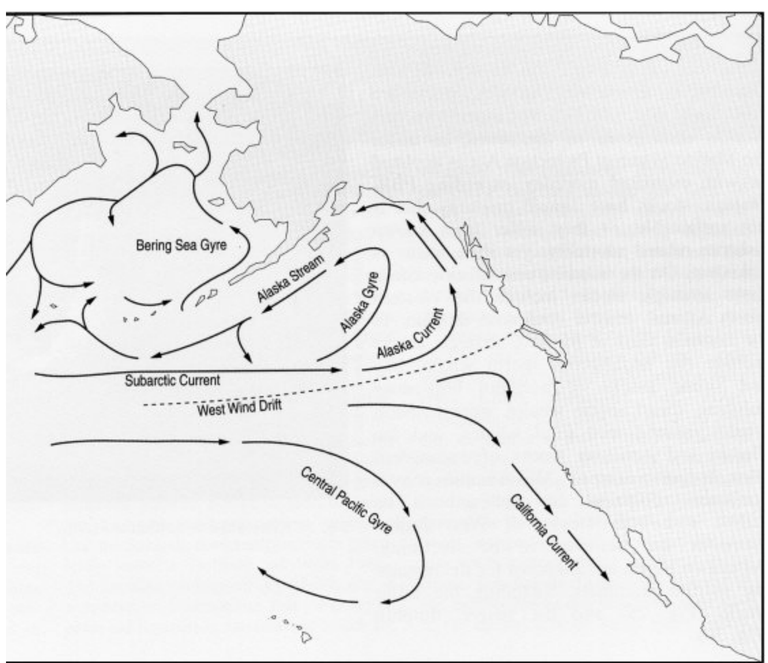
The West Coast marine environment is part of the California Current ecosystem (Figure 3.2). Large scale ocean currents, the North Pacific and Alaska gyres in particular, create a dynamic coastal environment. The North Pacific Current crosses the Pacific Ocean from Japan to Canada where it encounters the continental margin near Vancouver Island. The current splits into a northward flowing current carrying water into the Gulf of Alaska and a southward flowing current carrying water along the coast from Washington to California. This broad, shallow surface current which flows southward is called the California Current. It is strongest during the summer and is opposed by a weaker northward flowing and deeper California Undercurrent.

The California Current system changes significantly during the winter. The California Current moves farther offshore and the continental shelf is dominated by a strong northward flowing Davidson Current associated with winter storms.

Influenced by the California Current system and coastal winds, waters off the U.S. West Coast are subject to major nutrient upwelling as deep, nutrient-rich water is upwelled against the coastline. During periods of strong upwelling, primary ocean productivity is enhanced, increasing overall ocean production throughout many different trophic levels including those occupied by groundfish species.

Shoreline topographic features such as Cape Blanco and Point Conception, and bathymetric features such as banks, canyons, and other submerged features, often create large-scale current patterns such as eddies, jets, and squirts. For example, a current jet off Cape Blanco drives surface water offshore, which is replaced by upwelling sub-surface water. One of the better known current eddies off the West Coast occurs in the Southern California Bight between Point Conception and Baja, California, wherein the current circles back on itself by moving in a northward and counterclockwise motion just within the Bight.

Table 3.4.4Major ocean currents off the West Coast of North America.



3.2.3 Climate Climate can influence the distribution and abundance of marine species, which in turn, can be reflected in bycatch type and amount. Population data on some groundfish species seem to show a linkage between climate and recruitment. The effect of *EL NIÑO-SOUTHERN OSCILLATION* (*ENSO*) events on climate and ocean productivity in the northeast Pacific is relatively well-known. For example, Pacific whiting tends to have stronger year classes following an El Niño event than in other years. Also, some localized larval rockfish populations have shown lower survival rates in years when coastal upwelling and plankton production was reduced by El Niño events.

Periods of warmer or cooler ocean conditions and the event of shifting from warm to cool or vice versa can all have a wide array of effects on marine species abundance. Ocean circulation varies during these different climate events, affecting the degree to which nutrients from the ocean floor mix with surface waters. Periods of higher nutrient mixing tend to have higher phytoplankton (primary) productivity, which can have ripple effects throughout the *FOOD WEB*. In addition to changes in primary production, climate shifts may affect zooplankton (secondary) production in terms of increasing or decreasing abundance of the zooplankton biomass as a whole or of particular zooplankton species. Again, these changes in secondary production ripple in effect through the food web. Upper trophic level species depend on different lower order species for their diets, so a shift in abundance of one type of prey species will often result in a similar shift in an associated predator species. This shifting interdependency affects higher order species like groundfish in different ways at different life stages. Some climate conditions may be beneficial to the survival of larvae of a particular species but may have no effect on an adult of that same species.

EL NIÑO and *LA NIÑA* events are examples of short-scale climate change, six-month to two-year disruptions in oceanic and atmospheric conditions in the Pacific region. An El Niño is a climate event with trends such as a slowing in Pacific Ocean equatorial circulation, resulting in warmer sea surface conditions and decreased coastal upwelling. Conversely, a La Niña is a short-scale climate events characterized by cooler ocean temperatures. In years of poor upwelling or when El Niño warms the waters off the West Coast, ocean productivity is reduced. Under severe El Niño conditions, species distributions can change radically.

Recently, scientists have concluded that large scale regime shifts overlay shorter term El Niño and La Niña events, creating longer term changes in productivity associated with decades-long warm or cold periods. In the past decade, a still longer period cycle, termed the *PACIFIC DECADAL OSCILLATION* or *PDO*, has been identified. Although similar in effect, instead of the 1 year to 2 year periodicity of ENSO, PDO events affect ocean conditions for 15 years to 25 years. The PDO shifts between warm and cool phases. The warm phase is characterized by warmer temperatures in the northeast Pacific (including the West Coast) and cooler-than-average sea surface temperatures and lower-than-average sea level air pressure in the central North Pacific; opposite conditions prevail during cool phases. Because the effects are similar, in-phase ENSO events (that is, an El Niño during a PDO warm phase) can be intensified.

3.3 The Biological Environment

Detailed descriptions of the life history and status of groundfish, other fish and shellfish, marine mammals, sea turtles and seabirds are provided in Appendix B. For ease of readability, these descriptions are summarized below and the associated information sources are only cited in the appendix. Section 3.3.5 describes biological associations, that is, the geographic and trophic relationships of various species.

Primary production (phytoplankton abundance) and secondary production (zooplankton abundance) influence the abundance of higher trophic level organisms, including fish populations targeted by fishers. Changes in production in terms of increasing or decreasing abundance of the zooplankton biomass as a whole or of particular *ZOOPLANKTON* species ripple through the food web.

Upwelling zones are generally considered the most productive in the ocean. Upwelling occurs in the spring and early summer off central California. Submarine canyons along the Washington coast are sites of increased upwelling.

Brown, red, and green algae and coralline algae are abundant in the intertidal areas of rocky shorelines. These algae provide rich food supplies and provide cover for diverse communities of animal species. Eel grasses are also important spawning and nursery areas in estuaries.

The vegetation zone extends to from shore to depths where light penetration becomes insufficient for substantial plant growth. Kelp forests provide cover for many groundfish species, especially rockfishes, and they attract other species that may be prey, predators, or competitors with groundfish. Kelp forests of the Washington, Oregon and northern California coasts are dominated by bull kelp (*Nereocystis*), which is an annual species, dying each winter. Kelp forests off central and southern California are comprised of giant kelp (*Macrocystis*), which is a perennial species. It can live for several years in deeper water, but can be removed by storms on exposed coasts.

3.3.1 Groundfish

The Pacific Coast groundfish FMP manages more than 80 species. These species occur throughout the EEZ and occupy diverse habitats at all stages in their life history. While a few species have been intensively studied, there is relatively little information on the life history, habitat, and stock status of most groundfish species.

The life history, distribution, and stock status of each important groundfish species are summarized in Appendix B. More detailed information on the status of each of the groundfish species or species groups is available in the stock assessments associated with the annual SAFE report, as well as in the EIS for ABC and OY Specifications and Management Measures for the 2004 Pacific Coast Groundfish Fishery.

> More detailed information about groundfish and other species may be found in Appendix B.

In addition to the individual species descriptions in Appendix B, generalized descriptions are provided below for the following groundfish species groups: rockfishes, thornyheads, gadids, flatfishes, sharks, and skates. These generalized descriptions are followed by information on the stock status for each *OVERFISHED* species and *EMPHASIS SPECIES*. The term overfished describes a groundfish stock whose abundance is below its overfished/rebuilding threshold. Eight groundfish species are below the overfished threshold in 2004: bocaccio, canary rockfish, cowcod (south of Point Conception), darkblotched rockfish, lingcod, Pacific ocean perch, widow rockfish, and yelloweye rockfish. We are using the term "emphasis species" to describe a groundfish stock (other than an overfished stock) that is particularly relevant to bycatch issues and specifically incorporated in analyses of the alternatives in this EIS. Our groundfish emphasis species are black, yellowtail and chilipepper rockfish, shortspine and longspine thornyhead, sablefish, cabezon, English, Dover, and Petrale sole and arrowtooth flounder. The impacts of the alternatives described in Chapter 4 on these species should be representative of the impacts on species with similar life histories and distributions.

3.3.1.1 Generalized Rockfish (Sebastes spp.) Biology.

Rockfishes are a very diverse group of over 60 species that occur along the West Coast. Adults of many species are most common in nearshore areas, whereas others (e.g., yellowtail rockfish) inhabit deeper waters on the shelf. Most rockfishes are demersal, often solitary, and associated with rocky areas or other structure. Adults of these species tend to remain in localized areas and do not undertake significant migrations or movements. A few others (e.g, widow rockfish) are considered pelagic, schooling species. All bear live young. Most species mate in the fall and larvae are released in spring, often in rocky or reef habitats. Larvae are carried inshore to rear during the summer and fall. Typically young-of-the-year are associated with vegetated and/or rocky areas and may occur in groups or larger schools. As they grow older, they adapt the adult lifestyle. Most rockfishes are slow-growing, long-lived and produce relatively few young each year. For most species, average age of maturity is reached between five and ten years. Some species are estimated to have a life span well over 50 years, perhaps 100 years, and the longevity of many species is 20 years or more. More detailed life histories for many rockfish species are provided in Appendix B.

3.3.1.2 Generalized Thornyhead Biology.

Two species of thornyheads occur off the West Coast, shortspine thornyhead (*Sebastolobus alascanus*) and longspine thornyhead (*S. altivelis*). They are found from Baja California to the Bering Sea and occasionally to Japan. They are common from southern California northward. Thornyheads are demersal and occupy soft bottoms in deep water. Their distributions overlap considerably although longspines also inhabit somewhat deeper waters. Off Oregon and California, shortspine thornyhead mainly occur approximately 100 -1,400 m, most commonly from approximately 100 -1,000 m, and longspine thornyhead mainly occur at depths of approximately 400 -1,400+m, most often between about 600 -1,000 m in the oxygen minimum zone. Off California, spawning occurs in February and March in deep water. Eggs rise to the surface to develop and hatch. Floating egg masses can be seen at the surface in March, April, and May. Larvae are pelagic for about 12-15 months. During January to June, juveniles settle onto the continental shelf and then move into deeper water as they become adults. Off California, shortspines begin to mature at 5 years; 50% are mature by 12-13 years; and all are mature by 28 years. Although it is difficult to determine the age of older individuals, they may live to over 100 years of age. Thornyheads eat a variety of invertebrates such as shrimps, crabs, and amphipods, as well as fishes and worms. Longspine thornyhead are a common item found in the stomachs of shortspine thornyhead and cannibalism of newly settled juveniles is important in the life history of thornyheads. Sablefish commonly prey on longspine thornyhead.

3.3.1.3 Generalized Flatfish Biology

Twelve species of *FLATFISHES* are classified as West Coast groundfish: arrowtooth flounder, butter sole, curlfin sole, Dover sole, English sole, flathead sole, Pacific sanddab, Petrale sole, rex sole, rock sole, sand sole, and starry flounder. (Although they are flatfish, Pacific halibut and California halibut are not classified as West Coast groundfish, and are considered in Section 3.2.4 below.) Flatfish are demersal, inhabiting sandy, muddy, or gravelly bottoms from estuarine areas seaward over the shelf and onto the continental shelf. Starry flounder is common in estuarine areas and shallow nearshore areas and Dover sole and arrowtooth flounder are common on the outer shelf and slope. Others are most common nearshore and on the shelf. Individuals of the same species often occur together in large, non-random associations. Some may make extensive migrations, especially between feeding and spawning grounds. Spawning is most common during late winter and early spring. Except for rock sole, flatfish spawn many pelagic eggs, from hundreds of thousands to a few million, depending on species and size of the fish. Rock sole reportedly spawn over a variety of substrates, from rocky banks to sand and mud; their eggs are demersal and adhesive. For many species, eggs rise in the water column and are carried shoreward with the currents as they develop, and the young settle in relatively shallow waters. However, rex sole settle mainly on the outer continental shelf. As they age and grow, most flatfish move from shallow nursery areas into deeper waters. Age of maturity varies from 2 to 10 years, depending on species and sex. Longevity varies from 10 to 20 years with Dover sole living potentially twice as long. Juveniles and adults are carnivorous.

3.3.1.4 Generalized Gadid Biology

Two species of *GADIDS* are classified as groundfish off the West Coast: Pacific whiting (*Merluccius productus*) and Pacific cod (*Gadus macrocephalus*). (Another gadid, walleye pollock, is not classified as a West Coast groundfish under the FMP, but its biology is described in Section 3.2.4 below.) Pacific Whiting, also known as Pacific hake, range from Sanak Island in the western Gulf of Alaska to Magdalena Bay, Baja California Sur. Off the West Coast, Pacific cod are at the southern end of their range, which extends from northern China along the Pacific rim to the Bering Sea and southward to Santa Monica, California. Smaller populations of cod and whiting occur in several of the larger semi-enclosed inlets, such as the Strait of Georgia and Puget Sound. Whiting are semi-pelagic. The highest densities of Pacific whiting are usually between 50 and 500 m, but adults occur as deep as 920 m and as far offshore as 400 km. Whiting school at depth during the day, then move to the surface and disband at night for feeding. Coastal stocks spawn off Baja California in the winter, then the mature adults begin moving northward and inshore, as far north as southern British Columbia by fall. They then begin the southern migration to spawning grounds and further offshore. Spawning occurs from December through March, peaking in late January. Their eggs are neritic and float to neutral buoyancy. Age of maturity for males and females is three years and longevity is about 25 years. All life stages feed near the surface late at night and early in the morning. Juveniles and small adults feed chiefly on euphausiids. Large adults also eat amphipods, squid, herring, smelt, crabs, and sometimes juvenile whiting. Eggs and larvae of Pacific whiting are eaten by pollock, herring, invertebrates, and sometimes whiting. Juveniles are eaten by lingcod, Pacific cod and rockfish species. Adults are preyed on by sablefish, albacore, pollock, Pacific cod, marine mammals, soupfin sharks and spiny dogfish. The life history of Pacific cod off the West Coast differs in some aspects from the life history of Pacific whiting. Adult Pacific cod occur as deep as 875 m, but the vast majority occurs between 50 and 300 m. They are not considered to be highly migratory, but individuals can move long distances. Eggs are demersal, and eggs and larvae can be found over the continental shelf between Washington and central California from winter through summer. Most mature by 3 years of age, and longevity is about 15 years. Juveniles and adults are carnivorous and feed at night.

3.3.1.5 Generalized Shark Biology

On the West Coast, three species of sharks are classified as groundfish: spiny dogfish, soupfin shark and leopard shark. (Other sharks off the West Coast are more oceanic and as an example, the biology of the common thresher shark is considered in Section 3.2.4 below.) Leopard shark inhabit nearshore waters, including shallow bays and estuaries in California; soupfin shark occur near bottom in nearshore areas and over the shelf; and spiny dogfish occur near bottom and at times, higher in the water column from inshore areas to the outer shelf. They are schooling species and may make long migrations. They bear live young, primarily during the spring. Leopard sharks can produce up to 36 pups; soupfin sharks average 35 pups and spiny dogfish produce up to 20 pups, although litters of 4-7 are common. The gestation period lasts for 10-12 months for leopard shark, but two years for spiny dogfish. Age at maturity also varies by species and sex, but is about 10 to 20 years for females. These sharks are long-lived, from 30 to 70 years, depending on species and sex.

3.3.1.6 Generalized Skate Biology

Three species of skates are classified as West Coast groundfish: big skate, California skate, and longnose skate. Adults inhabit mud or sand bottom on the shelf, although California skate is more common in shallower areas, especially off California. They are *OVIPAROUS*, with fertilization occurring internally, and eggs are deposited on the bottom in egg cases. Young hatch and inhabit level, sandy or muddy bottoms. Age of maturity ranges from six to12 years and adults live for 20-30 years.

3.3.1.7 Lingcod Biology

Lingcod (*Ophiodon elongatus*), a top order predator of the family Hexagrammidae, ranges from Baja California to Kodiak Island in the Gulf of Alaska. Lingcod is *DEMERSAL* at all life stages. Adult lingcod prefer two main habitat types: slopes of submerged banks 10-70 m below the surface with seaweed, kelp and eelgrass beds and channels with swift currents that flow around rocky reefs. Juveniles prefer sandy substrates in estuaries and shallow subtidal zones. As the juveniles grow they move to deeper waters. Adult lingcod are considered a relatively sedentary species, but there are reports of migrations of greater than 100 km by sexually immature fish. Mature females live in deeper water than males and move from deep water to shallow water in the winter to spawn. Mature males may live their whole lives associated with a single rock reef, possibly out of fidelity to a prime spawning or feeding area. Spawning generally occurs over rocky reefs in areas of swift current. After the females leave the spawning grounds, the males remain in nearshore areas to guard the nests until the eggs hatch. Hatching occurs in April off Washington but as early as January and as late as June at the geographic extremes of the lingcod range. Males begin maturing at about 2 years (50 cm), whereas females mature at 3+ years (76 cm). In the northern extent of their range, fish mature at an older age and larger size. The maximum age for lingcod is about 20 years. Lingcod are a visual predator, feeding primarily by day. Larvae are zooplanktivores. Small demersal juveniles prey upon copepods, shrimps and other small crustaceans. Larger juveniles shift to clupeids and other small fishes. Adults feed primarily on demersal fishes (including smaller lingcod), squids, octopuses and crabs. Lingcod eggs are eaten by gastropods, crabs, echinoderms, spiny dogfish, and cabezon. Juveniles and adults are eaten by marine mammals, sharks, and larger lingcod.

3.3.1.8 Sablefish Biology

Sablefish (*Anoplopoma fimbria*) are abundant in the north Pacific, from Honshu Island, Japan, north to the Bering Sea, and southeast to Cedros Island, Baja California. There are at least three genetically distinct populations off the West Coast of North America: one south of Monterey characterized by slower growth rates and smaller average size, one that ranges from Monterey to the U.S./Canada border that is characterized by moderate growth rates and size, and one ranging off British Columbia and Alaska characterized by fast growth rates and large size. Large adults are uncommon south of Point Conception. Adults are found as deep as 1,000 fm (1,900 m), but are most abundant between 200 and 1,000 m. Off southern California, sablefish were abundant to depths of 1,500 m. Adults and large juveniles commonly occur over sand and mud in deep marine waters. They were also reported on hard-packed mud and clay bottoms in the vicinity of submarine canyons. Spawning occurs annually in the late fall through winter in waters greater than 300 m. Sablefish are oviparous with external fertilization. Eggs hatch in about 15 days and are demersal until the yolk sac is absorbed. After yolk sac is absorbed, the age-0 juveniles become pelagic. Older juveniles and adults are benthopelagic. Larvae and small juveniles move inshore after spawning and may rear for up to four years. Older juveniles and adults inhabit progressively deeper waters. The best estimates indicate that 50% of females are mature at 5-6 years (24 inches), and 50% of males are mature at 5 years (20 inches). Sablefish larvae prey on copepods and copepod nauplii. Pelagic juveniles feed on small fishes and cephalopods, mainly squids. Demersal juveniles eat small demersal fishes, amphipods and krill. Adult sablefish feed on fishes like rockfishes and octopus. Larvae and pelagic juvenile sablefish are heavily preyed upon by sea birds and pelagic fishes. Juveniles are eaten by Pacific cod, Pacific halibut, lingcod, spiny dogfish, and marine mammals, such as Orca whales. Sablefish compete with many other co-occurring species for food, mainly Pacific cod and spiny dogfish.

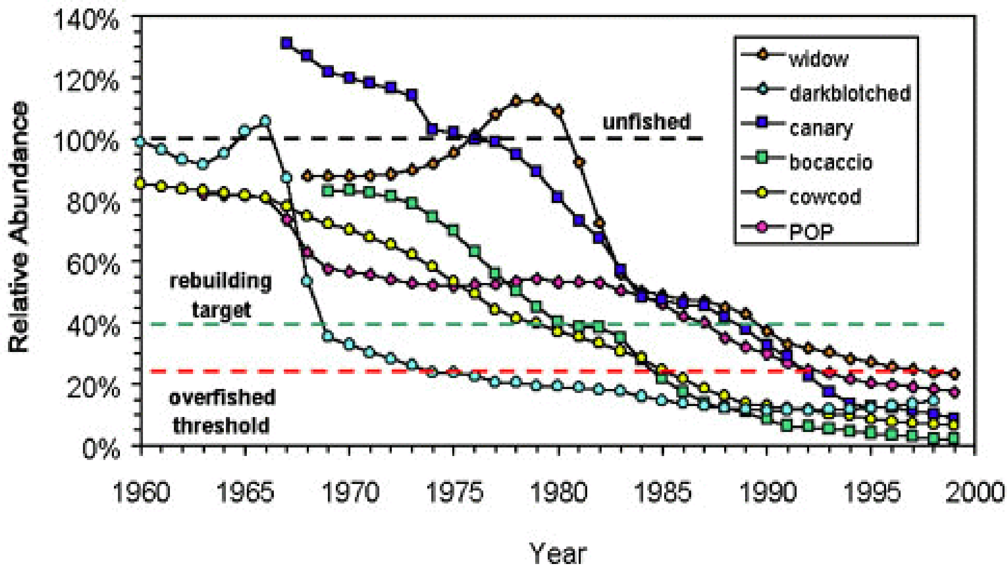
3.3.1.9 Cabezon Biology

Cabezon (*Scorpaenichthys marmoratus*) are found from central Baja California north to southeast Alaska. This species inhabits inshore waters from the intertidal out to depths of about 42 fm (76 m). It is most common at depths of 2.5 fm to 30 fm (5-59 m). Cabezon are found on rocky, sandy and muddy bottoms, and in kelp beds. They inhabit restricted home ranges. Age of maturity ranges from 3 to 6 years. Spawning takes place from late October to March in California, and from November through September in Washington. Fecundity ranges from 50,000 to 150,000 eggs, depending on size of the female. Eggs are deposited in clusters in shallow waters or in the low intertidal on bedrock, or in crevices. Males guard the nest after spawning and nest sites may be re-used from year to year. Eggs hatch two to three weeks after spawning. Small juveniles spend three to four months in the water column feeding on small crustaceans and other zooplankton. At about 1.5 inches (approximately 4 cm) they take up a demersal lifestyle. Adult cabezon primarily eat crustaceans (crabs, small lobster) but also mollusks (squid, octopus, abalone), smaller fishes, and fish eggs. Small cabezon are eaten by larger fishes including rockfishes, lingcod, adult cabezon, and other sculpins. Adults are eaten by pinnipeds.

3.3.1.10 Status of Overfished Groundfish Species

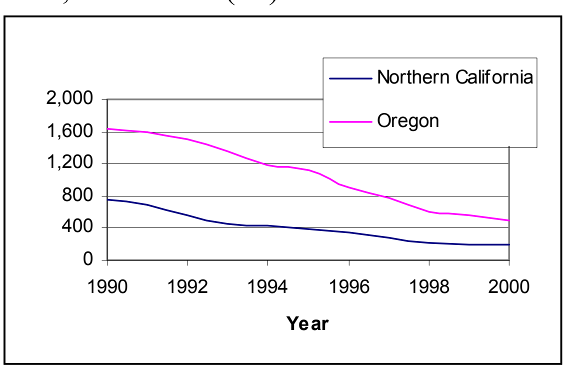
Eight groundfish species on the West Coast have been designated as overfished, based on estimates of their population abundance. A species is designated as overfished if its abundance has been estimated at less than 25% of its unfished population size. The rebuilding target for overfished species is 40% of its unfished population level. Historical estimates of relative abundance for six rockfish species are shown in the Figure 3.3 (adapted from S. Ralston, personal communication). Trends in relative abundance of darkblotched rockfish, bocaccio and cowcod show relatively long, steady declines during the 1970s and 1980s to very low levels in1990s. Trends in relative abundance for Pacific ocean perch, widow rockfish and canary rockfish are more variable, but abundance generally declined during the late 1980s and through the1990s. More detailed information about the status of these species, including biomass estimates, is provided in Appendix B.

Table 3.4.4Relative abundance trends of six overfished rockfish stocks.



Adopted from Steve Ralston; NOAA/NMFS/SW Fisheries Science Center

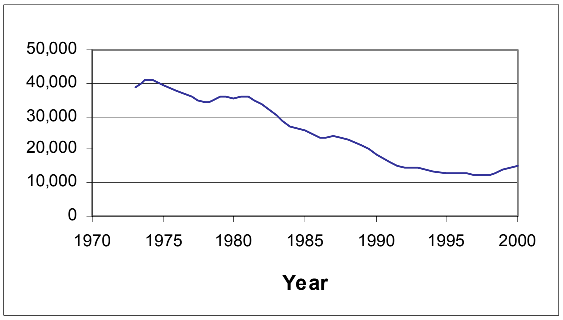
Table 3.4.4Yelloweye rockfish biomass trend, 1990-2000 (mt).



Yelloweye rockfish and lingcod have also been designated as overfished. The population status of these two species is presented below. (Pacific whiting is no longer classified as overfished.)

Yelloweye rockfish biomass shows a steady decline during the 1990s (Figure 3.4). The population was considerably below the unfished level when assessed in 2001, although there is relatively little information about yelloweye rockfish and uncertainties remain in the assessment. Regulations have severely restricted landings of yelloweye rockfish in recent years.

Table 3.4.4Lingcod population biomass (mt, age 2+).



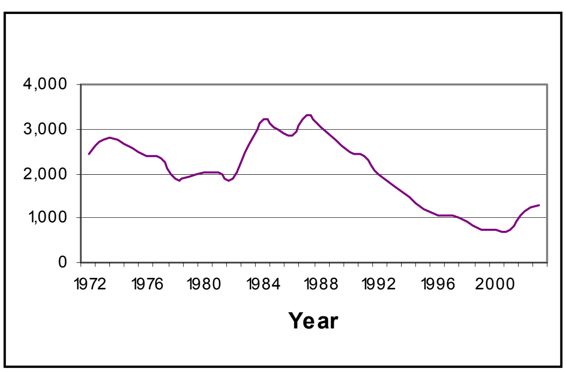
In 1997, lingcod was estimated to be at about 9% of its estimated unfished spawning potential (Figure 3.5). The estimated biomass of lingcod shows a decline from approximately 40,000 mt of fish, age 2 years and older, in the mid-1970s to a low of approximately 12,000 mt during the late 1990s.

3.3.1.11 Status of Emphasis Groundfish Species

In addition to the eight overfished species, the following 12 groundfish species are identified as emphasis species. These stocks are particularly relevant to bycatch issues and are highlighted in this EIS: Pacific whiting, sablefish, Dover sole, English sole, Petrale sole, arrowtooth flounder, chilipepper rockfish, yellowtail rockfish, shortspine thornyhead, longspine thornyhead, black rockfish and cabezon. Information about their population status is summarized below. More detailed information about their life histories and population status is provided in Appendix B.

The coastal population of Pacific whiting (Figure 3.6) was previously classified as overfished, but the 2004 assessment indicated the stock is now above the B40% level and may be classified as rebuilt. The whiting biomass fluctuates dramatically due to periodic fluctuations in recruitment strength. Stock biomass increased to a historical high in 1987 due to exceptionally large 1980 and 1984 year classes, then declined as these year classes passed through the population and were replaced by more moderate year classes. Stock size stabilized briefly between 1995-1997, but then declined continuously to its lowest point in 2001. The 2002 stock assessment indicated the population had fallen into the overfished category, based on an assumption about the size of the 1999 year class. Since 2001, stock biomass has increased substantially, and it now appears the 1999 year class was larger than anticipated. Based on this improved understanding of the large 1999 year class and a new acoustic survey,

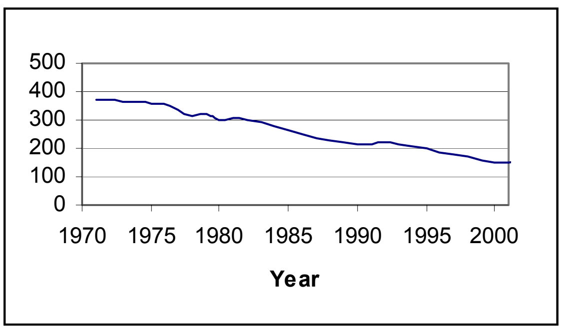
Table 3.4.4Pacific whiting female spawning biomass trend, 1972 - 2003.



the whiting stock in 2003 was estimated to range from 2.6 to 4.0 million mt (age 3+ biomass). The mature female biomass in 2003 was estimated to range from 47% to 49% of an unfished stock. Thus the stock is considered to be rebuilt to the target level of abundance only 3 years after reaching a low level that resulted in the overfished determination. It now appears the 2001 biomass had remained slightly above the overfished threshold. However, as the 1999 year class passes through its age of peak abundance, the stock is projected to decline again after 2004. By 2006, the spawning stock biomass is projected to again decline to near the overfished threshold.

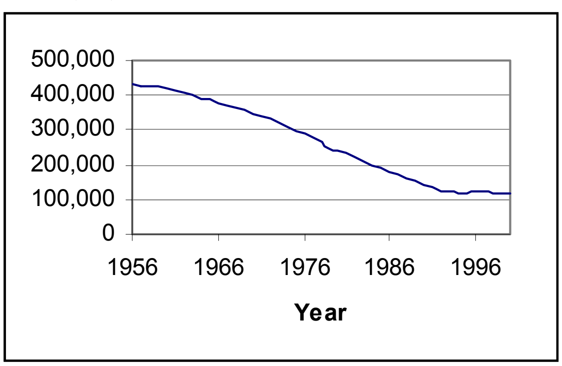
The coastwide ABC and OY for 2004 are estimated to be 514,441 mt and 250,000 mt, respectively. The ABC is based on the F40% harvest rate and the OY has been reduced from the ABC to protect widow rockfish, which is caught in common with whiting. At this time there is no evidence of sufficiently large recruitments after 1999 to maintain the stock at a high abundance level. However, as evidenced in the past, rapid increases and subsequent decreases in stock abundance and potential yield are typical for a stock with such extreme fluctuations in recruitment.

Table 3.4.4Sablefish biomass trend, 1970-2000 (1,000 mt)



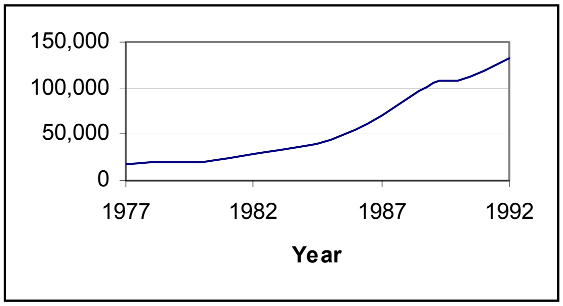
The estimated biomass of sablefish shows a slow, steady decline since the early 1970s (Figure 3.7). The stock is currently estimated to be between 27% and 38% of its unfished biomass and consequently, falls under the FMP's precautionary management principles.

Table 3.4.4Dover sole biomass trend, 1956-1996 (mt).



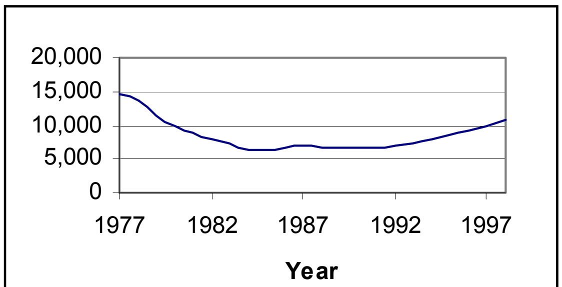
The most recent stock assessment for Dover sole completed in 2001 indicates that the current spawning stock size is about 29% of its unexploited biomass (Figure 3.8). Recent abundances appear to be without trend, but they have been preceded by a steady decline since the late 1950s.

Table 3.4.4English sole biomass trend (mt).



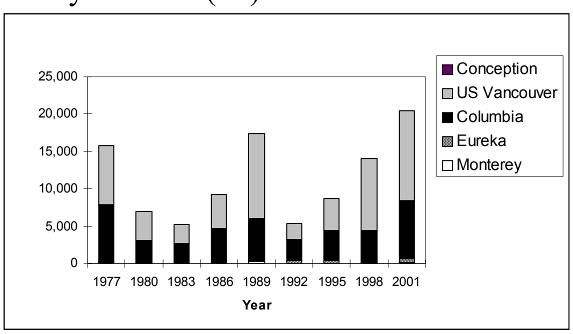
English sole has not been assessed since 1993. This assessment addressed English sole in northern areas (US Vancouver and Columbia) and indicated a nearly 7-fold increase in biomass since the 1970s to about 133,000 mt (Figure 3.9).

Table 3.4.4Petrale sole biomass trend, 1977-1997.



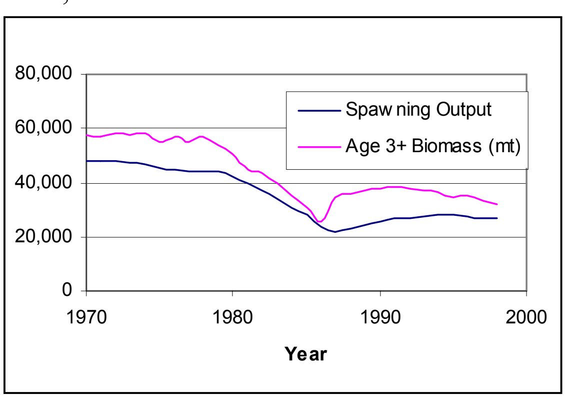
Petrale sole is currently estimated to be in excess of 39% of its unfished spawning biomass (Figure 3.10). The most recent assessment addressed the northern stock (US Vancouver and Columbia areas). Biomass appears to be stable or increasing after an initial fishing down process.

Table 3.4.4Arrowtooth flounder triennial survey biomass (mt).



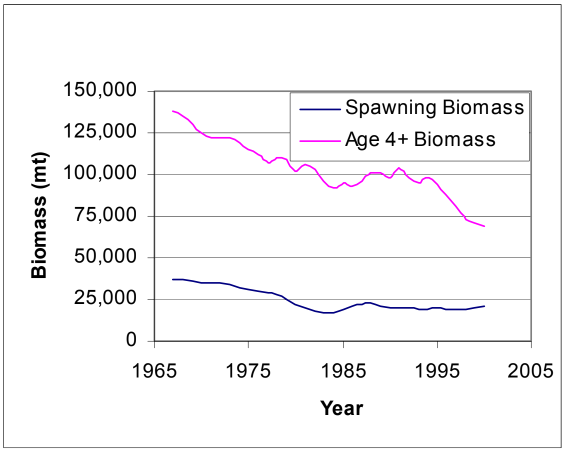
Arrowtooth flounder is at the southern end of its range in the Pacific region, and biomass off the West Coast appears to be highly variable, based on triennial trawl survey results (Figure 3.11). Most of the biomass occurs in the US Vancouver and Columbia areas, and a joint US/Canada assessment is recommended.

Table 3.4.4Chilipepper rockfish biomass trend, 1970 - 2000.



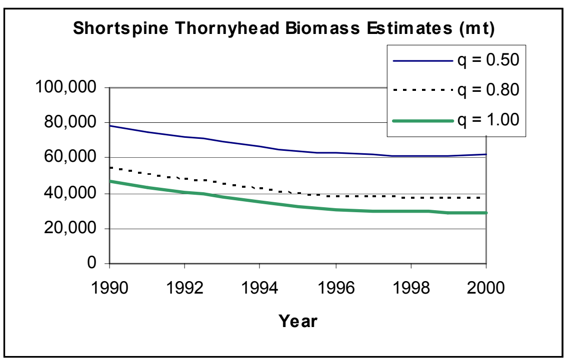
The most recent assessment of chilipepper rockfish in 1998 indicated a decline in biomass, but the stock remains above the target level (Figure 3.12). Chilipepper is managed as part of a complex, and regulations to protect bocaccio rockfish have reduced catches of chilipepper rockfish.

Table 3.4.4Yellowtail rockfish biomass trend, 1967-1997.



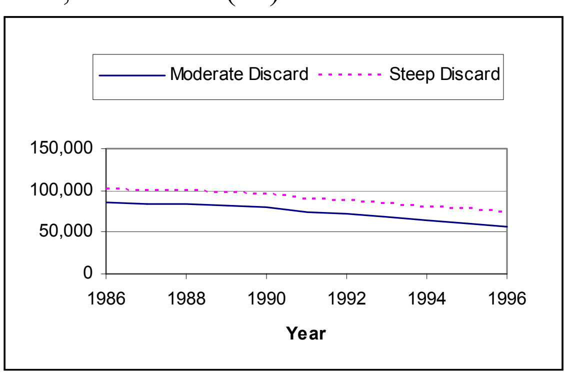
The most recent assessment for yellowtail rockfish in 2000 indicated that there has been a long-term decline in biomass, but the stock remains above the target level (Figure 3.13). Considerable uncertainty remains in the assessment, particularly over the relationship of yellowtail rockfish off the West Coast to those off Canada.

Table 3.4.4Shortspine thornyhead biomass trend, 1990-2000 (mt).



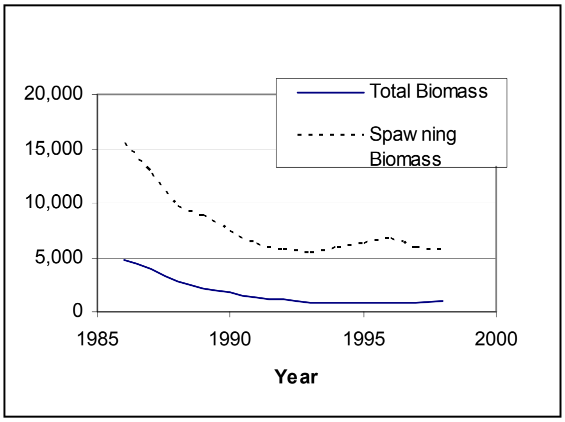
The most recent assessment for shortspine thornyhead in 2001 shows that the stock remains above the overfished level, between 24% and 48% of its unfished biomass (Figure 3.14). Considerable uncertainties remain in the assessments, particularly on the estimates of "q", the survey catchability coefficient.

Table 3.4.4Longspine thornyhead biomass trend, 1990-2000 (mt).



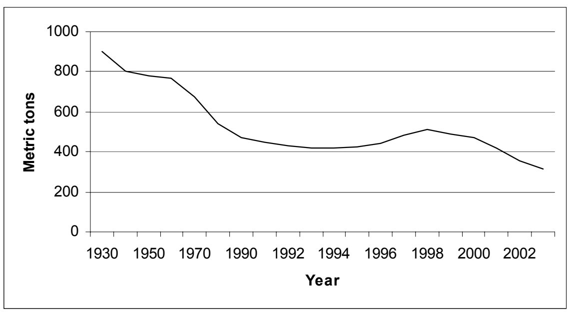
Longspine thornyhead (Figure 3.15) is estimated to be above 40% of its unfished biomass, according to the most recent assessment completed in 1997. One of the uncertainties in the assessment is the level of discard. The biomass trend is similar for both levels of discard, although estimated biomass is lower when a moderate level of discarding is assumed.

Table 3.4.4Black rockfish biomass trend, 1985-2000 (mt).



The black rockfish stock off Washington and Oregon is above the target biomass level (Figure 3.16). Estimated spawning biomass and total biomass declined during the 1980s , but appear to have remained relatively stable during the 1990s. However, uncertainties remain in the assessment.

Table 3.4.4Spawning biomass trend for cabezon in California.



The first West Coast cabezon assessment was prepared in 2004. Very little is currently known about cabezon life history, and even less is known about its population status. There is little direct information on the structure of cabezon stocks; however, the abundance trends for California and Washington are substantially different and the growth curves differ markedly. In addition, the historical fishing patterns are very different in the three states. For these reasons, the assessment treated the cabezon population as two stocks divided at the Oregon-California border. Due to data limitations, only the California stock was assessed (Figure 3.17). The assessment estimated the reproductive output of the California cabezon resource in 2003 to be 34.7% of its virgin level. The current reproductive output is estimated to be 313 mt.

Although the population in Oregon-Washington was not assessed, the available data indicate the population may be dropping rapidly.

3.3.2 Other Relevant Fish, Shellfish and Squid

We have selected twelve non-groundfish species (excluding protected species described in Section 3.3.3 below), identified as emphasis species, to capture the impacts of the alternatives. These twelve species are Pacific halibut, California halibut, pink shrimp, spot prawn, ridgeback prawn, Dungeness crab, jack mackerel, Pacific mackerel, walleye pollock, common thresher shark, and eulachon. These species represent the range of impacts likely experienced by a broader range of species, but with similar life histories, distributions, and vulnerabilities to bycatch impacts. Life histories of emphasis species are summarized below and more detailed descriptions, including available information on stock status, are given in Appendix B. Similar descriptions are also provided in Appendix B for additional species that would likely experience similar impacts under the alternatives. These additional species are blue shark, shortfin Mako shark, Pacific angel shark, Pacific herring, longfin smelt, night smelt, and surf smelt.

> The following non-groundfish have been selected to represent other fish species in order to illustrate the impacts of the alternatives on non-groundfish species that may occur with groundfish.

3.3.2.1 Pacific Halibut

Pacific halibut (*Hippoglossus stenolepis*) ranges from California to the Bering Sea and extends into waters off Russia and Japan. The International Pacific Halibut Commission (IPHC) is responsible for management of Pacific halibut in the Northeast Pacific ocean. Pacific halibut are demersal and inhabit sand and gravel bottoms, especially banks, on the continental shelf. Halibut from California through the Bering Sea are considered to form one homogeneous population. Halibut off the West Coast are at the extreme southern end of their range and those that inhabit West Coast waters result from the southerly migration of juveniles. Halibut spawn during the winter in deep water (1,000 feet or 300 m). Their eggs and larvae rise and drift great distances with the ocean currents in a counter-clockwise direction around the northeast Pacific Ocean. Young fish settle to the bottom in shallow feeding areas. After two or three years, young halibut tend to counter-migrate to more southerly and easterly waters. Adult fish tend to remain on the same grounds year after year, making only a seasonal migration from the more shallow feeding grounds in summer to deeper spawning grounds in the winter. Pacific halibut grow to about 500 pounds (227 kg). Females typically grow faster and live longer than males; nearly all halibut over 100 pounds (45 kg) are females. Age of maturity for females is approximately 12 years. Most halibut are less than 25 years old. Halibut are carnivorous. Adults prey upon cod, sablefish, pollock, rockfishes, sculpins, turbot, and other flatfish. They also leave the bottom to feed on sand lance and herring in the water column. Octopus, crabs, clams, and occasionally small halibut are also eaten. Large juvenile and adult halibut are occasionally eaten by marine mammals but are rarely prey for other fish.

3.3.2.2 California Halibut

California halibut (*Paralichthys californicus*) range from the Quillayute River, Washington to Almejas, Baja California, but their abundance and commercial fishery in U.S. waters are concentrated from Bodega Bay to San Diego, California. The State of California manages the California halibut resource off its coast; little fishing or catch occurs off Oregon and Washington. Adults live on soft bottom habitats in coastal water generally less than 300 feet (91 m) deep, with greatest abundance at depths less than 100 feet (30 m). California halibut live up to 30 years and reach 60 inches (153 cm). Male halibut mature at one to three years of age and eight to twelve inches (20 - 30 cm), whereas females mature at four to five years and 15 to 17 inches (38 - 43 cm). Adults spawn throughout the year with peak spawning in winter and spring. Pelagic eggs and larvae drift over the shelf but are in greatest densities within four miles of shore. Newly settled and larger juvenile halibut are usually found in unvegetated shallow-water bays. Juveniles emigrate from the bays to the coast at about one year of age and 6.9 to 8.7 inches (17.5 - 22 cm). Adult California halibut primarily prey upon Pacific sardine, northern anchovies, squid, and white croaker. Small juvenile halibut eat primarily crustaceans.

3.3.2.3 Pink shrimp

Pink shrimp(*Pandalus jordani*), also called ocean shrimp, occur from the Aleutian Islands to San Diego, California. State agencies plus the Washington treaty tribes manage the pink shrimp resource and fisheries off their respective coasts. Pink shrimp occur at depths from 150 to 1,200 feet (46 - 366 m) but are generally found at depths from 240 to 750 feet (73 - 229 m). Concentrations of shrimp remain in well-defined areas or beds from year to year. These areas are associated with green mud and muddy-sand bottoms. Most pink shrimp spend the first year and a half of life as males, then pass through a transitional phase to become females. Pink shrimp adjust their sex ratio to fluctuating age distributions. Mating takes place during September and October. Fertilization takes place when the females begin extruding eggs in October. Females usually carry between 1,000 and 2,000 eggs until the larvae hatch in March and April. The larval period lasts 2½ to three months. Developing juvenile shrimp occupy successively deeper depths, and often begin to show in commercial catches by late summer. Pink shrimp grow in steps by molting or shedding their shells and growth rates vary by region, season, sex and year class. Pink shrimp feed mainly at night on planktonic animals, such as euphausiids and copepods. Many species of fish prey on pink shrimp, including Pacific whiting, arrowtooth flounder, sablefish, petrale sole and several species of rockfish. Predation by whiting may affect the abundance of pink shrimp.

3.3.2.4 Spot Prawn

Spot prawn (*Pandalus platyceros*) ranges from the Aleutian Islands to San Diego, California, and extends to the Sea of Japan and the Korea Strait. Spot prawns are typically found at depths between 653 and 772 feet (198-234 m). Juvenile shrimp concentrate in shallower, inshore areas (<297 feet or 90m) and migrate offshore as they mature. Spot prawn distribution is very patchy and related to water temperature, salinity and physical habitat. Spot prawns typically inhabit rocky or hard bottoms, including reefs, coral or glass-sponge beds, and the edges of marine canyons. Spot prawns can live up to six years off California but longevity decreases in more northerly areas; the average age off Canada is only four years. Spot prawns change sex in midlife. They mature first as males, mate, and then change to females after a transition phase. Sexual maturity is reached during the third year (about 1.5 inches or 38 mm carapace length). By the fourth year (about 1.75 inches or 44 mm carapace length), many males begin to change sex to the transitional stage. By the end of the fourth year, the transitionals become females. Each individual mates once as a male and once or twice as a female. Spawning occurs once each year, typically in late summer or early autumn. Spawning takes place at depths of 500 to 700 feet (151-212 m). Females carry eggs for a period of four to five months before they hatch. Spot prawns produce a few thousand eggs. Eggs hatch over a 10-day period and is completed by April. The larvae spend up to three months in the water column and then begin to settle out at shallow depths. Spot prawns typically feed on other shrimp, plankton, small mollusks, worms, sponges and fish carcasses. They usually forage on the bottom throughout the day and night.

3.3.2.5 Ridgeback Prawn

Ridgeback prawn (*Sicyonia ingentis*) occurs from Monterey, California, to Cedros Island, Baja California. They inhabit depths ranging from less than 145 feet to 525 feet (44 - 160 m). Major concentrations occur in the Ventura-Santa Barbara Channel area, Santa Monica Bay, and off Oceanside. Other pockets of abundance occur off Baja California. Ridgeback prawns inhabit substrates of sand, shell and green mud. Because they are relatively sessile, little or no intermixing occurs. Their maximum life span is five years and sexes are separate. Females reach a maximum carapace length of 1.8 inches (46 mm) and males 1.5 inches (38 mm). Ridgeback prawns are free spawners, in contrast to other shrimps which carry eggs. Both sexes spawn as early as the first year, but most spawn during the second year at a size of 1.2 inches (30 mm). On average, females produce 86,000 eggs. Following spawning, both sexes undergo molting. The food habits of the ridgeback prawn are unknown, but it may feed on detritus like closely related species. Likely predators include rockfish, lingcod, octopus, sharks, halibut, and bat rays.

3.3.2.6 Dungeness Crab

Dungeness crab (*Cancer magister*) and their respective fisheries are managed by the West Coast states and Washington treaty tribes. Dungeness occur in coastal waters along North America from Unalaska Island to Magdalena Bay, Mexico. They are widely distributed over sandy or muddy bottom, generally in waters shallower than 90 feet (27.4 m), but they have been found as deep as 600 feet (183 m). Crabs grow each time they molt. Juveniles molt 11 or 12 times prior to sexual maturity, which may be reached at three years. At four to five years, a Dungeness crab can be over 6.5 inches (16.5 cm) in carapace width and weigh between 2 and 3 pounds (0.9 - 1.4 kg). The estimated maximum life span is between 8 and 13 years. Males mate only with female crabs that have just molted, from spring through fall. A large female crab can carry 2.5 million eggs under her abdomen until hatching. Young planktonic crabs go through six developmental stages before they molt into their first juvenile stage. After molting, the juveniles inhabit shallow coastal waters and estuaries with large numbers living among eelgrass or other habitats with aquatic vegetation. Shell hash is also important habitat for young Dungeness crabs. Dungeness crabs scavenge along the sea floor and their diet includes shrimp, mussels, small crabs, clams, and worms. Cannibalism is common. Young planktonic crabs are important prey for salmon and other fishes. Juveniles are eaten by a variety of fishes in the nearshore area, especially starry flounder, English sole, rock sole, lingcod, cabezon, skates and wolf eels. Octopus may also be an important predator.

3.3.2.7 Market Squid

Market squid (*Loligo opalescens*) is a coastal pelagic species (CPS) managed by the Council. They occur throughout the California and Alaska current systems from the southern tip of Baja California, Mexico, to southeastern Alaska. Market squid are most abundant from Punta Eugenio, Baja California and Monterey Bay, California. Although generally considered pelagic, they are found over the continental shelf from the surface to depths of at least 2,625 feet (800 m). Adults and juveniles are most abundant between temperatures of 10 °C and 16° C. Market squid are small, short-lived molluscs reaching a maximum size of 12 inches (30 cm) total length, including arms. Most mature and spawn when about one year old, then die. Spawning along the West Coast occurs year-round. Spawning squid concentrate in dense schools. Known major spawning areas are shallow semi-protected nearshore areas with sandy or mud bottoms adjacent to submarine canyons. In these locations, egg deposition occurs between 1.5 and 17 feet (5-55 m). Females produce 20 to 30 capsules and each capsule contains 200 to 300 eggs. Females attach each egg capsule individually to the substrate. As spawning continues, mounds of egg capsules covering more than 100 square meters (1076 sq. ft.) may be formed. Hatchlings are dispersed by currents, and their distribution after leaving the spawning areas is largely unknown. Market squid are important forage to a long list of fish, birds, and mammals. Some of the more important squid predators are chinook salmon, coho salmon, lingcod, rockfish, harbor seals, California sea lions, sea otters, elephant seals, Dall's porpoise, sooty shearwater, Brandt's cormorant, rhinoceros auklet and common murre.

3.3.2.8 Jack Mackerel

Jack mackerel (*Trachurus symmetricus*) is a coastal pelagic species (CPS) managed by the Council. It is a widely distributed, schooling fish throughout the northeastern Pacific Ocean and much of their range lies outside the EEZ. Young fish, up to six years old, are most abundant in the Southern California Bight and school over shallow rocky banks. Older fish, 16 to 30 years old are generally found offshore in deep water and along the coastline to the north of Point Conception. They are more available on offshore banks in late spring, summer, and early fall than during the remainder of the year. They remain near the bottom or under kelp canopies during daylight and move into deeper nearby areas at night. Young juveniles are sometimes found in small schools beneath floating kelp and debris in the open ocean. Jack mackerel live 35 years or more. Half or more of all females reach sexual maturity during their first year of life. The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July. Larval jack mackerel feed almost entirely on copepods. Small jack mackerel off southern California eat large zooplankton, juvenile squid, and anchovy. Large mackerel offshore primarily prey upon euphausiids, but also on small fishes. Large predators, such as tuna and billfish, and some marine mammals, like seals and sea lions, prey upon jack mackerel.

3.3.2.9 Pacific (Chub) Mackerel

Pacific mackerel (*Scomber japonicus*) is a coastal pelagic species (CPS) and one of three spawning stocks along the Pacific coasts of the US and Mexico. Only the northeastern Pacific stock extending northward from Punta Abreojos, Baja California is harvested by US fishers and managed by the Council. This stock is common from Monterey Bay to Cabo San Lucas. Pacific mackerel usually occur within 20 miles of shore, but have been taken as far offshore as 250 miles. Adults inhabit water ranging from 10°C to 22.2°C and they may move north in summer and south in winter between Tillamook, Oregon and Magdalena Bay, Baja California. They are found from the surface to depths of 300 meters and commonly occur near shallow banks. Juveniles are found off sandy beaches, around kelp beds, and in open bays. Larvae are found in water around 14°C. Pacific mackerel often school with other pelagic species, particularly jack mackerel and Pacific sardine. Pacific mackerel may reach 63 cm in length and 11 years in age. Age of maturity is two to four years. Spawning peaks from late April to July. Juvenile and adult Pacific mackerel prey upon small fish, fish larvae, squid and pelagic crustaceans. Juveniles and adults are eaten by larger fish, marine mammals, and seabirds. Pacific mackerel larvae are preyed upon by a number of invertebrate and vertebrate planktivores.

3.3.2.10 Walleye Pollock

Pollock (*Theragra chalogramma*) are found in the waters of the Northeastern Pacific Ocean from the Sea of Japan, north to the Sea of Okhotsk, east in the Bering Sea and Gulf of Alaska, and south along the Canadian and U.S. West Coast to Carmel, California. Adult walleye pollock are generally semi-demersal species on continental shelf and slope. A variety of environmental factors, including hydrographic fronts, temperature, light intensity, prey availability, and depth determine the distribution of juveniles and adults. They are not common off the West Coast, but occasionally sufficiently large enough numbers move south from Canadian waters to be targeted by West Coast commercial fishers. Adults most commonly occur between 100 and 300m. Most pollock are mature by age three. Spawning takes place at depths of 50 to 300m. Walleye pollock are oviparous and females spawn several batches of eggs, usually in deep water over a short period of time. Eggs are pelagic and are found throughout the water column. Larvae and juveniles are pelagic, and are generally found in the upper water column to depths of 60m. Adults are carnivorous and feed primarily on euphausiids, small fishes, copepods, and amphipods. In some areas, cannibalism can be an important food source for adults.

3.3.2.11 Common Thresher Shark

Thresher shark (*Alopias vulpinus*) is a highly migratory species (HMS). It is a large pelagic shark with a circumglobal distribution. In the northeastern Pacific, it occurs from Goose Bay, British Columbia south to Baja California. Abundance is thought to decrease rapidly beyond 40 miles from the coast, although catches off California and Oregon do occur as far as 100 miles offshore. This species is often associated with areas of high biological productivity, strong frontal zones separating regions of upwelling and adjacent waters, and strong horizontal and vertical mixing of surface and subsurface waters. They may migrate north-south seasonally between San Diego/Baja Mexico and Oregon and Washington. Large adults may pass through southern California waters in early spring of the year, remaining in offshore waters from one to two months for pupping. Pups are then thought to move into shallow coastal waters. Adults then continue to follow warming water and perhaps prey northward, and by late summer, arrive off Oregon and Washington. Subadults appear to arrive in southern California waters during the early summer, and as summer progresses move up the coast as far north as San Francisco, with some moving as far as the Columbia River. In the fall, these subadults are thought to move south again. Little is known about the presumed southward migration of the large adults, which do not appear along the coast until the following spring. The common thresher shark bears live young, usually 2-4 pups. Birth is believed to occur in the spring months off California. Size and age of first maturity for females is likely between 8.5-9 feet (260-270 cm) and about 4 or 5 years old. For males, size and age of first maturity is between 8-11 feet (246-333 cm) and 3 to 6 years. This species has been variously reported to reach a maximum age of from 19 to 50 years old. Primary prey items in the diet of the common thresher shark taken in the California-Oregon drift gillnet fishery included anchovy, sardine, Pacific whiting, mackerels, shortbelly rockfish, and market squid.

3.3.2.12 Eulachon

Eulachon (*Thaleichthys pacificus)* range from central California to Alaska. Off the West Coast, eulachon are managed by the respective states. Eulachon are anadromous, spending most of their life in the open ocean, schooling at depths of 150 to 750 feet (46 - 229 m). They migrate to lower reaches of coastal rivers and streams to spawn in fresh water; the largest run occurs in the Columbia River, where occasionally they travel over 100 miles upriver. Eulachon may live up to five years and reach 12 inches (30.5 cm) in length. Most eulachon reach maturity in two to three years and die after spawning. Each female lays about 25,000 eggs which stick to the gravel and hatch in two to three weeks. Upon hatching, larvae begin migrating to the sea. Eulachon feed mainly on euphasiids, copepods and other crustaceans, and they are a very important food for predatory marine animals, including salmon, halibut, cod and sturgeon.

3.3.3 Marine Mammals, Seabirds, Turtles and Salmon: Protected Species

Several species of marine mammals, seabirds, sea turtles and salmon on the West Coast have been listed as threatened or endangered under the ESA. A species is listed as *ENDANGERED* if it is in danger of extinction throughout a significant portion of its range and *THREATENED* if it is likely to become an endangered species within the foreseeable future throughout all, or a significant portion, of its range. The species listed in Table 3.3.1 are subject to the conservation and management requirements of the ESA.

In addition to these federally protected species, California lists several seabirds as endangered or species of special concern under the California Endangered Species Act. These include brown pelican, marbled murrelet, Xanthus murrelet, rhinoceros auklet, and tufted puffin.

The following species are emphasized in this EIS:
Steller sea lion
California sea lion
northern elephant seal
harbor seal
Dall's porpoise
Pacific white-sided dolphin
northern fulmars
gulls
Laysan albatross
black-footed albatross
chinook salmon
coho salmon

Some of these species and other marine mammals and seabirds are taken incidentally in West Coast groundfish fisheries and are therefore, especially relevant to bycatch issues. They are termed emphasis species (or species groups) for purposes of discussion of the alternatives in Chapter 4 and include 6 marine mammals, 4 seabirds and 2 salmon species. The marine mammals are Steller sea lion, California sea lion, northern elephant seal, harbor seal, Dall's porpoise and Pacific white-sided dolphin. Although more than 100 species of seabirds occur along the West Coast, little information is available about the incidental take of

Table 3.4.1. West Coast species listed under the ESA.

Marine Mammals
Threatened
Steller sea lion (*Eumetopias jubatus*) Eastern Stock; Guadalupe fur seal (*Arctocephalus townsendi*); Southern sea otter (*Enhydra lutris*) California Stock
Seabirds
Endangered
Short-tail albatross (*Phoebastria (=Diomedea) albatrus*), California brown pelican (*Pelecanus occidentalis*); California least tern (*Sterna antillarum browni*)
Threatened
Marbled murrelet (*Brachyramphs marmoratus*).
Sea Turtles
Endangered
Green turtle (*Chelonia mydas*); Leatherback turtle (*Dermochelys coriacea*); Olive ridly turtle (*Lepidochelys olivacea*)
Threatened
Loggerhead turtle (*Caretta caretta*)
Salmon
Endangered
Chinook salmon (*Oncorhynchus tshawytscha)* - Sacramento River Winter; Upper Columbia Spring
Sockeye salmon (*Oncorhynchus nerka)* - Snake River
Steelhead trout (*Oncorhynchus mykiss)* - Southern California; Upper Columbia
Threatened
Coho salmon (*Oncorhynchus kisutch)* - Central California, Southern Oregon, and Northern California Coasts
Chinook salmon (*Oncorhynchus tshawytscha*) - Snake River Fall, Spring, and Summer; Puget Sound; Lower Columbia; Upper Willamette; Central Valley Spring; California Coastal
Chum salmon (*Oncorhynchus keta)* - Hood Canal Summer; Columbia River
Sockeye salmon (*Oncorhynchus nerka)* - Ozette Lake
Steelhead trout (*Oncorhynchus mykiss)* - South-Central California, Central California Coast, Snake River Basin, Lower Columbia, California Central Valley, Upper Willamette, Middle Columbia, Northern California

seabirds by West Coast groundfish fisheries. Observers aboard groundfish vessels off the West Coast during August 2001-October 2002 reported four cormorants and one gull were taken by the limited entry trawl fleet. To approximate the impact of alternatives in Chapter 4, it is assumed that any species taken by West Coast longline fisheries will be similar to the incidental takes by Alaskan longliners, for which some information is available. Seabirds taken by Alaska longliners, and considered emphasis species are northern fulmars, gulls, Laysan albatross, and black-footed albatross. No sea turtles are included as emphasis species because there is minimal turtle take by West Coast groundfish fisheries. Chinook (king) and coho (silver) salmon are included as emphasis species.

Life histories are described below for each of these emphasis species. More detailed information is provided in Appendix B, as well as descriptions for other marine mammals, sea birds, and sea turtles that occur on the West Coast.

3.3.3.1 Steller (Northern) Sea Lion

Steller sea lions *(Eumetopias jubatus*) range along the North Pacific Ocean from Japan to California. Two stocks are designated in U.S. waters with the eastern stock extending from Cape Suckling, Alaska to southern California with a total of 6,555 animals off Washington, Oregon and California. They do not make large migrations, but disperse after the breeding season (late May-early July), feeding on rockfish, sculpin, capelin, flatfish, squid, octopus, shrimp, crabs, and northern fur seals.

3.3.3.2 California Sea Lion

California sea lions *(Zalophus californianus)* range from British Columbia south to Tres Marias Islands off Mexico. Breeding grounds are mainly on offshore islands from the Channel Islands south into Mexico. Breeding takes place in June and early July within a few days after the females give birth. The population is estimated at 214,000 sea lions. During the summer breeding season, most adults are present near rookeries principally located on the southern California Channel Islands and Año Nuevo Island near Monterey Bay. Males migrate northward in the fall, going as far north as Alaska and returning to their rookeries in the spring. Adult females generally do not migrate far away from rookery areas. Juveniles remain near rookery areas or move into waters off central California. Diet studies indicate that California sea lions feed on squid, octopus, and a variety of fishes: anchovies, sardine, mackerel, herring, rockfish, Pacific whiting, and salmon.

3.3.3.3 Northern Elephant Seal

Elephant seals *(Mirounga angustirostris*) range from Mexico to the Gulf of Alaska. Breeding and whelping occurs in California and Baja California, during winter and early spring on islands and recently at some mainland sites. The population was estimated at 127,000 elephant seals in the U.S. and Mexico during 1991. The population is growing and fishery mortality may be declining, and the number of pups born may be leveling off in California during the last five years.

Northern elephant seals are polygynous breeders with males forming harems and defending them against other mature males in spectacular battles on the beach. Female give birth in December and January, mate about three weeks later, after which the pups are weaned. They feed mainly at night in very deep water to consume whiting, skates, rays, sharks, cephalopods, shrimp, euphasiids, and pelagic red crab. Males feed in waters off Alaska, and females off Oregon and California.

3.3.3.4 Harbor Seal

Harbor seals *(Phoca vitulina richardsi*) inhabit nearshore and estuarine areas ranging from Baja California, Mexico, to the Pribilof Islands, Alaska. MMPA stock assessment reports recognize six stocks along the U.S. West Coast: California, Oregon/ Washington outer coastal waters, Washington inland waters, and three stocks in Alaska coastal and inland waters. The California stock is estimated at 30,293 seals; the Oregon/ Washington Coast stock at 26,180 seals; and the Washington inland-water stock at 16,056 seals. Harbor seals do not migrate extensively, but have been documented to move along the coast between feeding and breeding locations. The harbor seal diet includes herring, flounder, sculpin, cephalopods, whelks, shrimp, and amphipods.

3.3.3.5 Dall's Porpoise

Dall's porpoise *(Phocoenoides dalli*) are common in shelf, slope and offshore waters in the north eastern Pacific Ocean down to southern California. As a deep water oceanic porpoise, they are often sighted nearshore over deepwater canyons. These porpoise are abundant and widely distributed with at least 50,000 off California, Oregon, and Washington; however, because of their behavior of approaching vessels at sea, it may be difficult to obtain an unbiased estimate of abundance. Dall's porpoise calf between spring and fall after a 10-11 month gestation period. North-south movement between California, Oregon and Washington occurs as oceanographic conditions change, both on seasonal and inter-annual time scales. Dall's porpoise feed on squid, crustaceans, and many kinds of fish including jack mackerel.

3.3.3.6 Pacific White-Sided Dolphin

Pacific white-sided dolphin *(Lagenorhynchus obliquidens*) are abundant, gregarious and found in the cold temperate waters of the North Pacific Ocean. Along the West Coast of north America they are rarely observed south of Baja California, Mexico. Aerial surveys have exceeded 100,000 white-sided dolphins over the California continental shelf and slope waters. Little is known of their reproductive biology. Longevity is not known although a 29- year-old pregnant female has been reported. White-sided dolphins inhabit California waters during winter months moving northward into Oregon and Washington during spring and summer. Shifts in abundance likely represent changes in prey abundance or migration of prey species. They are opportunistic feeders and often work collectively to concentrate and feed small schooling fish including anchovies, Pacific whiting, herrings, sardines, and octopus.

3.3.3.7 Northern fulmar

Northern fulmar *(Fulmarus glacialis)* ranges along the Pacific Coast from Alaska to Oregon and they are primarily pelagic. The estimated total population of northern fulmars in the North Pacific is between 3 and 3.5 million individuals. This species primarily breeds in Alaska at colonies on sea cliffs and, less frequently, on low, flat rocky islands. Northern fulmars show strong mate and nest site fidelity. Nests are often raided by weasels and gulls. Northern fulmars are surface feeders; they swim or float upon the ocean's surface while feeding on organisms found just below the surface. The diet of this species includes fishes, mollusks, crustaceans, and cephalopods. Northern fulmars have also been observed following fishing vessels, presumably to feed on offal.

3.3.3.8 Gulls

Gulls (*Larus* spp.) that occur along the Pacific Coast include the glaucous gull (*Larus hyperboreus*), glaucous-winged gull (*Larus glaucescens*), western gull (*Larus accidentalis*), herring gull (*Larus argentatus*), California gull (*Larus californicus*), Thayer's gull (*Larus thayeri*), ring-billed gull (*Larus delawarensis*), mew gull (*Larus canus*), Heermann's gull (*Larus heermanni*), Bonaparte's gull (*Larus philadelphia*), and Sabine's gull (*Larus sabini*). For most marine-nesting species in the North Pacific, only rough estimates of nesting populations exist and reproductive success has only been investigated for one to two years. However, it is thought that most gull populations along the Pacific Coast are stable and not considered to be at risk. Most gulls along the Pacific Coast occur during the non-breeding season or are non-breeding individuals. Birds can be found at sea, along the coast, on rocky shores or cliffs, bays, estuaries, beaches, and garbage dumps. Only two species of gulls breed along the Pacific Coast. The glaucous-winged gull has breeding colonies in British Columbia and Washington and the western gull has breeding colonies in California (most are located on the Farallon Islands), Oregon, and Washington. Breeding habitat for these gulls includes coastal cliffs, rocks, grassy slopes or offshore rock or sandbar islands. Pacific Coast gulls feed at the ocean's surface and their diet typically includes fishes, mollusks, crustaceans, carrion, and garbage.

3.3.3.9 Laysan Albatross

Laysan albatross (*Phoebastria immutabilis*) is the most abundant North Pacific albatross species. The vast majority of the Laysan albatross population breeds on the northwestern Hawaiian Islands, fewer numbers breed on the Japanese Ogasawara Islands, and still fewer pairs breed on islands off Baja California, Mexico (Guadalupe Island, Alijos Rocks, and in the Revillagigedo Islands). When at sea, the Laysan albatross ranges from the Bering Sea, to California, to Japan. Surveys at three sites indicate breeding populations total about 400,000 breeding pairs, but this represents an average decline of 3.2% per year since 1992. Laysan albatross feed on schooling fish and squid at the ocean's surface.

3.3.3.10 Black-Footed Albatross

Black-footed albatross (*Phoebastria nigripes*) ranges throughout the North Pacific. Breeding occurs on northwestern Hawaiian Islands and Torishima Island and the species disperses from the Bering Sea south along the Pacific Coast to California. Black-footed albatross is the most numerous albatross species along the Pacific Coast and is present throughout the year. The global black-footed albatross population is estimated at about 56,500 breeding pairs and is thought to be decreasing. Black-footed albatross feed on fish, sea urchins, amphipods, and squid; foraging is done at night and prey is caught at the ocean's surface. This species will also follow fishing vessels and feed on discard.

3.3.3.11 Chinook (King) Salmon

Chinook salmon (*Oncorhynchus tshawytscha*) range widely throughout the north Pacific Ocean and the Bering Sea, and as far south as the U.S./Mexico border. After leaving the freshwater and estuarine environment, juvenile chinook disperse to marine feeding areas. Some tend to be coastal-oriented, preferring protected waters and waters along the continental shelf. In contrast, others pass quickly through estuaries, are highly migratory, and may migrate great distances into the open ocean. Chinook salmon typically remain at sea for one to six years. They are most abundant at depths of 30-70m and often associated with bottom topography. However, during their first several months at sea, juveniles are predominantly found at depths less than 37 m and are distributed in the water column. Juvenile chinook are generally found within 55 km of the U.S. West Coast, with the vast majority of fish found less than 28 km offshore. Concentrations may be found in areas of intense upwelling. The historic southern edge of their marine distribution appears to be near Point Conception, California. Throughout their range, adult chinook salmon enter freshwater during almost any month of the year. For example, chinook enter the Columbia River between March and November and the Sacramento River between December and July. Chinook salmon mature at a wide range of ages, from two to eight years. Most adult females are 65-85 cm in length and males are 50-85 cm, although fish larger than 100cm are not uncommon. Chinook salmon are the most piscivorous of the Pacific salmon. Fish make up the largest part of their diet, but squids, pelagic amphipods, copepods, and euphausiids are also important.

3.3.3.12 Coho (Silver) Salmon

Coho salmon (*Oncorhynchus kisutch*), also called silver salmon, are a commercially and recreationally important species. They are found in small rivers and streams throughout much of the Pacific Rim, from central California to Korea and northern Hokkaido, Japan. Coho salmon spawn in freshwater streams, juveniles rear for at least one year in fresh water and spend about 18 months at sea before reaching maturity as adults. North American populations are widely distributed along the Pacific coast and spawn in tributaries to most major river basins from the San Lorenzo River in Monterey Bay, California, to Point Hope, Alaska. Two primary dispersal patterns have been observed in coho salmon after emigrating from freshwater. Some juveniles spend several weeks in coastal waters before migrating northwards into offshore waters of the Pacific Ocean while others remain in coastal water near their natal stream for at least the first summer before migrating north. The latter dispersal pattern is commonly seen in coho salmon from California, Oregon, and Washington. Coho salmon rarely use areas where sea surface temperature exceeds 15° C and are generally found within the uppermost 10 m of the water column. While juvenile and maturing coho are found in the open north Pacific, the highest concentrations appear to be found in more productive waters of the continental shelf within 60 km of the coast. Adults enter fresh water during October and November in Washington and Oregon and during December and January in California. Marine invertebrates, such as copepods, euphausiids, amphipods, and crab larvae, are the primary food when coho first enter salt water. Fish represent an increasing proportion of coho salmon diet as they grow and mature.

3.3.4 Miscellaneous Species

Commercial and recreational fisheries for groundfish take various other fish, including finfish, shellfish, corals and other invertebrates. There is little information about the amounts or distribution of such bycatch. Although gear size and configuration and fishing operations are not the same as for commercial fisheries, information available from groundfish assessment surveys with bottom trawl gear can give an indication of the potential types of bycatch of benthic animals. In these surveys, a variety of benthos are taken, including sea urchins, starfish, snails, octopuses, various crustaceans and small fishes. At times, coral, sponges, and other animals may be taken or damaged during fishing (and survey) operations, but the distributions of these benthic animals are poorly known on the West Coast. Pot and longline fisheries may also take some of these animals, but little is known about this bycatch.

3.3.5 Biological Associations

> Biological associations are dynamic, changing with time of day, season, life history stage, prey availability, mating opportunities, and environmental variables. Within each of the five regional environments, species associations also vary with depth and latitude. This results in substantial variability in encounter rates in various fisheries.

Most bottom-dwelling groundfish are currently managed based on distinction between nearshore, continental shelf, and continental slope species. For example, rockfishes are managed as assemblages of species grouped into nearshore, shelf, and slope categories (PFMC 2004). These categories reflect differences in fisheries catch compositions and are based primarily on depth which, in combination with distance from shore, roughly characterizes ecological zones. In addition, groundfish that live higher in the water column are managed differently than those living on the bottom. Some groundfish, such as Pacific whiting and shortbelly rockfish inhabit midwater along the coast. For many species, the biogeographic zone varies by life history stage; many groundfish produce pelagic larvae, and juveniles of many species are more commonly found in nearshore areas than as adults. These biogeographic zones also have a north south component, with Cape Mendocino representing an important break in the distribution of many groundfish species (particularly rockfish), hence the use of 40°10' N latitude to separate northern and southern management regions. Finally, particular species may exhibit seasonal migrations, producing some annual variation in the characteristics of these different ecological zones. The nearshore, shelf, slope and pelagic environments can be characterized by combinations of the habitats described below, the species associations (and life stages) particular to these environments, and the trophic relationships between these species. Biological associations are dynamic, changing with time of day, season, life history stage, prey availability, mating opportunities, and environmental variables. Within each of the five regional environments, species associations also vary with depth and latitude. Of necessity, characterization of biological associations in the following sections provides only broad generalizations based on the available information. Most of the information also only pertains to adults; references to other life stages are noted as such.

Non-groundfish species, including other finfish, shellfish, marine mammals, marine birds, and sea turtles, also occupy specific biogeographic zones, often similar to those occupied by various groundfish species. For example, pink shrimp and Pacific halibut co-occur with several flatfish species on the northern shelf. Marine mammal communities are pelagic, but some are found primarily in nearshore waters, whereas others are more common over the shelf or slope. Sea turtles occur in midwater and sea birds are found primarily in or near surface waters all along the West Coast.

Information collected to understand biological associations of West Coast groundfish comes primarily from three sources: fishing activities, research surveys, and research studies. All of the means to collect information have limitations for the purpose of characterizing biological associations. Fishing, survey activities and research studies are often quite limited by gear selectivities, and temporal and spatial scales. Consequently, our understanding of biological associations and ecological relationships for West Coast groundfish is incomplete.

3.3.5.1 Northern Shelf Environment

The boundaries of the northern shelf environment are 40° 10' N. Lat. (Cape Mendocino) on the south and the US/Canada border to the north, and between 20 and 109 fm, up to 5.5 fm off the sea floor.

Emphasis species that commonly occur on the northern shelf include four overfished groundfish species, as well as arrowtooth flounder, English sole, yellowtail rockfish, Pacific halibut and pink shrimp. The overfished groundfish species are lingcod, canary rockfish, yelloweye rockfish, and bocaccio. Associations among these and other species, as well as habitat on the northern shelf, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the northern shelf and are not considered in the northern shelf environment. These species are considered as part of the pelagic environment (Section 3.3.5.4).

Habitat Off the West Coast, the continental shelf generally broadens from south to north. It widens from a few miles at Cape Mendocino to about 50 miles off northern Washington and generally slopes gently westward. Bordering the nearshore zone, the shelf extends seaward to about 100 fm.

The shoreward edge of the shelf off Oregon is usually composed of soft substrates, primarily sand or green mud. This expanse of soft substrate is interrupted by prominent rocky banks, especially at the seaward edge of the shelf. These banks, such as Heceta Bank, Coquille Bank, Daisy Bank and Stonewall Bank, contain unique habitats formed by varied combinations of rock ridges, boulders, cobbles and pebbles. For example, submersible operations at Heceta Bank showed that diagonally stacked ridges are separated by sand, pebble, and cobble-filled depressions. A narrow band of precipitous pinnacles is located on the edge of the bank and large, round boulders are found on the eastward slope, which gradually fades to cobble and finally mud. In comparison, Coquille Bank is comprised largely of siltstone and mudstone and characterized by eroded, flat, slab-like boulders which were mostly covered by a layer of silt. No rocky ridges were observed on the bank (Barss 1994).

Off Washington, broad fans of gravel created by retreating glaciers from the northern Cascade and Olympic mountains, produce structural habitat on the seafloor. Similarly, empty shells from mussels and gastropods, and deposits of other biogenic debris, such as coral skeletons, sponge spicules, urchin tests (shells), and worm tubes, provide some shelter for fish and attachment substrate for invertebrates.

Submarine canyons, such as Astoria Canyon off the Columbia River, are also prominent features of the northern shelf. Canyon habitat is structurally complex and diverse. It is characterized by vertical walls (textured with joints, fractures and overhangs), ledges, talus slopes, and the canyon floor covered with cobble, boulder and mud substrates.

Climatic conditions influence productivity; the duration and strength of winds favorable for upwelling along the West Coast diminish northward. Wind velocities and upwelling are variable but tend to be at a maximum in the spring to early summer in the region between Point Conception (34.5° N) and the Oregon border (42° N). Off Washington upwelling is relatively minor and is largely restricted to the late spring to early fall; winter storms there result in intense downwelling events (Leet, *et al.* 2001).

Bottom water temperatures on the northern shelf make good habitat for sub-arctic and cold-temperate species. Summertime bottom temperatures observed during the 1986-1998 West Coast triennial bottom trawl surveys ranged between about 7° C and 8.5° C (Shaw, *et al.* 2000).

Biological Associations Plant life on the shelf is small and sparse. Light does not usually penetrate below 60 fm, so algae are not found below that depth (Barss1994).

Non-rocky substrates are commonly used by pink shrimp, sea pens, and weathervane scallops. In addition, English sole, petrale sole, arrowtooth flounder, Pacific halibut, big skate and longnose skate frequently co-occur on or very near the bottom in these areas. Hagfish also occur over soft substrates. All flatfish species inhabit the non-rocky substrates on the northern shelf (EFH appendix), but their distributions differ by depth and substrate type (e.g., mud versus sand). Although their distributions overlap, adult arrowtooth flounder, rex sole, curlfin sole, Dover sole, rock sole and petrale sole also occupy deeper waters than sand sole and starry flounder (EFH appendix). Sablefish (particularly juveniles), spiny dogfish, ratfish and soupfin shark also cruise over these soft bottom habitats, in search of prey. Some nearshore species, such as blue rockfish, and deeper dwelling species like yellowtail rockfish, Pacific Ocean perch and Pacific whiting move into these areas to feed.

Banks create locally shallow areas in the otherwise deeper water of the shelf and are highly productive. Rocky substrates are often covered with a distinct and diverse suite of invertebrate species including sponges, corals, anemones, crinoids, hydroids, tunicates, bryozoans, tube worms, mussels, and other animals. These creatures form a structurally complex environment for other animals, such as brittle stars, shrimp, clams, mussels, barnacles, worms, crabs and fishes.

Common fish species in rocky habitats on the northern shelf include yellowtail, canary, sharpchin, greenstriped, pygmy and rosethorn rockfishes, kelp greenling, and lingcod. Many juvenile rockfishes inhabit these areas, and dense schools above the shallower rocky ridges have been observed at Heceta Bank. These isolated rocky areas may serve as nursery grounds especially in areas where other suitable nursery habitat is unavailable.

Common fish and invertebrates seen in submersible operations at various habitat types on Heceta Bank and Coquille Bank are summarized in the Table 3.3.3 (Barss 1994).

Table 3.3.3. Species observed in submersible operations at Heceta and Coquille Bank.

NEARSHORE-SAND & MUD	ROCK RIDGE & PINNACLES	BOULDER-COBBLE	MUD
English sole petrale sole rex sole slender sole hagfish ocean shrimp sea pens scallops	juvenile rockfishes yellowtail rockfish widow rockfish basketstars anemones coral sponges crinoids	pygmy rockfish sharpchin rockfish juvenile rockfishes yellowtail rockfish canary rockfish widow rockfish rosethorn rockfish lingcod greenling yelloweye rockfish bocaccio crinoids sponges anemones shrimp sea cucumbers sea stars octopus	Dover sole rex sole slender sole sablefish thornyheads splitnose rockfish ratfish poachers eelpouts hagfish fragile urchins sea cucumbers snails sun stars brittle stars euphausiids box crabs hermit crabs

Species associations vary during the year, generally related to feeding, growth, and reproduction. Many species make seasonal spawning migrations; for example, female lingcod move to shallow water during the winter to lay their eggs in nests. Dover sole and sablefish are common on the continental slope but make seasonal migrations onto the shelf. Juveniles of many groundfish species also move to deeper areas as they grow and take advantage of new prey sizes and species.

As on rocky banks, invertebrates, such as crinoids, sea anemones, and sponges create additional structural habitat and diversity in submarine canyons. Information about species that commonly inhabit canyons on the northern shelf is very limited, although soupfin sharks and sablefish reportedly are associated with canyons, along with other habitats (See EFH appendix).

Emphasis Species Canary, yellowtail, widow and silvergray rockfish, lingcod and sablefish frequently co-occur in areas of the continental shelf. Although widow rockfish often occur near bottom, they more commonly inhabit midwater and are considered a component of the pelagic complex (Section 3.3.5.4).

Yelloweye rockfish are generally a solitary, rocky reef fish. Researchers have observed adult yelloweye rockfish associated with bocaccio, cowcod, greeenspotted, and tiger rockfish (Appendix B).

Adult bocaccio have two primary habitat preferences: some are semipelagic, forming loose schools above rocky areas; and some are non-schooling, solitary individuals (EFH appendix). Solitary bocaccio have been found in association with large sea anemones. Bocaccio are often caught with chilipepper rockfish and have been observed schooling with speckled, vermilion, widow and yellowtail rockfish (Appendix B).

English sole, petrale sole, arrowtooth flounder, Pacific halibut, big skate and longnose skate frequently co-occur. Although distributions of English sole and arrowtooth flounder overlap, arrowtooth flounder are much more abundant at deeper depths in the northernmost areas, especially off Cape Flattery, Washington. English sole are most common in the shallower waters all along the shelf. Although fishing and survey reports indicate Pacific halibut frequently occur at Heceta and other banks on the northern shelf, they probably occupy areas of low-relief and soft substrates on these banks.

Pink shrimp are associated with green mud and muddy-sand bottoms and are important prey for many species. Arrowtooth flounder, petrale sole, sablefish, and Pacific whiting are some of the groundfish that prey heavily on pink shrimp. Predation by whiting may affect the abundance of pink shrimp (Appendix B). The list of common groundfish species inhabiting rocky and non-rocky substrates in the Northern Shelf Environment is presented in Table 3.3.4 below. Other relevant fish and shellfish species to groundfish bycatch on the northern shelf are also included in the list.

Table 3.3.4. Species associations in the **Northern Shelf Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Lingcod	**Arrowtooth Flounder**
Canary Rockfish	**English Sole**
Yelloweye Rockfish	**Pacific Halibut**
Yellowtail Rockfish	**Ocean Shrimp**
Bocaccio	Sablefish
Chilipepper Rockfish	Dover Sole
Greenstriped Rockfish	Pacific Sanddab
Redstripe Rockfish	Petrale Sole
Rosethorn Rockfish	Rex Sole
Silvergray Rockfish	Sand Sole
Tiger Rockfish	Soupfin Shark
Vermilion Rockfish	Spiny Dogfish
Spiny Dogfish	Big Skate
Ratfish	Dungeness Crab
Spot Prawn	

3.3.5.2 Southern Shelf Environment

The boundaries of the southern shelf environment are 40°10' N. Lat. (Cape Mendocino) on the north and the US/Mexico border to the south, and between 20 and 109 fm, up to 5.5 fm off the sea floor.

Emphasis species that commonly occur on the southern shelf include two overfished species, as well as chilipepper rockfish and ridgeback prawn. The overfished groundfish species are bocaccio and cowcod. Associations among these and other species, as well as habitat on the southern shelf, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the southern shelf and are not considered in the southern shelf environment. These species are considered as part of the pelagic environment (Section 3.3.5.4).

Habitat The continental shelf diminishes southward along the California coast, from its widest (about 50 nm) at Cape Mendocino to its narrowest, only a few miles wide along the Southern California Bight. The shelf also forms very narrow rings around several islands in the Southern California Bight which rise sharply from the deep sea floor.

The southern shelf is comprised of similar substrate types as the northern shelf, although species assemblages are often different, largely due to the warmer waters south of Cape Mendocino. In addition to banks, reefs, and sandy or muddy bottoms like those described for the north, canyons are a prominent feature of the shelf. Submersible observations at depths from 40 to 150 fm in Soquel Canyon, Monterey Bay revealed a structurally diverse habitat, comprised of vertical walls (with joints, fractures, and overhangs), ledges, talus slopes, and a canyon floor with cobble, boulder and mud substrates. Invertebrates such as crinoids, sea anemones, and sponges create additional structural diversity.

Biological Associations Many of the species that co-occur on rocky and non-rocky substrates on the northern shelf similarly co-occur on the southern shelf, particularly between Cape Mendocino and the Southern California Bight. Redstripe, rosethorn, and silvergray rockfish are minor species associated with rocky substrates on the southern shelf but are considered more important on the northern shelf. In contrast, greenblotched, greenspotted, and Mexican rockfish and California scorpionfish are important species associated with rocky substrates on the southern shelf, but not in the north. Non-rocky substrates are more abundant on the northern shelf and consequently, flatfishes and pink shrimp are typically more important in the north.

Submersible observations of benthic rockfishes in Soquel Canyon revealed six distinct habitat guilds. In general, small species were associated with mud and cobble substrates of low relief and larger species were associated with high-relief habitat (Table 3.3.5). Some of these guilds observed at Soquel Canyon were remarkably similar to observations at several other sites along the Pacific Coast from Central California to Alaska. Sedentary fishes, such as bocaccio, lingcod, cowcod, greenblotched, greenspotted and yelloweye rockfish, were primarily sheltered under ledges, in crevices, and among large sea anemones on an isolated rock outcrop (Yoklavich, *et al.* 2000).

Table 3.3.5. Main habitat guilds observed in Soquel Canyon (from Yoklavich, *et al.* 2000.)

Mud	Cobble-Mud Mud-Pebble	Mud-Cobble Mud-Rock	Boulder-Mud	Mud-Boulder Rock-Mud Rock Ridge	Rock- Boulder
Stripetail R Dover sole Agonidae Shortspine Th	Halfbanded R Greenstriped R Greenspotted R Pygmy R	Stripetail R Rosethorn R Agonidae Greenspotted R Greenstriped R	Rosethorn R Greenspotted R Bocaccio	Bocaccio Rosethorn R Greenspotted R	Pygmy R Bocaccio

Emphasis Species Bocaccio occur in a wide variety of habitats, often on or near bottom features but sometimes over muddy bottoms. Adult bocaccio are often caught with chilipepper rockfish and have been observed schooling with speckled, vermilion, widow and yellowtail rockfish. Chilipepper rockfish occur over the lower shelf and upper slope at depths between 41 and 168 fm. They are semi-pelagic and are found on deep rocky reefs as well as sand and mud bottoms. At times, they form large schools. Adult cowcod inhabit the lower shelf and upper slope, primarily at depths between 82 and 164 fm in the Southern California Bight. They are often found on bottoms with high relief such as rocky reefs. Two cowcod conservation areas encompassing most of their known habitat were established to provide protection to this overfished species. Ridgeback prawns occur only south of Monterey, California, at depths ranging from 24 to 87 fm. They inhabit substrates of sand, shell and green mud. Species associations for common groundfish and other species in the Southern Shelf Environment are listed in Table 3.3.6.

Table 3.3.6. Species associations in the **Southern Shelf Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Bocaccio	**Ridgeback Prawn**
Cowcod	Sablefish
Chilipepper	California Scorpionfish
Lingcod	Dover Sole
Canary Rockfish	English Sole
Yelloweye Rockfish	Pacific Sanddab
California Scorpionfish	Petrale Sole
Greenblotched Rockfish	Rex Sole
Greenspotted Rockfish	Spiny Dogfish
Greenstriped Rockfish	Big Skate
Mexican Rockfish	Pacific Halibut
Tiger Rockfish	Dungeness Crab
Vermilion Rockfish	
Yellowtail Rockfish	
Spiny Dogfish	
Ratfish	
Spot Prawn	

3.3.5.3 Slope Environment

The slope environment is bounded by the US/Canada and US/Mexico borders to the north and south, respectively, and depths greater than 109 fm, up to 11 fm off the sea floor. The slope extends westward onto the deep continental basin (>1000 fm), which covers most of the EEZ.

Emphasis species that commonly occur on the slope include two overfished species, as well as Dover sole, sablefish, shortspine thornyhead, longspine thornyhead, and spot prawn. The overfished groundfish species are darkblotched rockfish and Pacific ocean perch. Associations among these and other species, as well as habitat on the slope, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the slope and are not considered in the slope environment. These species are considered as part of the pelagic environment (Section 3.3.5.4).

Habitat The continental slope forms a narrow, steep strip at the seaward edge of the continental shelf. Except for the Southern California Bight, the slope drops rapidly from approximately 100 fm to 1,000 fm, less than 50 miles from shore. The islands of the Southern California Bight rise sharply from depths of about

1,000 fm. Beyond 1,000 fm, the bottom gradually slopes downward, to depths of 2,000 fm to form the continental basin which comprises most of the EEZ.

Relatively little is known about bottom types and their distributions on the continental slope. Descriptions of bottom type have been generally identified as hard or soft, often based on experiences with bottom gear during fishing operations. An oxygen minimum zone occurs on the deep slope; thornyheads spawn in this zone at about 300-500 fm.

Biological Associations Little is known about biological associations on the deep, steep slope. Most information comes from co-occurrence of species in fisheries catches. Aurora, bank, blackgill, rougheye, sharpchin, shortraker and yellowmouth rockfish are considered important slope groundfish species on hard bottom. Bank, redbanded, rougheye, and splitnose are also important groundfish species on soft bottom. Bronze-spotted, chilipepper, greenblotched, redstripe, rosethorn, and stripetail rockfish occur on the slope, but are not a major component of fisheries catches. Other groundfish including petrale sole, rex sole, finescale codling and Pacific rattail are also considered minor species on the slope. Little is known about other fish and shellfish species on the slope, except spot prawns. Spot prawns typically inhabit rocky or hard bottoms, including reefs, coral or glass-sponge beds and the edges of marine canyons.

Emphasis Species Dover sole, shortspine thornyhead, longspine thornyhead, and sablefish comprise a deepwater assemblage (DTS) managed as a complex under the FMP. These species occur primarily over soft bottom on the slope. Shortspine thornyhead also co-occur with Pacific ocean perch, darkblotched, splitnose, redbanded and rougheye rockfishes.

Pacific ocean perch occur on the upper slope (109-150 fm) during the summer and somewhat deeper (164-246 fm) during the winter. Adults sometimes aggregate up to 16 fm above hard-bottom features and may then disperse and rise into the water column at night. Most adult darkblotched rockfish are associated with hard substrates on the lower shelf and upper slope at depths between 77 and 200 fm. As mentioned above, spot prawns are also associated with hard bottoms.

The list of common groundfish species inhabiting hard and soft substrates in the Slope Environment is given in Table 3.3.7. Other fish and shellfish species relevant to groundfish bycatch are also included.

Table 3.3.7. Species associations in the **Slope Environment**. Emphasis species are shown in bold; minor species are not included.

HARD SUBSTRATES	SOFT SUBSTRATES
Pacific Ocean Perch **Darkblotched Rockfish** **Spot Prawn** Aurora Rockfish Bank Rockfish Blackgill Rockfish Rougheye Rockfish Sharpchin Rockfish Shortraker Rockfish Yellowmouth Rockfish	**Sablefish** **Longspine Thornyhead** **Shortspine Thornyhead** **Dover Sole** Bank Rockfish Redbanded Rockfish Rougheye Rockfish Splitnose Rockfish

3.3.5.4 Pelagic Environment

The pelagic environment includes waters overlying the slope, shelf, and nearshore environments, all along the West Coast EEZ. Emphasis species that commonly occur in the pelagic environment include two overfished species, as well as market squid, mackerels, sharks, eulachon, and 16 protected species/species groups. The overfished groundfish species is widow rockfish (Pacific whiting is no longer overfished). The protected species include Steller sea lion, California sea lion, harbor seal, harbor porpoise, Dall's porpoise, Pacific white-sided dolphin, short-beaked common dolphin, long-beaked common dolphin, northern elephant seal, black-footed albatross, Laysan albatross, cormorants, northern fulmar, gulls, chinook salmon and coho salmon. California's protected species also include marbled murrelet, Xanthus murrelet, and rhinoceros auklet.

Habitat The California Current System and climate are the most influential factors in determining the diversity and distribution of marine life in the pelagic environment. Currents and climate off the West Coast are briefly described earlier in Section 3.2. The California current generally moves from north to south along the West Coast, transporting cooler water toward the equator. It flows near the coast north of Point Conception during most of the year, except in winter when southeast winds force it farther offshore, producing the Davidson Current that flows north near the coast. In some years, this counter current is stronger than normal and is forced as far north as British Columbia, Canada. South of Point Conception, in the Southern California Bight, the coast bends sharply to the east. There, the California Current breaks away from the coast and flows offshore along the continental edge until it swings back toward the mainland south of San Diego. In the Southern California Bight, the usual surface flow, called the California Countercurrent, moves north along the coast resulting in a counterclockwise gyre that mixes offshore and nearshore surface waters off southern California (Leet, *et al.* 2001).

Temperature is the most commonly correlated climatic variable used to determine associations with biological processes. The colder, northern waters are good habitat for sub-arctic and cold-temperate species, such as Dungeness crab, Pacific salmon, and petrale sole. The warmer, southern waters are suited to warm-temperate and sub-tropical species, such as California halibut and spiny lobster. The offshore environment is often more stable than nearshore and estuarine environments, where the distribution of warm and cold waters can be highly variable. For example, average monthly sea surface temperatures offshore of San Francisco indicate a distinct summer upwelling pattern with cold sea surface temperatures nearshore, as well as large yearly variations. Within this strong upwelling cell, sea surface temperatures can be colder during the summer in cold years than they are during the winter in warm years (Leet, *et al.* 2001). Local physical processes including intense winds, extended periods of calm, infusions of freshwater runoff, and currents also greatly affect the growth, survival and distribution of many marine species. In addition, seasonal-scale influences are so important to many species that their life cycle is often largely adapted to these seasonal cycles.

Biological Associations Many marine species in the pelagic environment are sub-arctic and cold-temperate species, others are warm-temperate or sub-tropical and still others prefer nearshore areas, perhaps living on land at times. In addition, some pelagic species commonly occur all along the West Coast. Consequently, these species are grouped into northern offshore, southern offshore, and/or nearshore categories to approximate species associations.

Few groundfish species are considered pelagic: Pacific whiting, Pacific cod, widow rockfish, yellowtail rockfish, shortbelly rockfish, soupfin shark, leopard shark and spiny dogfish. Some marine mammals are residents (e.g., seals, California sea lions) and others are migrants (gray and humpback whales). Groundfish species provide an important prey source for most marine mammals. Seabirds can search large expanses of the ocean for prey and generally take the most abundant and high energy prey available, especially sardines, herring, smelt, anchovies, squid, some crustaceans and juveniles of many larger fish species. Some seabirds feed near the surface, especially on large fish schools, and others may dive for their prey. More detailed information about the life histories and distributions of the numerous seabirds and marine mammals found on the West Coast is provided in Appendix B. Although protected species are wide-ranging, their distributions have been categorized as primarily northern offshore, southern offshore and/or nearshore and included in the species associations listed in Table 3.3.8 for the Pelagic Environment.

Emphasis Species Pacific whiting forms very large aggregations and migrates long distances between feeding grounds off the northern coast and winter spawning grounds off southern California. Pacific whiting and widow rockfish can co-occur; midwater trawl fisheries for Pacific whiting also catch widow and yellowtail rockfish and sometimes small quantities of canary, darkblotched, and yelloweye rockfish, Pacific ocean perch, and lingcod. Widow rockfish sometimes form large schools, sometimes associated with bottom features. At other times, they may be dispersed in mid waters or on the bottom. Adults are often caught with yellowtail rockfish off Washington.

Relevant species of other fish, shellfish, and squid include jack mackerel, Pacific mackerel, market squid, and walleye pollock. Fisheries for these species may take groundfish species, especially some overfished species, vice versa. In addition, the coastal pelagic species provide an important prey source for Pacific whiting and other marine species. At times, fisheries for Pacific whiting have taken chinook and coho salmon as bycatch and pelagic sharks, such as the common thresher shark, may be vulnerable to capture in groundfish fisheries.

The list of common groundfish species inhabiting offshore and nearshore waters in the Pelagic Environment is given in Table 3.3.8. Other fish and shellfish species relevant to groundfish bycatch are also included. All of the protected species of salmon, marine mammals, sea turtles, and sea birds that have been identified as potentially vulnerable as bycatch (takes) in groundfish fisheries off the West Coast are included in this list.

Table 3.3.8. Species associations in the **Pelagic Environment**. Emphasis species are shown in bold; minor species are not included.

NORTHERN OFFSHORE	SOUTHERN OFFSHORE	NEARSHORE
Widow Rockfish **Pacific Whiting** **Jack Mackerel** **Walleye Pollock** **Thresher Shark** **Chinook Salmon** **Coho Salmon** **Stellar Sea Lion** **California Sea Lion** **Dall's Porpoise** **Harbor Porpoise** **Pacific White-Sided Dolphin** **Northern Elephant Seal** **Black-Footed Albatross** **Laysan Albatross** **Northern Fulmar** **California Gull** **Bonaparte's Gull** Shortbelly Rockfish Soupfin and Blue Sharks Spiny Dogfish Eulachon Northern Fur Seal Risso's Dolphin Short-Finned Pilot, Gray, Minke, Sperm, Humpback, Fin, and Killer Whales Leatherback Sea Turtle Short-Tailed Albatross Arctic, Common, and Black Terns Marbled, Xantu's, and Ancient Murrelets Fork-Tailed, Leach's, Sooty, Short-Tailed, Pink-Footed, Flesh-Footed, and Buller's Shearwaters Pomarine, Parasitic and Long-Tailed Jaegers Black-Legged Kittiwake Common Murre Pigeon Guillemot Parakeet, Rhinoceros, and Cassin's Auklets Horned and Tufted Puffins South Polar Skua	**Widow Rockfish** **Pacific Whiting** **Market Squid** **Jack Mackerel** **Pacific Mackerel** **Thresher Shark** **Stellar Sea Lion** **California Sea Lion** **Dall's Porpoise** **Harbor Porpoise** **Pacific White-Sided Dolphin** **Short-Beaked Common Dolphin** **Northern Elephant Seal** **Black-Footed Albatross** **Laysan Albatross** **California Gull** **Bonaparte's Gull** Shortbelly Rockfish Soupfin, Blue, and Shortfin Mako Sharks Spiny Dogfish Chinook and Coho Salmon Guadalupe and Northern Fur Seals Risso's Dolphin Short-Finned Pilot, Gray, Minke, Humpback, Blue, Fin, Killer, and Sei Whales Loggerhead, Green, Leatherback, and Olive Ridley Sea Turtles California brown pelican Short-Tailed Albatross Arctic, Common, and Black Terns Marbled, Craveri's, Xantu's and Ancient Murrelets Black, Fork-Tailed, Ashy, Least, Galapagos, Wilson's and Leach's Storm-Petrels Townsend, Black-Vented, Wedge-Tailed, Sooty, Short-Tailed, Pink-Footed, and Bugler's Shearwaters Polarize, Parasitic and Long-Tailed Gaugers Black-Legged Kittiwake Common Murre Pigeon Guillemot Rhinoceros and Casein's Auklets Horned and Tufted Puffins South Polar Skua	**Jack Mackerel** **Pacific Mackerel** **Chinook Salmon** **Coho Salmon** **California Sea Lion** **Harbor Seal** **Dall's Porpoise** **Harbor Porpoise** **Long-Beaked Common Dolphin** **Black-Footed Albatross** **Brandt's Cormorant** **Double-Crested Cormorant** **Pelagic Cormorant** **Glaucous Gull** **Glaucous-Winged Gull** **Western Gull** **Herring Gull** **California Gull** **Thayer's Gull** **Ring-Billed Gull** **Mew Gull** **Heerman's Gull** **Bonaparte's Gull** **Sabine's Gull** Soupfin Shark Spiny Dogfish Pacific Angel Shark Pacific Herring Eulachon Southern Sea Otter, Sea Otter Risso's Dolphin Fin and Killer Whales California Brown Pelican Black, California Least, Caspian, Forster's, Gull-Billed, Royal and Elegant Terns Marbled Murrelets Wedge-Tailed Shearwater Parasitic Jaeger Black-Legged Kittiwake Common Murre Pigeon Guillemot Rhinoceros Auklet Black Skimmer

3.3.5.5 Nearshore Environment

The nearshore environment extends from the high tide line seaward to 20 fm, from the US/Canada border on the north to the US/Mexico border on the south. It also includes estuarine habitats along the West Coast.

Emphasis species that commonly occur nearshore include cabezon, Dungeness crab, and California halibut. Associations among these and other species, as well as habitat in the nearshore environment, are more fully described below.

Many protected species occur in the nearshore environment, but most are highly mobile and are frequently found in offshore areas, as well. To capture their wide distribution, they are considered as part of the pelagic environment (Section 3.3.5.4).

Habitat The nearshore environment is comprised of a variety of habitats ranging from high-relief rocky reefs to broad expanses of sand and mud. The diversity of physical habitat in the nearshore environment is similar to that of the continental shelf, but being shallower, sunlight, tides, and waves are also important features. Intertidal and subtidal plant communities are highly productive and provide food and shelter for a wide variety of fish, shellfish, and invertebrates. The dominance and diversity of species varies latitudinally with temperature, as well as levels of solar radiation, wave exposure, rainfall and tidal range.

San Francisco Bay, Willapa Bay, and Grays Harbor are large estuaries and important nursery areas for many species of fish and shellfish. Flows from the Columbia River and Strait of Juan de Fuca influence the variety of marine life and are seasonally affected by the direction of the current system off the West Coast.

Biological Associations Nearshore areas north of Cape Mendocino are often dominated by black rockfish, cabezon, redtail perch, and night and surf smelt. Quillback and china rockfish, kelp greenling, and monkeyface prickleback are common in northern nearshore areas, but rarely seen in southern areas. South of Cape Mendocino, where rocky-reef habitat dominates, kelp beds are home to a variety of nearshore rockfish, abalone and sea urchins. California scorpionfish, black-and-yellow, gopher, grass, kelp, olive and calico rockfishes, and treefish are common in southern nearshore areas, but uncommon in northern areas.

Estuaries provide nursery areas for California halibut, surfperches, Dungeness crab, leopard sharks, starry flounder, and other marine species.

Emphasis Species Cabezon commonly inhabit rocky bottoms and kelp beds, although they may also be found on sandy and mud bottoms. To spawn, they deposit eggs in shallow waters on bedrock or in crevices. Adult black rockfish are semi-pelagic and commonly associated with kelp forests and rocky pinnacles. They frequently form midwater schools, but at other times they may be on the bottom. Adults are often caught with other fish, such as yellowtail and widow rockfish. Lingcod is an overfished groundfish species that is common in nearshore areas, and has been considered as an emphasis species in the Northern Shelf Environment (Section 3.3.5.1).

California halibut and Dungeness crab are abundant on sandy bottoms in the southern and northern nearshore environment, respectively. Both species co-occur with a variety of flatfishes may be taken as bycatch in some fisheries for groundfish. California halibut is commonly associated with white seabass. Dungeness crab, through all its life history stages, is an important prey species for many groundfish.

The list of common groundfish species inhabiting rocky and non-rocky substrates in the Nearshore Environment is presented in Table 3.3.9. Other fish and shellfish species relevant to groundfish bycatch are also included in the list among the emphasis species.

Table 3.3.9. Species association in the **Nearshore Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Cabezon **Black Rockfish** Lingcod Kelp Greenling Black-and-Yellow Rockfish Blue Rockfish Brown Rockfish Calico Rockfish California Scorpionfish China Rockfish Copper Rockfish Gopher Rockfish Grass Rockfish Kelp Rockfish Olive Rockfish Quillback Rockfish Treefish Vermilion Rockfish	**California Halibut** **Dungeness Crab** California Scorpionfish Pacific Sanddab Rock Sole Sand Sole Starry Flounder White Seabass Spiny Dogfish California Skate Big skate Rays

3.4 The Social and Economic Environment

This section describes the human activities that directly relate to or are dependent on the groundfish resources. Table 3.4.1 identifies the most relevant components of the human environment. These components are described, focusing on those aspects (impact variables) that are predicted to change under the various alternatives. One of the most important considerations is the incentives that lead to bycatch and those that lead to bycatch avoidance and using more of what is caught. The most relevant human components of the affected environment include groundfish harvesters, seafood processors, fishing communities, seafood consumers, and the general public. Bycatch and bycatch mitigation measures (rules made to avoid and reduce bycatch) affect each of these components. In addition, bycatch mitigation measures affect fishing vessel safety and public costs to administer and enforce the fishery management program.

Information sources to characterize the groundfish industry and fishery included Leet *et al.* (2001), and several recent PFMC documents including the FEIS for the 2004 Annual Optimum Yield Specifications and Management Measures, Groundfish FMP Amendment 17 for Multi-Year Management (PFMC, 2003a),

Table 3.4.1. Socioeconomic Components of the Human Environment and Impact Assessment Variables.

Component of the Human Environment	Impact Assessment Variables
Incentives and disincentives regarding bycatch	The benefits and costs to fishers of avoiding and/or discarding fish
Commercial harvesters	Production levels of different sectors; ex-vessel revenues and operation expenses (average costs); distributional effects among commercial harvesters such as changes in level of dependence and involvement; effects on other fisheries.
Recreational fisheries	Value of the recreational experience
Tribal fisheries	Fulfillment of ceremonial and subsistence needs; revenues and costs
Buyers and processors	Gross product revenues and operation expenses (average costs)
Communities	Employment and income
Consumers of groundfish products and other members of the general public	Product prices, quality and availability; non-consumptive and non-use values
Fishing vessel safety	At-sea fatalities and injuries
Management and enforcement costs	At-sea and dockside monitoring and enforcement costs; practicability and administration costs

and the Environmental Assessment for a Vessel Monitoring System of Groundfish Fisheries (PFMC, 2003b).

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. In addition, seafood buyers and processors depend on groundfish harvests. Fishing communities are made up of fishers, processors, and supporting infrastructure such as gear suppliers, grocery suppliers, other enterprises, housing and other typical community services.

Non-tribal commercial fisheries include those that target groundfish, which for the most part are regulated under a license limitation program (limited entry) implemented in 1994, and fisheries that target other species. From November 2000 through October 2001, 4,579 vessels participated in West Coast commercial fisheries. Of these, 1,341 vessels (37% of the fleet) landed some groundfish. At the beginning of 2003, there were about 500 vessels with Pacific coast groundfish limited entry permits, of which approximately 55% are trawl vessels, 40% are longline vessels, and 5% are pot/trap vessels. (In December of 2003, 92 trawl permits were eliminated through a government/industry buyback program.) Vessels without limited entry permits are categorized as open access because no federal groundfish permit is required for their activities, although some target groundfish species at least part of the time. Gears used by participants in open access commercial fisheries include longline, vertical hook-and-line, troll, pot, setnet, trammel net, shrimp and prawn trawl, California halibut trawl, and sea cucumber trawl gears.

The groundfish limited entry program applies to bottom and midwater trawl, longline, and trap (or pot) gears. Each limited entry permit is endorsed for a particular gear type and that gear endorsement cannot be changed, so the distribution of permits among gear types has been fairly stable. Each permit also has a vessel length endorsement. The total number of permits has typically changed only when multiple permits have been combined to create a new permit with a longer length endorsement. However, in December 2003 a buyback program permanently retired 92 trawl permits, roughly 35% of the total. Limited entry permits can be sold and leased out by their owners, so the distribution of permits among the three states often shifts. At the beginning of 2003, roughly 39% of the limited entry permits were assigned to vessels making landings in California, 37% to vessels making landings in Oregon, and 23% to vessels making landings in Washington.

The Council allocates harvest specifications (OYs) between the limited entry and open access categories. Most of the Pacific coast commercial groundfish harvest is taken by the limited entry fleet.

Commercial harvest rates of groundfish are constrained by annual harvest guidelines, two-month or one-month cumulative period landing limits, individual trip limits, size limits, species-to-species ratio restrictions, and other measures. This program is designed to control effort so that the allowable catch is taken at a slow enough rate to stretch the season over the full year. Cumulative period catch limits are set by comparing current and previous landings rates with the year's total available catch and predicted participation.

Participants in marine recreational fisheries fish from private and Commercial Passenger Fishing Vessels (CPFV)/charter vessels, as well as from shore. CPFV/charter vessels are vessels for hire that are typically larger and can fish farther offshore than most vessels in the private recreational fleet. Both nearshore and shelf opportunities are important for West Coast recreational groundfish fisheries.

Members of the Makah, Quileute, Hoh, and Quinault tribes participate in commercial, ceremonial and subsistence fisheries for groundfish off the Washington coast. Participants in the tribal commercial fishery use similar gear to non-tribal commercial fishers who operate off Washington, and groundfish caught in the tribal commercial fishery is typically sold through the same markets as non-tribal commercial groundfish catch.

3.4.1 Incentives and Disincentives Regarding Bycatch

Bycatch occurs when a fisher fishes for any particular species and catches something else. Under the Magnuson-Stevens Act, nearly every marine species is classified as a fish, and any fish that is not kept is classified as bycatch. The Magnuson-Stevens Act sets the highest priority as avoiding catching anything that would not be kept, especially if it would die as a result of being captured. There is also a clear priority to prevent injury and death as much as possible. Finally, if something is caught and is dead or will inevitably die, it should be used if practicable. In the groundfish fishery, trip limits are intended and used to keep harvest rates low enough through the season so the limits are not reached too early. This would be effective if fishers could always catch the right fish in the right amounts, but that is impossible in a fishery of more than 80 species, plus all the other marine creatures. The only way to avoid catching something is to not fish, or at least not fish where that species is present. The more one fishes where the fish live, the more will be caught (if he is using a type of gear that catches that species). Fishing where the fish are more abundant also increases the catch. The amount of fishing is called effort. The measure of how well the gear catches a particular species is called the selectivity or catching efficiency. These can be combined into a simple equation that describes how these are related:

$$\text{catch} = \text{effort} \times \text{selectivity} \times \text{abundance}$$

It is more appropriate to say catch is proportional to effort, selectivity and abundance, but the general relationships are the same. In simple terms, this equation says you will catch more fish if you fish harder (increase effort), use more efficient gear (increase selectivity), and/or the fish are more abundant. To reduce catch (or bycatch), reduce effort, reduce selectivity, or fish where they are less abundant. All bycatch mitigation tools work on one of these components. At the same time, it is important to keep in mind the following facts:

- **no fish species exists in isolation (they appear in assemblages or mixed groups)**
- **geographic distributions of any two or more species do not match exactly**
- **where two or more species occur in the same location or habitat, their abundances will be different**
- **a gear type is unlikely to be equally selective for all species; it will catch (or avoid) some better than others**

Taking these and other relevant factors into account, the question each fisher faces is how to catch the desirable species (the ones he wants) without catching undesirable species (ones he does not want). A slightly different angle to this question may be how to catch fewer of the undesirable fish. Another consideration is how to turn the undesirable fish into desirable/useable fish, that is, how to improve the value and use of those that cannot be avoided. A major bycatch management challenge is how to set the incentives and disincentives to get the best results at the least cost to the fishers.

Under the current management regime, quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely.

Incentives and disincentives relating to bycatch are discussed in greater detail in Section 4.1.5.

3.4.2 Commercial Harvesters

Commercial fishing 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 salmon, shrimp, crab, or albacore, in addition to various high-value groundfish species.

The total amount of groundfish landed in West Coast groundfish fisheries increased from under 200 million pounds in 1987 to a peak in 1996 of over 300 million pounds (Figure 3.18). However, revenues to the commercial fleet have declined significantly in recent years. While landings of Pacific whiting increased during this period, landings of other West Coast groundfish, primarily rockfish and deepwater flatfish species, have declined by nearly 50%. This general decline in groundfish landings other than whiting has been driven by declining stocks of major target species primarily rockfish—several of which have been declared overfished. Part of the decline in landings has been due to reduced harvest of the particular overfished stocks. However, a large part of the overall reduction is due to constraints on harvests of healthier stocks in order to prevent bycatch of overfished stocks.

The decline in landings of non-whiting groundfish has had a significant adverse economic impact on a number of harvesting sectors.

Table 3.4.4Groundfish landings, excluding at-sea whiting, 1987 - 2000. (PacFIN data).

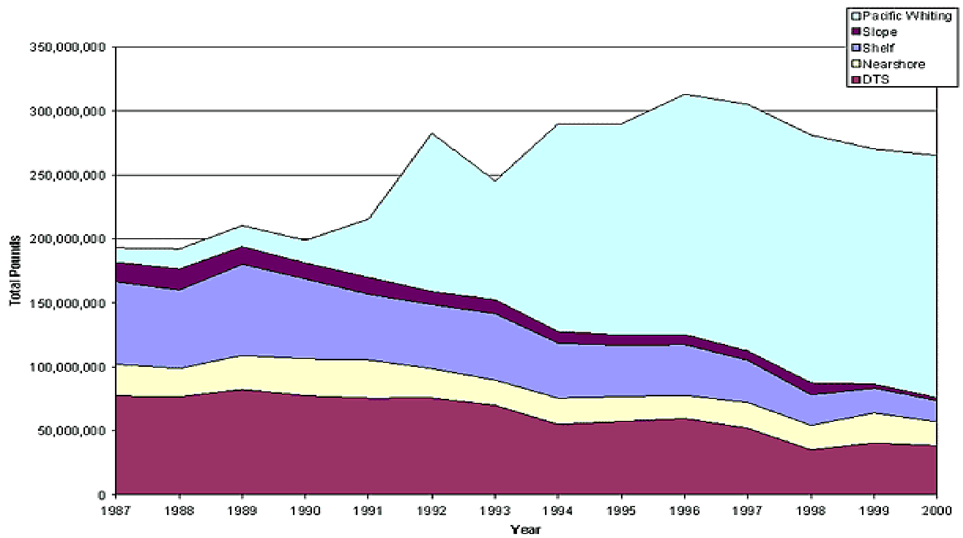


Table 3.4.2 shows exvessel revenues in the West Coast groundfish fisheries (excluding the Pacific whiting fishery) for the years 1999-2002. In general, revenues increased in 2000 by 9% from 1999 levels, then dropped by 16% in 2001 and another 16% in 2002. The declines were greater in the limited entry sector than in the open access sector. Within the limited entry sector, fixed-gear revenues fell by a greater percentage than trawl revenues, primarily due to reduction of the sablefish OY and reduced access to nearshore rockfish.

Table 3.4.2. Exvessel revenues in the groundfish fisheries (excluding the Pacific whiting fishery) by sector, 1999-2002.

	1999	**2000**	**2001**	**2002**
Sector	**Exvessel Revenues ($1,000)**			
Limited Entry Non-Trawl	9,814	10,946	8,693	6,852
Limited Entry Trawl	32,634	34,032	28,257	24,010
Open Access (All)	7,762	8,732	8,254	7,161
Total	**50,210**	**53,710**	**45,205**	**38,023**

Source: Data provided by the Pacific Coast Fisheries Information Network (PacFIN).

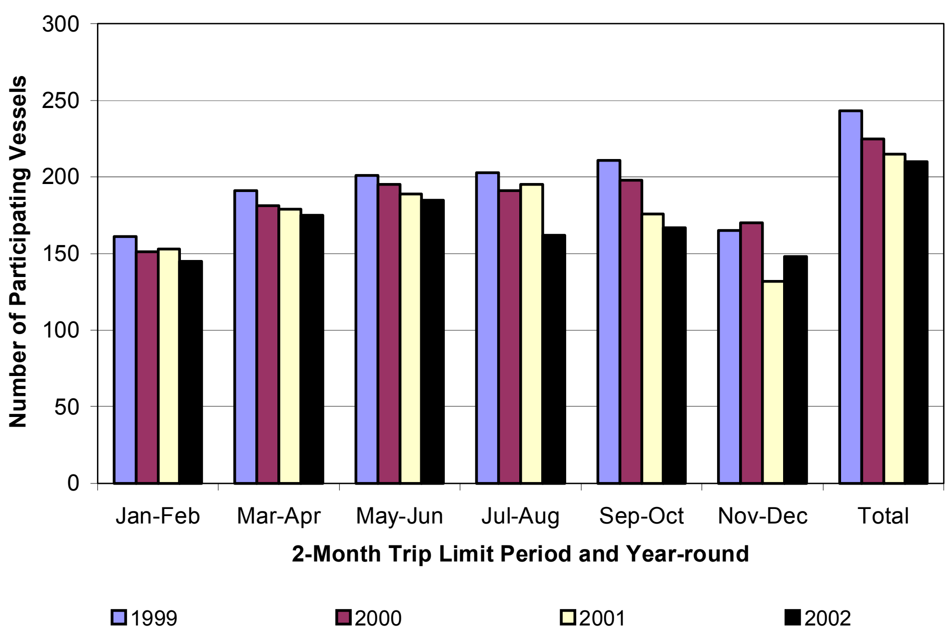
3.4.2.1 Limited Entry Trawl Fisheries

Limited entry trawl fishers target many different of the more than 80 groundfish species, with the largest landings by volume (other than Pacific whiting) of Dover sole, sablefish, thornyheads, widow rockfish, and yellowtail rockfish. Taken as a whole, the 62 rockfish species have made up the largest volume of non-whiting landings in the Pacific coast commercial groundfish fishery. Trawlers take the vast majority of the groundfish harvest by weight and value. In 2001, groundfish trawlers landed 97% of total groundfish harvest by weight (including whiting) but only 75% by value. Trawling is much more dominant north of Cape Mendocino, California (the Vancouver, Columbia, and Eureka management areas) than south of Cape Mendocino (Monterey and Conception areas).

Figure 3.19 shows the seasonal participation pattern of limited entry trawl vessels, except those vessels that participated exclusively in the Pacific whiting fishery. Participation by the non-whiting trawl sector is spread out more evenly over the six 2-month periods in comparison to the participation seen in the fixed gear sector. While there has been a decline in participation by the non-whiting trawl sector during the 4-year period, the decline is relatively small. However, the trawl buyback program approved in late 2003 eliminated 92 trawl permits, so participation will change significantly in 2004.

In addition to these mixed-species fisheries, there is a distinct mid-water trawl fishery that targets Pacific whiting. This fleet includes catcher boats that deliver to shore-based processing plants, vessels that deliver to at-sea processor ships,

Table 3.4.4Limited entry trawl vessel participation by period and year, 1999-2002, excluding whiting-only vessels. Source: PacFIN data.



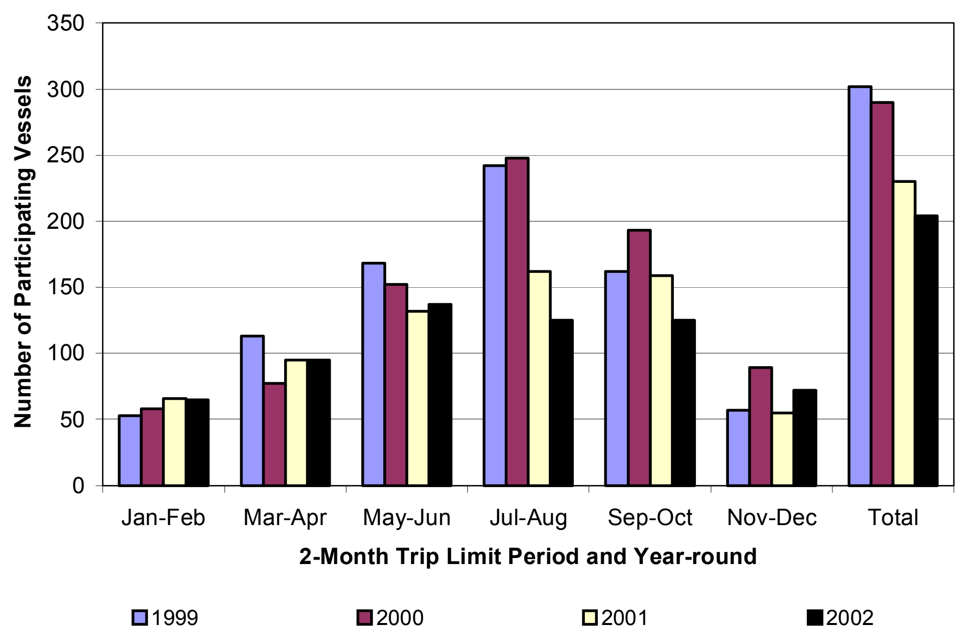
and catcher-processor vessels. Pacific whiting landings are significantly higher in volume than any other Pacific coast groundfish species. In 1998, whiting accounted for approximately 66% of all Pacific coast commercial groundfish shoreside landings by weight. However, whiting commands a relatively low price and accounts for only about 9% of commercial groundfish shoreside landings by value.

3.4.2.2 Limited Entry Fixed-gear Fisheries

Limited-entry fixed-gear vessels use longline or trap (pot) gear. Sablefish has long been an important target species in this sector; however, some shelf and slope rockfish species have also been important and valuable targets. In recent years, nearshore rockfish and other species have been harvested by the live-fish fishery. Although about 230 fixed-gear permits are issued, only about 180 vessels are active in a given year.

Figure 3.20 shows limited entry fixed-gear vessel participation from 1999 through 2002. During the 4-year period, the number of unique limited entry vessels participating in the groundfish fishery declined from 302 in 1999 to 204 in 2002. Declines in participation have been most noticeable during the summer months—in the July-August period the number of participating vessels declined from 242 to 142. The establishment of a sablefish permit endorsement, the tier system, and ability fixed gear vessels to stack permits have facilitated a reduction in fleet capacity.

Table 3.4.4Limited entry fixed-gear vessel participation by period and year, 1999-2002. Source: PacFIN data.

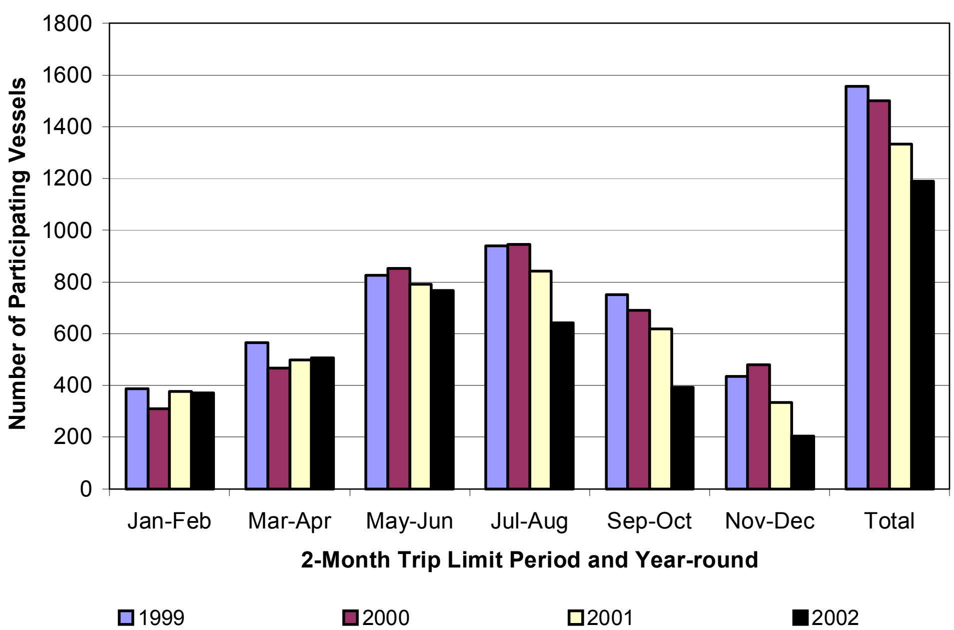


While non-trawl vessels took only 2% of the coastwide groundfish harvest by weight, their harvest accounted for about 25% of the exvessel value due to the prevalence of relatively high value sablefish and live fish landed in this fishery. When whiting is excluded from the totals, non-trawl landings are 10% to 12% by weight and 25% to 27% by value (percent of coastwide total groundfish excluding whiting).

3.4.2.3 Open Access – Directed Groundfish Fishery

Several thousand vessels without limited entry permits have made commercial groundfish landings since the limited entry program went into effect in 1994. Many open access fishers have traditionally targeted groundfish, while others catch groundfish incidentally in other target fisheries. Most open access vessels targeting groundfish use hook-and-line gear for sablefish, rockfish, and lingcod. Others use pot gear, primarily for sablefish and some rockfish species. In southern and central California, some vessels have used setnet gear to target rockfish, including chilipepper, widow rockfish, bocaccio, yellowtail rockfish, olive rockfish and, to a lesser extent, vermilion rockfish. Setnet gear is rarely used now due to area and species restrictions and the greater value of live fish. (Fish caught with setnets usually are dead before the nets are retrieved.) From 1999 through 2002, approximately 1,200 to 1,500 vessels per year made small groundfish landings (Figure 3.21). In 2003 (not shown) the number was substantially less. The seasonal fishing pattern is similar to that seen in the limited entry fixed gear sector, with higher levels of participation during the summer months, but some level of participation throughout the year. In 1999,

Table 3.4.4Open access vessel participation by period and year, 1999-2002. Source: PacFIN data.



about 1,000 open access vessels landed their catch in California, about 400 in Oregon, and about 100 in Washington. Since 1999, commercial fishers in California have been required to purchase a nearshore fishery permit to land shallow nearshore rockfish, California scorpionfish, cabezon, greenlings, and California sheephead. This has resulted in a substantial decrease in the number of open access vessels landing these groundfish from 1,100 in 1999 to 202 in 2003.

It is difficult to determine whether an open access vessel targets groundfish or targets other species, because fishing intentions or strategies are not explicitly reported. In this EIS, a given trip or vessel is considered to target groundfish 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. Other commercial fisheries taking groundfish are described below in the section titled "Other Fisheries That Affect Groundfish (Open Access Non-groundfish Fisheries")

In the directed open access fishery, fishers target groundfish in the dead and/or live fish fishery using a variety of gears. The terms dead and live fish fisheries refer to how the fish are landed and sold. The dead fish fishery has historically been the most common way to land fish and made up 80% of the directed open access landings by weight coastwide in 2001. More recently, the greater market value for live fish has led to increased landings of live groundfish. Fish are caught using pots, stick gear, and rod-and-reel, and kept aboard the vessel in a seawater tank, to be delivered to fresh markets—such as the large Asian-American communities in California—that pay a premium for live fish. Determining landings from this fishery is difficult because fishing intentions or strategies are not known. In practice, only those sales of species other than sablefish that garner a landed price above $2.50 per pound are classified in the live fish sector. Using this criterion, 20% of coastwide directed open access landings by weight in 2001 are considered live fish, compared to only 6% in 1996. This growth in landings may be attributed to the price premium awarded live fish.

3.4.3 Recreational Fisheries

Recreational fishing has been part of the culture and economy of West Coast fishing communities for more than 50 years (PFMC, 2003d). Recreational fishing is conducted from shore, such as beaches, banks, piers, docks, and jetties and from boats, including private, rental, party and charter boats. Groundfish are both targeted and taken incidentally when other species, such as salmon, are targeted. Historically, most recreational fishing along the northern coast targeted salmon and groundfish, especially rockfish, were taken incidentally. Recreational fishing in the open ocean has been on an increasing trend since 1996; however, charter effort has decreased while private effort increased during this period. Coastwide, about twice as many angler trips for groundfish were taken by private anglers (1.33 million) as charter anglers (0.63 million) in 2001. Of these trips, 33,000 private angler trips for groundfish were taken off Washington and Oregon combined, with the remaining 1.3 million trips taken off California. Similarly, a total 59,000 angler trips aboard charter vessels were taken off Washington and Oregon in 2001 and 569,000 private angler trips for groundfish were taken off California. Angler trips for groundfish comprised 43% of all charter trips but only 16% of all private trips. Along the northern coast, recreational fishing traditionally targeted salmon, but rockfish and lingcod often provided a bonus to anglers.

The estimated number of recreational marine anglers in Southern California was two and a half times the number in the next most numerous region, Washington state. While the bulk of recreational fishers in all areas were residents of those areas, a significant share were non-residents. Oregon had the greatest share of non-resident fishers at more than one-fifth of total ocean anglers.

While the contribution of groundfish catches to the overall incentive to engage in a recreational fishing trip is uncertain, it seems likely that the possibility or frequency of groundfish catch on a trip adds to overall enjoyment and perceived value. Some effort shift from salmon to groundfish likely occurred around 1996, when salmon seasons were shortened.

Fishing effort, both private and charter, is related to weather, with relatively more effort occurring in the milder months of summer and less in winter. This seasonal trend is more pronounced in higher latitudes, although the reasons include opportunity as well as climate. Salmon seasons are longer in California than in Oregon, which in turn are longer than in Washington. Groundfish seasons, until recently were also more restrictive in Washington; the lingcod season is closed from November through March.

In 2001, the estimated total catch of all groundfish species coastwide was similar for charter (1,445 mt) and private recreational anglers (1,632 mt). About half of these catches were made up of nearshore rockfish species, followed by lesser amounts of shelf rockfish, other nearshore groundfish and lingcod.

3.4.4 Tribal Communities and Fisheries: Social, Economic and Historical Information about West Coast American Indian Groundfish Fisheries[2/]

Four Indian tribes in Western Washington exercise treaty rights to harvest groundfish and other marine species in the Pacific Ocean off the northwest coast of the U.S.: the Hoh, Makah, and Quileute Tribes and the Quinault Indian Nation. Each has reservation lands, but their fishing is not confined to the reservation. Each of these tribes has USUAL AND ACCUSTOMED FISHING AREAS (U & A) that extend into the groundfish fishery management area (FMA). Information relating to Treaty rights and litigation is provided in Appendix C.

In pre-treaty times, Native American settlements were widely dispersed throughout Western Washington. Coastal tribes fished and hunted various species of fish, shellfish, and marine mammals for sustenance and trade. They took these species from ocean waters, beaches, and rivers. Fish were vital to the Indian diet and played an important role in tribal ceremonial and religious practices as well as the native economy.

The sea and waterways provided major advantages to Indian existence. The Indians invariably lived next to waterways, traveled on them, and depended on the resources of the waters for their major livelihood. Some of the coastal groups engaged in marine hunting on the open sea and in the Straits of Juan de Fuca. Saltwater and/or freshwater fishing was actively pursued by virtually every adult male throughout the area. Fishing was the universal male occupation.

The water resources were rich, but with tremendous local diversity. Types of marine life differed in the open sea, in bays, rivers and lakes. Topographic features such as depth of water and nature of bottom or shoreline predicated presence or absence of specific species in a given locale. Availability varied not only from area to area, but also seasonally. This depended not only on presence or absence of a given species in local waters at different times of the year, but also on seasonal availability of suitable bait. Furthermore, storms, rough seas, and fog made fishing impossible at certain times. In addition to area and seasonal variations, there was considerable fluctuation in abundance and availability from year to year. Some of this was regular and predictable, as in the case of runs of certain species and races of salmon. Other causes were erratic, such as flooding and alterations in watercourses.

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2. Sources for this section include American Indian Reservations and Trust Areas, 1996 (updated 2000); U.S. Census of 1990 and 2000; Lane PhD; National Park Service "Tribes of the Olympics;" Jim Harp personal communication; "*Land of the Quinault*" published in 1990 by the Quinault Indian Nation; and Craig Bowhay (NWIFC).

Tribal communities used a wide variety of fish, wildlife, and plants for food, medicines, and trade. Food was unevenly distributed over space and time. The successful and efficient use by tribal communities required an intimate knowledge of local environments and the locally available species and a repertoire of specialized taking techniques. In the case of fishing, gear and techniques were specific not only to a species but also to water conditions.

Fishing methods varied according to the locale, but generally included trapping, dip-netting, gill-netting, reef-netting, trolling, long-lining, jigging, set-lining, impounding, gaffing, spearing, harpooning, raking and so on. Species of fish taken included salmon and steelhead, halibut, cod, flounder, ling cod, rockfish, herring, smelt, eulachon, dogfish, trout, crab, clams, seals, otters, whales and many others. Throughout most of the area, salmon was the staple food and the most important single food resource available to the native population. Western Washington tribes traded fish with each other and with tribes across the Cascade Mountains during treaty times.

The initial effect of the influx of non-Indians into western Washington was to increase the demand for fish both for local consumption and for export. Almost all of this demand, including that for export, relied on Indians to supply the fish. Non-Indians did not engage as fishing competitors on any scale until the late 1870s.

Available evidence suggests that Indian fishing increased in the pre-treaty decade for three major reasons: (1) to accommodate increased demands for local non-Indian consumption and for export; (2) to provide money for the purchase of introduced commodities like calico, flour, and molasses; and (3) to obtain substitute non-Indian goods for native products no longer available because of non-Indian movement into the area.

Customary use rights varied according to the type of locale and the gear being used. Techniques such as spearing or trolling in saltwater, which involved individual effort, were not regulated or controlled by anyone else. The deeper saltwater areas, Puget Sound, the straits, and the open sea, served as public thoroughfares, and as such, were used as fishing areas by anyone traveling through such waters. However, both within the straits and off the West Coast in the open sea, there were halibut banks known to the Indians, used by them, and claimed as private property.

3.4.4.1 The Hoh Tribe

The 443-acre Hoh reservation is located in Jefferson County, on the Pacific Coast of northern Washington. The reservation lies within the boundaries of the Olympic National Park, and in the area of the Hoh River drainage system. The Hoh River empties into the Pacific and serves as the reservation’s northern boundary. The Hoh U&A within the FMA is between 47°54'18"N (Quillayute River) and 47°21'00"N (Quinault River) and east of 125°44'00"W.

The Hoh people's principal freshwater fisheries were on the Hoh River and its tributaries from the upper reaches to the mouth. In treaty times, the Tribe's U&A fishing places included the entire Hoh river system and the Quillayute, Dickey, Bogachiel, Calawah, Soleduck, Queets and Quinault river systems. Their saltwater fisheries were in the area adjacent to Hoh Territory. The Hoh were primarily dependent on salmon for their staple food. Although they had a summer troll fishery in the coastal water, they relied on the fall runs in the river for their winter stores. The upriver fisheries were of strategic importance.

Prior to the treaties, the Hoh had devised fish taking techniques adaptable for a variety of water and weather conditions. They constructed artificial falls by placing hemlock logs across the smaller streams. During periods of high water, they would catch salmon below the falls with special falls nets. They observed certain rituals to assure continued fish runs.

Currently, Hoh tribal members harvest shellfish, smelt, sturgeon, sablefish, rockfish, Dungeness crab, salmon (spring, summer fall chinook, and fall coho), steelhead, trout, and halibut within their U & A.

3.4.4.2 The Makah Tribe

The 27,950-acre Makah reservation is located on the northwestern tip of Washington's Olympic Peninsula in Clallam County. It includes Cape Flattery and Koitlah Point. Vancouver Island, Canada is across the Strait of San Juan de Fuca. The reservation lies 70 miles west of Port Angeles, and 17 miles from the nearest neighboring community, Sekiu. Unlike many other tribes in the U.S., the Makah Tribe still holds title to a substantial portion of their ancestral land base, engendering a high degree of continuity in both place-oriented identity and subsistence practice (Sepez 2000). The Makah U&A includes Washington state statistical area 4B and that portion of the FMA north of 48°02'15"N (Norwegian Memorial) and east of 125°44'00"W.

The Makah lived in 5 villages that were occupied all year long (Neah Bay, Ozette, Biheda, Tsoo-yess, and Why-atch). In addition, there were temporary residences at locations that attracted people seasonally. These places allowed Makah people to harvest and process special food resources such as halibut and summer salmon. Makah people made use of the abundant resources of the ocean, tidelands, forests, and rivers, and Makah fishermen and sea mammal hunters traveled far from the sight of land in large cedar canoes. They hunted whales in the open ocean, especially gray and humpback whales, and archaeological evidence indicates the Makah used other varieties of whales as well. Archaeological data indicate the Makah people hunted whales for some 2,000 years before the present. In addition to hunting whales, Makah hunters pursued a variety of seals and sea otters.

The Makah people created a thriving commercial maritime economy which was well established prior to 1855. Their wealth, power and culture depended on the sea; the Makah were primarily a seafaring people who spent their lives either on the water or close to the shore. Most of their subsistence came from the sea. They fished for salmon, halibut and other fish, and hunted for whale and seal. Halibut and whale were especially important. What they did not consume themselves, they traded to other tribes for many of the raw materials and some of the finished articles used in the daily and ceremonial life of the village. The Makah imported some basic needs such as housing materials and ocean-going canoes used for sea mammal hunting and ocean fishing. The Makah were fairly unique in their use of Pacific halibut, which were particularly abundant and available offshore. The Makah claimed ownership of the lucrative halibut fishing banks, and this ownership was respected by competing tribes. They had a highly developed technology capable of efficiently harvesting the resource, and intensive processing and marketing of the finished product. At the time of the treaties, the Makah people relied more heavily on halibut than on salmon or steelhead for their diet and trade. In addition to the marine products which the Makah consumed themselves and sold to other native people, they produced a considerable surplus for sale to non-Indians.

Currently, Makah tribal members harvest halibut, whiting, rockfish, lingcod, sablefish, flatfish, salmon, steelhead, sturgeon, shellfish, other groundfish, and gray whales within their U&A.

3.4.4.3 The Quileute Tribe

The 694-acre Quileute reservation is located entirely in Clallam County, Washington, on the south banks of the Quillayute River along the Pacific Ocean. It is surrounded on three sides by the Olympic National Park, and the fourth side of the Reservation is on the Pacific Ocean—First Beach. Just beyond the reservation lies Quillayute Needles National Wildlife Refuge. The surrounding waters also fall within the Olympic Coast National Marine Sanctuary. The Quileute Reservation encompasses the mouth and about one mile of mainstem of the Quillayute River and a jetty on its north side; and James Island and the small islands between the mouth and James Island, all of which are connected at low tide to the mainland. The headquarters for the tribe is in La Push, and most Quileute live in Clallam County; however, some enrolled members live in other counties of the state (e.g., adjacent Jefferson to the south) and even outside Washington. Virtually all of the lands surrounding the reservation are timberlands—the largest is Olympic National Park, then private large timber growers, with some small farms and resorts present, especially at Three Rivers, six miles away. The closest city is Forks, population about 2500, 15 miles away. Beyond Forks is more timber, private and state forests (WDNR), Olympic National Forest, and Olympic National Park. Small communities of perhaps a few hundred people are located along U.S. 101. The state's Olympic Experimental Forest was established in state forests of this region. The Quileute

U & A includes the FMA between 48°07'36"N (Sand Point) and 47°31'42"N (Queets River) and east of 125°44'00" W. The National Park Service operates Rialto Beach to the North and Second Beach and Third Beach to the South. These beaches fall within the Quileute Tribe's U & A Fishing Grounds.

The Quileute Tribe are descendants primarily of the Quil-leh-ute and other bands of Indians residing on the watershed of the Quileute and Hoh River systems. The Quileute culture was centered around the ocean, river, and forest. Whales, seals, and other marine animals were hunted and the rivers were fished for Quileute subsistence, ceremony and trade with other tribes. The last whaling days were held in 1910; the last seal days were in 1955. They used canoes for the ocean or river. At the time of the treaty, the Quileute (including the Hoh) relied primarily on salmon and steelhead taken in their long and extensive river systems. These Indians took canoes far up into the foothills country by following the river system, not only to take salmon and steelhead, but also to hunt land game in the foothills. The reliance on fish as a food staple is reflected in their calendar. Quileute Indian names for some months are related to fish or fishing activities, such as "Beginning of the spawning of the steelhead salmon" or "time for silver salmon." Quileute people continue to fish in rivers, lakes and the ocean. Fishing grounds in the river are still used by individual families, and those in the lakes and ocean continue to be used in common. Traditionally, they caught fish with drag nets, scoop nets and fish traps, fish baskets, dip nets, spears, hooks and lines. Quileute aboriginal fishing gear included a stake trap stretching across a stream with open spaces at intervals in which dip nets were suspended; triangular fish traps which often could catch a canoe-load of fish at a time; and sloping dams across a river along which dip or bag nets were suspended from the downstream side into which the fish would jump in their attempts to get over the dam.. Quileute today continue to use nets in the river and troll for salmon in the ocean, as well as using modern methods of fishing for groundfish, crab, and tuna, all of which are fished commercially. They collect bivalves and other invertebrates along the coast for ceremony/subsistence purposes.

Before, during and after treaty times, the Quileute (and Hoh) U&A fishing areas included the Hoh River from the mouth to its uppermost reaches, its tributary creeks; the Quillayute River, including its major tributaries—the Dickey River (and Lake Dickey), the Sol Duc River (and Lake Pleasant), the Bogachiel River, and Calawah River, and their respective tributary creeks; Lake Ozette, and adjacent tidewaters from Sand Point (north) to Queets River (south) and westward well into the open ocean. In the rivers, the Quileute caught salmon and trout species as well as herring and smelt. Along the adjacent Pacific Coast, Quileute people caught salmonids, smelt, rockfish, puggy, cod, halibut, flatfish, bullheads, devilfish, shark, herring, sardines, sturgeons, seal, sea lion, porpoise and whale. The Quileute had the canoes, the gear, and the expertise for an open-sea fishery many miles from shore. They also harvested Dungeness crab and a variety of invertebrates and littoral shellfish, including but not limited to anemones, sea cucumbers, razor clams, California and blue mussels, butter clams, and littleneck clams.

The Quileute Tribe has regulated its marine and freshwater fishery for many years. The Quileute today commercially harvest groundfish (including halibut, sablefish, lingcod, and rockfish), Dungeness crab, tuna, smelt, salmon, and steelhead from the marine environment. Seals, sea lions, bivalves (California and blue mussels, razor clams, littlenecks, and butter clams), and other invertebrates are harvested ceremonially and for subsistence. In fresh water, they harvest smelt, salmon, trout, and steelhead commercially as well as for ceremony and subsistence. Salmonids include chinook, coho, sockeye, steelhead, sea trout, and cutthroat trout.

3.4.4.4 The Quinault Indian Nation

The 208,150 acre Quinault Reservation is located in Grays Harbor and Jefferson Counties on the western shore of the Olympic Peninsula. The western boundary of the triangular reservation is the Pacific Ocean coastline, stretching about 26 miles. On the other sides, the Reservation is surrounded by a mixture of public and private lands. The northern boundary is primarily shared with the Olympic National Park and Olympic National Forest. Private land holdings border the south and southeastern boundaries. Much of the surrounding forest is managed for timber production by the Washington Department of Natural Resources and private interests. To the east lies Olympic National Park, and beyond it, Lake Quinault and a Forest Service wilderness area. The Olympic National Park was designated a Biosphere Reserve by UNESCO in 1976 and a World Heritage Site by UNESCO in 1981, based on an evaluation by the International Union for the Conservation of Nature.

The Reservation’s 26 miles of coastline is part of a unique, largely undeveloped, stretch of coastline widely recognized for its international, national, and regional importance. In 1907, the Copalis National Wildlife Refuge, encompassing portions of the Reservation, was established. In 1970, the Copalis Refuge, together with the Quillayute Needles and Flattery Rocks Refuges were designated as wilderness areas. Recently, the Olympic Coast National Marine Sanctuary was established adjacent to and north of the Reservation. The Quinault U&A includes the portion of the FMA between 47°40'06"N (Destruction Island) and 46°53/18"N (Point Chehalis) and east of 125°44'00"W.

The Quinault Indian Nation includes descendants of Quinault, Queets, Quileute, Hoh, Shoalwater, Chehalis, Cowlitz and Chinook ancestors. The Quinault hunted and fished the Clearwater, Queets, Salmon, and Quinault Rivers (including Lake Quinault and the Upper Quinault tributaries), the Raft, Moclips, and Copalis Rivers, and Joe Creek. They also relied on ocean fisheries in the waters adjacent to their territory.

In addition to the salmon and steelhead fished in the rivers, the Quinault Nation also fishes the ocean areas adjacent to its territory for chinook and coho salmon, halibut, eulachon, trout, smelt, lingcod, rockfish, sablefish, sturgeon, flatfish, various other groundfish, albacore tuna, and shellfish (including razor clams) within their U & A.

The Quinault Indian Nation has regulated its river fisheries since 1916, both for a commercial and sports fishery. It has regulated its off-reservation river fisheries and ocean fisheries since 1974. As a self-regulating tribe, the tribe also regulates the fishery and all other activities on Lake Quinault and its Reservation beaches. Along with the rivers and streams that run through the Quinault Reservation, Lake Quinault is entirely within the Reservation. Reservation beaches and Lake Quinault are closed to non-members except by permission of the Quinault government. The tribe has on occasion closed its waters to all fishing and prohibited certain types of gear in order to conserve fish runs.

3.4.4.5 Tribal Communities: Income, Poverty, Economy, Infrastructure

The overall population of Washington state was just under 6 million in the year 2000 census. American Indian and Alaska Native persons make up 1.6% of Washington population (Table 3.4.3) and 0.9% of US population. The population of Clallam County was 64,525 in 2000 and 56,494 in1990. Clallam County had 2,695 American Indian and Alaska Natives in 1990 and 3,303 in 2000, making up 5.1% of the county population. The population in Grays Harbor County was 67,194 in 2000, and Jefferson County was 25,953.

Enrollment figures for the Hoh Tribe indicate 147 members in 1977-1998 (Tiller and Chase 1999). Enrollment figures for the Makah were 2,300, with 706 for the Quileute and 2,217 for the Quinault. Other enrolled members live off-reservation in nearby Forks, other portions of Clallam County, other Washington counties, and elsewhere in the nation.

Table 3.4.3. Profile of Selected Economic Characteristics of Northwest Indian Tribes, 2000. Data set: Census 2000 American Indian and Alaska Native Summary File (SFAIAN) - Sample Data, 5/24/04.

	Washington	Clallam County	Grays Harbor Co	Jefferson Co.	Hoh Reservation	Makah Reservation	Quilleute Reservation	Quinault Reservation
Population (16 yrs and older)	4553591	52,214	52,065	21,502	139	912	249	910
Tribal service population a/	--	--	--	--	97		700	
% American Indian or Alaska Native	1.6%	5.1%	4.7%	2.3%	--	1,868 --	--	3,203 --
Unemployment rate	6.2%	7.7%	8.3%	6.7%	NA	23.7%	27.4%	14.7%
Number of Households	2272261	27187	26807	11649	31	470	124	413
Median household income	$45,776	$36,449	$34,160	$37,869	$21,925	$24,091	$21,750	$26,488
Median family income	$45,776	$44,381	$39,709	$45,415	NA	$27,946	$21,250	$27,500
Per Capita Income	$22,973	$19,517	$16,799	$22,211	NA	$10,986	$9,589	$9,621
Poverty Status (1999)								
Families	7.3%	8.9%	11.9%	7.2%	34.6%	26.8%	37.3%	27.3%
Individuals	10.6%	12.5%	16.1%	11.3%	42%	31.3%	34.5%	27.2%

a/ "Tribal service population" is the tribe's estimate of all American Indians and Alaska Natives, members and non-members, who were living "on or near' the tribe's reservation during the 2001 calendar year and who were eligible to use BIA funded services. Typically, Indians included in a tribe's service population live within a reasonable distance of the reservation from where they can access the tribe's services.

Income Census 2000 figures for Washington State as a whole show median household money income of $45,776 with 10.6% of persons below poverty (see Table 3.4.3). Washington's per capita income for 2000 was $30,380. For comparison, median household money income for the Nation as a whole was $37,000 with 13.3% persons below poverty (1997 model-based estimate for US). Clallam County median household income was $25,434 (1990 Census) and per capita income of $12,798 (1990 Census). Clallam County's per capita income is $19,517 for 2000. The median family income is $44,381. Grays Harbor median household money income, 1997 model-based estimate, is $31,091 with 16.2% persons below poverty. (2000 Census)

Poverty Status Washington's poverty status in 1999 for families is 7.3% and 10.6% for individuals. Clallam County's poverty in 1999 for families is 8.9% (2000 Census) and 12.5% for individuals. Jefferson County's poverty in 1999 for families is 7.2% and 11.3% for individuals. Grays Harbor County's poverty in 1999 for families is 11.9% and 16.1% for individuals.

Census figures (2000) consider all Native Americans in the vicinity of the reservation (the service area), not just the stated tribe. Various data sources differ in their population estimates and tribal enrollment figures, which makes it difficult to precisely determine conditions for individual tribes. However, the data are consistent in their general description of social and economic conditions on and near the reservations and for the Indian people in the region.

For the Hoh reservation, poverty rates for individuals is 42% and 34.6% for individuals with families. For the Makah Tribe, the poverty rate is 31.3% for individuals and 26.8% for families. For the Quileute, according to 2000 Census figures (taken from Factfinder Page on Internet), Median Household Income for the Quileute Tribe was $21,750, compared to $36,449 for Clallam County, $45,776 for the State of Washington, and $41,994 for the U.S. The percentage of Quileute individuals below the poverty level is well above the national and regional levels: 34.5% for the reservation, compared to 12.5% for Clallam County. On the Quinault reservation, 27.3% with families and 31.5% of individuals lived in poverty (2000 Census).

Economy Hoh: Most is derived from fishing and shell fishing (NPS/Tribes of the Olympics). The tribe operates a fish hatchery program.
Makah: The fishing industry represents the most important aspect of the Makah's economy. Presently, about 110 tribal members find full-time employment in fishing for salmon, halibut, whiting, sablefish and other groundfish, and sea urchins. A fish buying and processing plant employs another 25 members.

Quileute: The economy of the Quileute Tribe is now, as in the past, strongly tied to fishing. Reductions in the fishery resources that have resulted in reduced allowable harvests have impacted the tribe's economy. Restoration efforts have improved the condition of some salmon populations, but benefits have been offset by reductions in marine fishing opportunities. The tribe has a small fishing fleet, and the small boats typically must stay in port during small craft warnings. The tribe is working to obtain larger vessels to overcome this handicap, but is facing financial constraints.

The largest source of income to Quileute is the fishery. While only 10% of the labor force is actually participating in the fishery, almost 50% of the government staffing is dedicated to natural resources; QNR is a major employer on the reservation. Further, other reservation businesses such as the seafood packing plant, the marina, the restaurant, and the resort are tied to local fishing. Other funds come into the community for government operations under federal and state programs, including leasing to the USCG, operation of public utilities, housing, a clinic, a tribal school, a tribal court, and other government functions. The tribe is continuously striving to improve and enlarge its resort along First Beach.

Quinault: (NPS/Tribes of the Olympics) The tribe has its own seafood processing plant that processes a variety of seafood products and markets them under the label “Quinault Pride.”

Labor Force Status The 1990 Census indicated there were 70 Hoh members 16 years and over in the areas, 41 of whom were in the labor force. The online data from the 2000 Census do not show the Hoh reservation. On the Quileute Reservation, according to 2000 Census figures (Factfinder on the Internet), the number of persons 16 years and over is 249, of which 14.6 % are in the labor force. Eleven enrolled members work directly in the fishery, and related positions in the seafood plant, the restaurant, the resort, and Natural Resources are tied directly to the fishery. An estimated 50 more tribal members work in these positions.

Infrastructure Makah: Makah have a marina which opened in 1997. It is open year round and consists of 200 slips, ranging from 30' to 70'. The marina can accommodate vessels up to 200' in length. Each slip has running water and full electrical service. A waste water pump out station is also located at the marina.

Quileute: The Quileute marina was completed in the 1990s (some parts open before final completion). Some 90 slips are available, 50 for vessels up to 60' and 8 for larger vessels. The marina has 30-amp power plug-ins and fresh water faucets/hoses between each slip, and a waste water pump-out station has been constructed. State Route 110 links US Hwy 101 to the Reservation and goes all the way to the waterfront. A seafood packing plant is located at the mouth, adjacent to the marina and the road. Sport fishermen, commercial fishermen, pleasure craft, and the Coast Guard use the marina.

The waters off the Pacific coast that include the Quileute U&A are considered some of the most dangerous on the coast. A U.S. Coast Guard station is based in La Push in the harbor of the Reservation—La Push is the only safe harbor between Neah Bay and Westport. The tribe has a marina with some 90 slips, 50 of which can hold vessels up to 60 feet in length. There are 8 places on the ends of the slips for larger vessels. The tribe leases a seafood packing plant on its premises to an outside company, which serves buyers on the reservation as well as commercial enterprises in Port Angeles and elsewhere. The dangerous bar at the mouth of the Quillayute and the high seas just off shore, as well as hidden and visible sea stacks, make the Coast Guard an essential part of this coast. During severe weather, the Coast Guard sometimes closes the bar. A jetty protects the boats from the Quillayute River currents. The Army Corps of Engineers regularly dredges the river to keep the port open. It is the only safe harbor between Neah Bay and Westport.

Quinault: The tribe owns a seafood processing plant established in 1961 in Taholah, WA. The tribe also owns a receiving facility in the city of Aberdeen and a marina in Ocean Shores.

3.4.4.6 Tribal Groundfish Fisheries

The Makah Tribe has the largest fleet of groundfish and/or halibut vessels, followed by the Quinault (Table 3.4.4). Most tribal fishers who target groundfish and/or halibut fish with hook-and-line gear. Only the Makah Tribe also uses trawl vessels that are equipped to fish midwater trawl gear. Tribal fisheries harvest a variety of groundfish and other marine fish species (Table 3.4.5). The primary groundfish species targeted by tribal fisheries are sablefish and Pacific whiting. Tribal fishers also take small amounts of black rockfish in their *USUAL AND ACCUSTOMED FISHING AREAS*. The Tribes and NOAA Fisheries have negotiated formal allocations for sablefish and Pacific whiting. In addition, the tribes' anticipated black rockfish catches are taken into account when the Council makes its annual harvest recommendations. There are also several groundfish species taken in tribal fisheries for which the tribes have no formal allocation.

Table 3.4.4 Number of Tribal longline and trawl vessels used to fish for groundfish and/or halibut (source: Jones, NWIFC).

	Longline (length in ft)	Trawl (length in ft)	Total	
Makah	35 (33-62)	10 (49-62)	41[a/]	Neah Bay
Hoh	1	-	1	La Push
Quileute	7	-	7	La Push

In most recent years, Pacific whiting accounted for the bulk of tribal groundfish harvest tonnage (PFMC, 2003d). In 1999 and 2000, 32,500 mt of whiting was set aside for treaty Indian tribes of the U.S. OY of 232,000 mt for 2000. In 2001 and 2002, the whiting OY was reduced 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. To date, only the Makah Tribe has fished on the tribal whiting allocation.

In terms of exvessel revenue, sablefish landings have provided well over half of total tribal groundfish revenue in each year except 1998, 1999 and 2002 (PFMC, 2003d). Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery. This 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 among the tribes according to a mutually agreed-upon allocation scheme.

The bulk of tribal groundfish landings, other than Pacific whiting, occur during the March-April halibut and sablefish fisheries. A small number of tribal fishers use bottom trawl gear. Most continental shelf species taken in the tribal groundfish fisheries are taken during the halibut fisheries, and most slope species are similarly taken during the tribal sablefish fisheries. About one-third of the tribal sablefish allocation is taken during an open competition fishery, in which member vessels from the sablefish tribes all have access to this portion of the overall tribal sablefish allocation. The open competition portion of the allocation tends to be taken during the same period as the major tribal commercial halibut fisheries in March and April. Tribe-specific sablefish allocations are managed by the individual tribes, beginning in March and lasting into the autumn, depending on vessel participation management measures used. Participants in the halibut and sablefish fisheries tend to use hook-and-line gear, as required by the IPHC for halibut.

In 2004, tribal sablefish longline fisheries were allocated 10% of the total catch OY (751 mt) and then were discounted 3% of that allocation for discard mortality, for a landed catch allocation of 728.5 mt. For the commercial harvest of black rockfish off Washington State, the treaty tribes have a harvest guideline of 20,000 lb (9,072 kg) north of Cape Alava (48°09'30" N. lat.) and 10,000 lb (4,536 kg) between Destruction Island (47°40'00" N. lat.) and Leadbetter Point (46°38'10" N. lat.).

In addition to these hook-and-line fisheries, the Makah Tribe annually harvests a whiting allocation using midwater trawl gear. Since 1996, a portion of the U.S. whiting OY has been allocated to the Pacific Coast treaty tribes. To date, only the Makah Tribe has fished on the tribal whiting allocation.

Table 3.4.5. Groundfish catch (excluding whiting) and bycatch (in pounds) in Indian fisheries, 2000-2003. Data from Rob Jones (NWIFC) 5/17/04.

	Makah Midwater Trawl				Makah Bottom Trawl			
	2000	2001	2002	2003	2000	2001	2002	2003
black rockfish	0	0	0	0	0	53	0	23
lingcod	0	6	215	66	7	508	9,603	29,544
canary	306	1,366	3,151	895	24	0	1,068	624
yelloweye	0	0	53	0	0	0	0	0
widow	2,036	11,549	27,639	20,438	0	0	0	3
yellowtail	67,872	190,494	577,510	548,664	563	505	5,909	31,025
POP	0	0	0	0	0	0	0	0
darkblotched	0	102	2,898	32	0	0	0	0
shortspine thornyhead	0	0	0	0	0	0	283	1,364
	Makah Troll				**Makah Longline**			
	2000	2001	2002	2003	2000	2001	2002	2003
black rockfish	0	0	0	84	0	0	0	0
lingcod	1,958	773	2,006	1,935	3,434	6,138	10,793	11,715
canary	381	607	1,189	753	19,547	2,330	597	931
yelloweye	988	43	83	0	523	2,075	1,819	0
widow	0	32	0	5	3	19	0	0
yellowtail	8,948	7,060	7,071	17,994	0	382	235	690
POP	0	0	0	0	0	0	0	0
darkblotched	0	0	0	0	0	0	0	0
shortspine thornyhead	0	0	0	0	7,662	10,081	9,229	11,531
sablefish (pounds)					490,229	464,723	227,740	493,616
	Quileute Longline				**All Tribes Total** a/			
	2000	2001	2002	2003	2000	2001	2002	2003
black rockfish	30	0	0	0	30	53	0	107
lingcod	144	1,599	1,074	119	5,543	9,024	23,691	43,379
canary	74	25	117	20	20,332	4,328	6,122	3,223
yelloweye	2,365	4,224	3,287	520	3,876	6,342	5,242	520
widow	0	0	0	0	2,036	11,963	27,874	21,136
yellowtail	63	19	74	154	77,449	198,097	590,564	597,837
POP	0	0	0	0	0	0	0	0
darkblotched	0	0	0	0	0	102	2,898	32
shortspine thornyhead	624	482	91	137	8,286	10,563	9,603	13,032
sablefish	164,016	143,591	92,438	76,352	964,007	896,825	434,447	823,380

a/ includes sablefish taken by Quinault fishers

In 2001 and 2002, the landed catch OY was set at 190,400 mt and 129,600 mt, respectively, and the tribal allocations for those years were 27,500 mt and 22,680 mt, respectively. In 2003 and 2004, landed catch OY was set at 148,200 mt and 250,000 mt, respectively, and the tribal allocations for those years were 25,000 mt and 32,500 mt, respectively. Makah vessels fit with midwater trawl gear have also been targeting widow rockfish and yellowtail rockfish in recent years.

Twelve western Washington tribes fish for halibut, including the four tribes that fish for groundfish. Specific halibut allocations for the treaty Indian tribes began in 1986. The tribes did not harvest their full allocation until 1989, when the tribal fleet had developed to the point that it could harvest the entire Total Allowable Catch (TAC) off Washington, Oregon and California. In 1993, judicial confirmation of treaty halibut rights occurred and treaty entitlement was established at 50% of the harvestable surplus of halibut in the tribes' combined 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 transfer at least 25,000 lb per year to the tribal halibut fisheries, for a total of 200,000 lb to be transferred to the tribal fisheries over the period. Tribal allocations are divided into a tribal commercial component and the year-round ceremonial and subsistence component.

Tribal commercial halibut fisheries have historically started at the same time as Alaskan and Canadian commercial halibut fisheries, generally in mid-March. The tribal halibut allocation is divided so that approximately 80–85% of their allocation is taken in brief open competition derbies, in which vessels from all halibut tribes compete against each other for landings. In 2003, two of these unrestricted openings were held in the spring: a 48-hour opening on March 1-3 and a 36-hour opening on April 15-16. 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. Three restricted opening opportunities were available in 2003: March 1-31, April 2-6, and April 22-30. Similar to the unrestricted openings, these restricted openings are available for vessels from all halibut-fishing tribes.

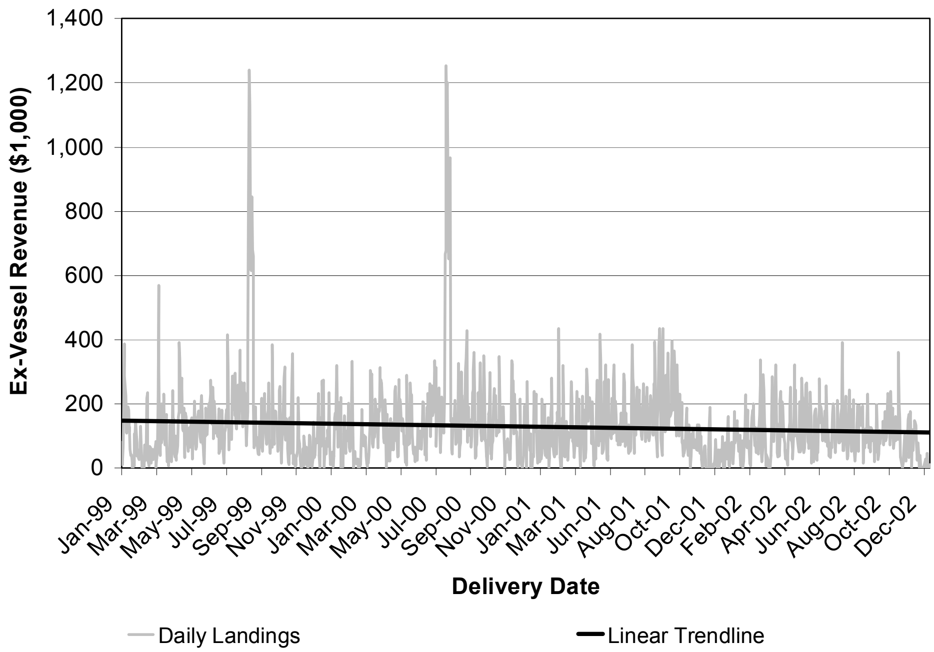
3.4.5 Buyers and Processors

With the exception of the portion of Pacific whiting catch that is processed at sea, all other Pacific coast groundfish catch is processed in shore-based processing plants along the Pacific coast. The majority of the whiting catch is delivered to Oregon processing plants, so total groundfish landings in Oregon are substantially larger than the other states. By weight, 2002 commercial shoreside groundfish landings were distributed 28% to Washington, 56% to Oregon, and 16% to California. In contrast, the exvessel value was 22% to Washington, 40% to Oregon and 32% to California. The difference is because Oregon processors handle a relatively high proportion of the whiting landings, while California fishers land proportionately more high value species.

One of the primary goals of the West Coast Groundfish FMP is to ensure a steady flow of fish to buyers and processors throughout the year. This section examines flows of non-whiting groundfish to buyers and processors and attempts to determine the impact of 2-month cumulative trip limits.

Figure 3.22 shows ex-vessel value of West Coast groundfish landings (excluding Pacific whiting) from 1999-2002. While the data reflect a general downward trend in revenues, they also show that there is a relatively steady overall flow of groundfish landings. In other words, the management regime appears to be relatively successful in maintaining a steady flow of product to seafood processors. It should be noted that fishery-wide data may mask variation in product flow to individual processors.

Table 3.4.4Value of daily landings of groundfish (excluding Pacific whiting), 1999-2002. Source: PacFIN.



However, data also suggest that large buyers of groundfish have been hit hard by decreases in groundfish harvest. There was a 36% decline in buyer counts between 1995 and 2000 for those entities where groundfish was greater than 33% of their purchases and total purchases were greater than $10,000 (OCZMA, 2002). The number of buyers with total purchases greater than $1.5 million decreased by 56%.

The precipitous decline in the number of business entities is due both to reduced deliveries of groundfish and the overall consolidation within the processing industry (OCZMA, 2002). The buyer/processor sector has become quite concentrated, with approximately 5% of the buyers responsible for 80% of purchases (PFMC, 2003b). 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% bought from trawl vessels.

3.4.6 Fishing Communities

The groundfish fisheries have historically provided West Coast commercial harvesters and processors with a relatively steady source of income over the year, supplementing the revenues earned from more seasonal fisheries. By maintaining year-round fishing and processing opportunities, the 2-month cumulative trip limits have promoted year round employment in coastal communities. However, the downward trend in revenues caused by lower catch limits and area closures has had a significant negative economic impact on local businesses that are directly or indirectly involved in and are supported by the groundfish fisheries. In particular, the decrease in groundfish catches has had a direct and significant negative impact on individual fishing enterprises. Fishery participants have suffered from a loss of earning potential, investment value and lifestyle. Some fishing operations have been forced to change fisheries or leave the industry. The groundfish crisis has also had a significant effect on the shoreside part of the industry (Chambers, 2002). Included are individuals or firms that process, distribute and sell fishery products and enterprises that provide goods and services to the fish-harvesting sector, such as chandlers, gear manufacturers, boatyards, tackle shops, bait shops and insurance brokers. While the percentage of business derived from the groundfish fisheries may be relatively small for some of these firms, any permanent loss of income during this extended period of stagnation in the U.S. economy could affect their economic viability.

On the other hand, when examined from a community frame of reference, the economic contribution of the harvesting and processing of groundfish fishery resources to the total economy of even small coastal communities is diluted by the relative scale of other economic activities, such as tourism and the wood products industry.

Those who have become unemployed face the social and psychological costs of job loss. Individuals who lose their jobs typically experience heightened feelings of anxiety, depression, emotional distress and hopelessness about the future, increases in somatic symptoms and physical illness, lowered self-esteem and self-confidence, and increased hostility and dissatisfaction with interpersonal relationships. In addition, both spouses and children of such individuals are at risk of similar negative effects. Families may find it difficult to pay bills and afford transportation, health care, and even food and clothing. The results of this financial strain may be high levels of psychological distress among some family members as well as an increase in physical health problems.

In addition to economic losses associated with declines in landings and revenues, there has been the loss of lifestyle to contend with. It is likely that enjoyment of the lifestyle or work itself is an important motivation for fishing among fishery participants. Moreover, some individuals may be motivated to fish for a living by a long-term family tradition. The loss of fishing-related jobs has caused some individuals to abandon the fishing life style. A decrease in the economic viability of the commercial fishing lifestyle has, in turn, diminished the influence of local maritime culture in some communities. The groundfish fisheries are a historically important component of an industry that is deeply intertwined with the social and cultural resources of some coastal communities. For example, the Newport Beach dory fishing fleet, founded in 1891, is a historical landmark designated by the Newport Beach Historical Society.

It is also important to recognize that fishing communities are typically dynamic and continually adapting to change (Gilden, 1999). Despite reductions in groundfish fisheries, other substantial and well managed fisheries remain available to West Coast fishers — Dungeness crab, sardines, Pacific shrimp and albacore tuna (OCZMA, 2002). Many commercial groundfish fishers have already diversified their fishing operations to include these non-groundfish fisheries. Processors, wholesalers, distributors and brokers are obtaining their groundfish from other sources or have looked for substitute products. This period of transition for the communities involved in the groundfish fisheries has been eased by Congressional appropriations for economic adjustment and recovery programs. In 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon and Washington to mitigate the effects of the groundfish crisis. While this level of government assistance is unlikely to continue, coastal communities are expected to continue to find ways to successfully adapt to contracting groundfish fisheries, although many more individual businesses involved in these fisheries will likely face economic hardship and possible bankruptcy.

3.4.7 Consumers of Groundfish Products and Other Members of the General Public

Consumers of groundfish products have a number of substitutes for West Coast groundfish products in the regional food distribution (PFMC, 2003d). Most supermarkets and restaurants do not rely on local supplies to stock their shelves or prepare menus (although some retail or restaurant patrons may place a premium on knowing the product they are purchasing is locally caught (Parrish et al., 2001)). Locally caught products are often replaced with close substitutes obtained from elsewhere in the global supply chain. Although rockfish caught in West Coast fisheries are considered to be of high quality and are valued in West Coast fresh markets, similar products from South America, Mexico, Canada or Alaska can substitute for West Coast production.

Marine ecosystems and species associated with them provide a broad range of benefits to the American public (National Research Council 2001). Some of the goods and services these ecosystems produce are not exchanged in normal market transactions but have value nonetheless. For example, in addition to supporting commercial fisheries, these ecosystems support an array of recreational fishing and subsistence activities as well as non-consumptive activities such as wildlife viewing and research and education (Carter 2003; Parrish et al. 2001).

Furthermore, some people may not directly interact with the marine environment, but derive satisfaction from knowing that the structure and function of that environment is protected.

Members of the public, in particular representatives of various environmental organizations, have advised the Council and NOAA Fisheries to endorse the recommendations of the National Research Council 2001 report and the 2003 PEW Oceans Committee report regarding MPAs to protect large numbers of species, their interrelationships, and maintenance of natural processes. They believe these positive effects on marine ecosystems and associated species would lead to a significant increase in the levels of the range of benefits these ecosystems and species provide. However, MPA-related changes in these benefits have not been estimated. It is also important to note that some individuals may hold religious or philosophical convictions that humankind has an ethical obligation to preserve species and ecosystems, notwithstanding any utilitarian benefits. Parrish et al. (2001) note that a 1999 survey conducted by the Mellman Group for SeaWeb found a high level of approval for the establishment of MPAs. Seventy-five percent of the individuals surveyed favored having certain areas of the ocean as protected areas; 60% believed that there should be more marine sanctuaries; and 3% believed there were already too many marine sanctuaries. Survey respondents cited the following as convincing reasons for creating MPAs: 1) distinctive areas should be protected similar to what is done for national parks (65%); 2) less than 1% of U.S. waters are in MPAs (63%); 3) MPAs would be an important step in improving the health of oceans (58%); 4) harmful activity should be restricted in order to preserve ocean beauty for future generations (57%). Support for MPAs diminished by only 1% when respondents were first read a statement outlining potential negative socioeconomic effects of creating MPAs and increased by 6% when respondents were first read a statement outlining potential positive effects of creating MPAs.

Additional surveys and polls are needed to better understand the values and motives underlying public support of measures that protect marine species and ecosystems, as well as the extent of public support.

3.4.8 Fishing Vessel Safety

Low earnings on the part of individual harvesters limit funds for maintenance and safety equipment. Poor maintenance, bad weather and a desperate need to fish may to lead to significant incidence of injury and losses in life and capital (Young, 2001). In addition, 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 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). To the extent that the groundfish crisis will deepen in the future, these negative effects on fishing vessel safety are likely to continue.

3.4.9 Management and Enforcement

The current groundfish management program relies heavily on trip limits to control fishing effort, with a major goal to maintain commercial groundfish production over the year. Usage of the term "trip limit" has evolved over the past 20 years; initially it referred to the amount of fish a commercial vessel was allowed to catch and retain on a single fishing trip. Over time, this was modified to include trip frequency limits and ultimately the amount of groundfish that may be caught and retained during a specified period of time, typically one or two months. A critical feature of trip limits is that they do not directly limit the amount of catch, but rather only the amount groundfish that may be retained and delivered for sale. Commercial vessels are allowed (and expected) to discard unusable fish and any fish in excess of a specified limit. This approach creates what is referred to as perverse incentives, which means some of the effects are contrary to what is desired. Specifically, trip limits are intended to slow the rate of groundfish harvest so the fishery may remain open all year. However, in reality, it is only the rate of retention that is directly controlled, and the actual catch is only indirectly controlled. Some amount of discarding (called *REGULATORY BYCATCH*) is required each time a vessel reaches a retention limit. Under trip limits, a vessel is not restricted from continuing to fish, but only restricted from retaining any more of the particular species. Also, only the amounts retained and delivered must be reported and recorded under the no action alternative; commercial vessels are not required to report any discarded fish.

This trip limit program was more successful when stocks were near pristine levels and trip limits were fairly liberal; relatively few vessels bumped up against the limits. However, as trip limits were reduced in response to declining stock size and/or premature OY attainment, the rate of discard of many species became critical. Lack of accurate records of total catch (that is, retained plus discarded) could jeopardize efforts to rebuild overfished groundfish stocks and could lead to unintentional overfishing. In addition, there were few records of incidental take (bycatch) of non-groundfish species.

Federal funds have not been available to monitor bycatch in the West Coast groundfish fishery until recently, and NOAA Fisheries has relied primarily on state monitoring programs that have not adequately recorded total catches. To avoid a costly and controversial on-board observer program, in the face of excessive competition and depleted stocks, NOAA Fisheries and the Council have developed an increasing complex management approach, usually without the means to monitor its effects and effectiveness. As regulations have become more complicated and restrictive, compliance has dropped along with public respect for the management program.

Beginning in 2002, large areas, corresponding to general locations of overfished groundfish species, have been closed to reduce the likelihood those species might be caught accidentally. To the degree the closures correspond to where the overfished fish are, this approach can effectively prevent bycatch of those species. However, traditional enforcement methods are inadequate for such extensive boundaries. Also, the shape of a closed area influences both monitoring complexity and ease of compliance.

3.4.10 Catch and Bycatch Monitoring Programs

[This section includes material from the NOAA Fisheries report titled *Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs*, December 2003, as well as information on the observer program from the NOAA Fisheries Northwest Fishery Science Center website and the 2003 NOAA Fisheries Bycatch Plan. Those documents are hereby incorporated by reference.]

Several types of monitoring programs have been developed to estimate fisheries bycatch. These include the use of data collected aboard fisheries research vessels and chartered vessels, self-reporting by fishermen and/or other industry representatives, at-sea fisheries observers, video cameras, digital scanning devices, alternate platforms or remote monitoring, and stranding networks. The choice of which method to use for monitoring bycatch in any particular fishery is based on a number of factors. These factors may also determine the practicability of bycatch monitoring and reduction methods.

- **Quality** – in general, how precise and how accurate are the data that are collected?
- **Completeness** – does sampling cover the entire range of the fishery or fisheries that interact with the species of concern?
- **Credibility** – how well do the data stand up to scrutiny by affected stakeholders and other constituents?
- **Cost** – what are the relative expenses associated with the sampling method, and are there economies of scale that can be realized?
- **Timeliness** – how quickly are the data available to fisheries scientists and managers?
- **Safety** – how safe is the methodology compared to other monitoring methods, and what safeguards are in place to ensure the safety of the data collectors?
- **Logistics** – how easily is the monitoring program implemented and maintained?

Most of the fishery data collection programs are conducted under state regulatory authority rather than federal regulations. The notable exceptions are the at-sea whiting fishery and the federal groundfish observer program.

3.4.10.1 State Commercial Fish Ticket Programs and the Pacific Fishery Information Network (PacFIN)

Washington, Oregon and California state regulations require completion of a written record (fish ticket) of the amounts of fish landed by commercial fishing vessels. The federal groundfish management program acknowledges these data collection programs and relies on this source of information for most commercial groundfish catch statistics. Although all three states collect the same type of information, each state defines the format of its fish tickets and the species categories.

In California, official landing receipts must be completed for all fish or shellfish purchased or received by commercial fish dealers (persons licensed as a fish receiver or multi-function fish business). There are several types of landing receipts, and the fish dealer determines which landing receipt is used based on the fishing gear used and the market categories that compose the landing. The fish dealer is legally obligated to include the date, market category, landing weight, price, port, gear, area fished, vessel registration number and name, dealer number and name, and fisher license number and name on each landing receipt. The market categories listed on the landing receipts represent individual species or groups of species. Market categories are defined by different sizes of fish, price, or mandated by federal/state regulations. Historically, as many as 94 groundfish market categories have been officially recognized by CDFG, including 47 nominally single species rockfish market categories and 10 multi-species rockfish market categories.

In Oregon, any fish dealer who purchases groundfish from a commercial fisher is required to complete an Oregon Fish Receiving Ticket, indicating the weight and value of the fish purchased. ODFW determines the physical format of the ticket and the official market categories under which the fish must be landed. Market categories have been established for all species that must be separated before or upon delivery. More than 89 official market categories have been used by ODFW.

Washington’s Marine Fish Receiving Ticket is the official document used to record the landed weight and value by species of designated marine food fish. Additionally, the fish ticket must identify the fisher, their address, vessel name, vessel registration number, the fishing gear, date of landing, area fished, the processor purchasing the fish, whether the fish were caught within three miles of the coast (state waters), within 200 nautical miles (federal waters) or outside 200 nautical miles (international waters), and the number and amount of fish retained by the crew for personal use. Market categories recorded on the fish ticket are established by WDFW in accordance with the selling practices of the fish processors. Several codes and species descriptions are preprinted on the fish ticket: any other market categories must be handwritten onto the fish ticket. The processor is required to list purchases of any species with an explicit trip limit in a separate market category.

The PacFIN central database includes fish-ticket and vessel registration data provided by the Washington, Oregon, and California (W-O-C) state fishery agencies. In addition, the W-O-C data sources supply species-composition and catch-by-area proportions developed from their port sampling and trawl logbook data systems. NOAA Fisheries/NWR supplies the central database with limited-entry permit data, and U.S. Coast Guard vessel data is also incorporated.

3.4.10.2 State Logbook Programs

West Coast groundfish trawl vessels are required by state regulations to record their retained catch in logbooks; they are not required to record amounts of discarded fish or other species. Although some other commercial vessels are also required by state regulations to record catch information in logbooks, that information is seldom entered into electronic databases for analysis. Some information from trawl logbooks is integrated with other information for management and for stock assessments.

The accuracy of self-reporting (logbooks) has been evaluated from comparisons of discard information derived from logbooks or vessel trip report systems and observers (either on the same trips or operating in similar areas). For example, researchers compared logbook data submitted by Hawaii longline fishermen to observer data (Walsh 2000). The study compared the accuracy of logbook data on important commercial species versus species of lesser importance, or species caught in great numbers. The study also examined the accuracy of fish identifications and compared logbook data to landings receipts (fish tickets). The study found biases due to under reporting in logbooks, species identification errors by both novice observers and fishermen, difficulties by both groups in counting abundantly caught species, and incorrect use of logbooks (e.g., recording data in the wrong area of the logbook). The study also determined that the most common errors in logbooks were under reporting of catches and rounding of values reported for abundantly caught species catch. Logbooks may not be reliable for estimating bycatch of abundantly caught species or species of lesser economic value (NMFS 2003c).

The costs of logbook programs to the agency include producing and distributing the logbooks, data entry, database maintenance, and analytical costs. These costs are typically less than the costs of observer programs, if compared on a per sea day basis.

In summary, where fishers are required to record bycatch, logbooks may provide qualitative estimates; however, the accuracy of these data is of concern. Logbooks are more useful in providing estimates of total effort by area and season that can then be combined with observer data to estimate total bycatch. With respect to safety, there are minimal concerns associated with logbook programs, compared to at-sea data collection programs. Logistics associated with processing the data collected have limited the usefulness of the data. However, this may be improved by recent technology advancements designed to increase the speed at which data are transferred while also improving the quality of data submitted.

3.4.10.3 State Port Sampling

West Coast port samplers are typically state employees or contracted biologists (typically through PSMFC) trained to collect fishery information and biological samples of fish that are brought to shore. Samplers collect information primarily on catch, but also bycatch when available. As with logbook data, there are significant concerns about the completeness and accuracy of bycatch data collected by port samplers. Biological sampling is limited to only the landed catch, and does not include sampling of any discarded species. This is a major shortcoming, especially when discard rates are substantial. In addition, port sampling typically results in only a small sample of total fishing effort.

It would be possible to create a port sampling program in conjunction with a requirement that fishers retain all their catch and a system to verify that no discard takes place. In effect, this would be an onshore observer program that could avoid much of the cost associated with at-sea programs. This type of program has been use for the shore-based whiting fishery to monitor salmon bycatch. However, there are substantial issues relating to full retention, such as disposal of unmarketable species and disposition of marketable fish beyond local market needs.

3.4.10.4 Recreational Sampling West Coast recreational data have been collected under the annual Marine Recreational Fisheries Statistics Survey (MRFSS) and cooperative angler surveys administered by states. The objective of MRFSS is to provide estimates of recreational catch and effort over fairly large strata (by state and two-month wave). The MRFSS data are collected by two independent, but complementary, surveys: 1) a telephone survey of households in coastal counties, and 2) an intercept (i.e., interview) survey of anglers at fishing access sites. The intercept survey is analogous to the commercial port sampling program, with similar advantages and disadvantages. Estimates of bycatch by recreational fishermen are made based upon self-reporting during the intercept. In addition, some recreational catch and bycatch data are collected by observers on charter fishing vessels.

Central California Marine Sport Fish Project The Central California Marine Sport Fish Project has been collecting angler catch data from the Commercial Passenger Fishing Vessel (CPFV) industry intermittently for several decades in order to assess the status of the nearshore California recreational fishery. The project has focused on rockfish and lingcod angling and has not sampled salmon trips. Reports and analyses from the project document trends by port area in species composition, angler effort, catch, and, for selected species, catch per unit effort (CPUE), mean length and length frequency. In addition, total catch and effort estimates are made based on adjustments of logbook data by sampling information.

Before 1987, catch information was primarily obtained on a general port basis from dockside sampling of CPFVs, also called party boats. This did not allow documentation of specific areas of importance to recreational anglers and was not sufficient to assess the status of rockfish populations at specific locations.

CPFV operators are required by California law to record total catch and location for all fishing trips in logbooks provided by the CDFG. However, the required information is too general for use in assessing the status of the multi-species rockfish complex on a reef-by-reef basis. Rockfish catch data are not reported by species and information on location is only requested by block number (a block is an area of 100 square miles). Many rockfishes tend to be residential, underscoring the need for site-specific data. Thus, there is a strong need to collect catch information on board CPFVs at sea. However, locations of specific fishing sites are not revealed since that information is confidential. In May 1987 the Central California Marine Sport Fish Project began on-board sampling of the CPFV fleet. Data collection continued until June 1990, when state budgetary constraints temporarily precluded further sampling, resumed in August 1991, and continued through 1994. The program depends on the voluntary cooperation of CPFV owners and operators. Angler catches on board central and northern California CPFVs were sampled from fourteen ports, ranging from Crescent City in the north to Port San Luis (Avila Beach) in the south. For additional information on this program, see the PSMFC web site at: (www.psmfc.org/recfin/ccmsp.htm).

Oregon Marine Recreational Observation Program In response to overfished species declarations and increasing concerns about fishery interactions with these species, ODFW started this program to improve understanding of recreational impacts. There were three objectives to this project; (1) document the magnitude of canary rockfish discard in the Oregon recreational fishery; (2) improve the biological database for several rockfish and groundfish species; and (3) gather reef location information for future habitat mapping.

A seasonal sampler was stationed in each of the ports of Garibaldi, Newport and Charleston to ride recreational groundfish charter vessels coastwide in Oregon from July through September, 2001. The Garibaldi sampler covered boats out of

Garibaldi, the Newport sampler covered both Newport and Depoe Bay, and the Charleston sampler covered Charleston, Bandon, and Brookings charter vessels. During a typical day the sampler would ride a 5 to 8 hour recreational groundfish charter trip and spend the remainder of the day gathering biological and genetic data dockside from several rockfish and groundfish species for which little is known mostly due to their infrequency in the catch. When allowed by the captain, the sampler also obtained GPS locations of fishing sites for future use by the Habitat Mapping Project of the Oregon Department of Fish and Wildlife (ODFW) Marine Resources Program. Results from this program have been incorporated into recreational fishery modeling by ODFW. For more information on this program as well as other fishery research and survey programs see the ODFW Marine Program web site at: http://hmsc.oregonstate.edu/odfw/reports/finfish.html.

WDFW Ocean Sampling Program In addition to its at-sea data collection program, WDFW collects at-sea data through the Ocean Sampling Program. The at-sea portion is not intended to be an observation program for the purposes of enumerating the bycatch alone but is coupled with shore-based sampling of anglers to calculate an estimated discard weight. At-sea samplers record biological information from discarded species. Shorebased creel surveys of anglers provide the estimate of total number of discards. Combining these two data sources yields estimates of the weight of total fishery discard by species.

3.4.10.5 Federal Vessel Monitoring System (VMS) As of January 1, 2004, every limited entry groundfish vessel is required to carry a Vessel Monitoring System (VMS) unit at all times the vessel is operating. VMS in other regions has proven to be an effective, cost-saving technology for the monitoring and enforcement of large restricted areas over great distances. A VMS is an automated, real-time, satellite-based tracking system operated by NOAA Fisheries and the U.S. Coast Guard that obtains accurate geographic position reports from vessels at sea. The cost of VMS transmitting units has decreased as new technologies have emerged. At this time, VMS transceiver units range in price from approximately $800 to $5,295 per unit, installed (PFMC, 2003b). The more expensive units allow two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel.

VMS does not replace or eliminate traditional enforcement measures such as aerial surveillance, at sea patrol boats, landing inspections and documentary investigation (PFMC, 2003b). Traditional enforcement measures may need to be activated in response to information received via the VMS. However, VMS positions can be efficient in identifying possible illegal fishing activity and can provide a basis for further investigation by one or more of the traditional enforcement measures. In doing so, it makes certain activities of investigating officers more cost effective because less time will be spent pursuing false trails and fishing operators who are following the rules. Furthermore, VMS positions in themselves can also be used as the basis for an enforcement action.

Another major benefit of VMS is its deterrent effect (PFMC, 2003b). It has been demonstrated that if fishing vessel operators know that they are being monitored and that a credible enforcement action will result from illegal activity, then the likelihood of that illegal activity occurring is significantly diminished. Beyond the enforcement benefits of the VMS program, NOAA Fisheries expects to use VMS data to better characterize fishing activities by geographic area. This data, in combination with observer and landings data, will improve the NOAA Fisheries' ability to estimate species -specific catch by area.

3.4.10.6 Electronic (Video) Monitoring Electronic monitoring (EM) is an automated alternative to some human data collection systems. EM equipment can provide accurate, timely, and verifiable fisheries data at a lower cost than that provided by an at-sea observer. EM is an integrated assortment of electronic components combined with a software operating system. An EM typically includes one or more video cameras, a CPU with removable hard drive, and software that can integrate data from other components of a vessel's electronic equipment. The system autonomously logs video and vessel sensor data during the fishing trip without human intervention. When the vessel has completed its fishing operations and returned to port, the video and other data are transferred to a separate computer system for analysis. Video records are typically reviewed by human samplers on shore, but electronic techniques are being to developed to automate some of this activity.

Electronic monitoring has been tested in various Canadian fisheries and has successfully addressed specific fishery monitoring objectives. NOAA Fisheries is testing EM equipment in the 2004 shore-based whiting fishery, where discarding is limited by an EFP. Electronic monitoring is a relatively new technology, and standards for data confidentiality and privacy are still being developed.

The cost of an EM unit is about $6,000, plus the additional costs for the labor and analysis components. The estimated overall costs in Canadian fisheries currently using EM systems are $212 (Canadian dollars) per vessel per day for electronic monitoring compared to $470 per day for observers. The cost of video monitoring includes the cost of the equipment (3-5 cameras per vessel and a CPU with a removable hard drive), installation of cameras on vessels, and post-cruise analysis of the video stream. The estimated cost to equip 10 vessels for 60 days, including analysis of video, is approximately $90,000 (McElderry, pers. comm.). The equipment cost could be lower on a per day basis if the units were installed for a longer time period; however, the costs of analyses are more fixed. A report on the use of video monitoring in the Canadian halibut longline fishery provided as Appendix D.

3.4.10.7 Observer Programs Observer programs are a reliable method for estimating bycatch. The quality of the data and the precision and accuracy associated with bycatch estimates are determined by sample size and the design and execution of a robust sampling scheme. Realizing the potential for timely access to observer data can increase the benefits of an observer program relative to other data collection methods. For example, real-time access by fishermen to observer data in the Alaska groundfish fisheries has resulted in reduced bycatch of halibut and, consequently, longer groundfish fishing seasons. Real-time access by fishery managers in Alaska also allows for inseason management of groundfish quotas in terms of total catch and of non-groundfish bycatch quotas. In the West Coast groundfish fisheries, real-time access by fishery managers to observer data collected in the at-sea whiting fishery allow for in-season management. In addition (similar to the North Pacific program), whiting vessels typically submit daily catch and bycatch information to a third party that complies and distributes summaries to the fleet to help minimize salmon bycatch. Information on rockfish bycatch hot spots is also reported and share among the fleet.

Observer programs can be one of the most expensive monitoring methods available for estimating bycatch, especially if fisheries managers intend to use the data for inseason management. Estimates of cost per observation day are quite variable between fisheries and between regions. Estimates range from $350 to $2000 per observation day (at-sea day). Direct expenses include the cost of recruiting and training observers, salaries and benefits (including premium pay while at sea and on-call pay while waiting for a vessel to depart), contractor profit, travel costs, gear and equipment, and insurance (which can be up to 30% of the cost of a sea day). Variations in these factors influence the wide range of cost estimates. Other factors include logistical difficulties for observers to join trips (lengthy travel, onshore travel costs), insurance, food[3/], data entry, quality control, training, analytical costs and program management. Some of the cost differences arise from differences in who pays for these various costs, whether the program is large enough for economies of scale and the geography of the fishery. Increased costs are associated with observation of seasonal fisheries, fisheries operating in remote areas, low effort fisheries that require 100% coverage, fisheries with unpredictable levels of effort, and fisheries where fishermen embark unpredictably out of any number of ports.

The logistics associated with implementing observer programs and deploying observers can be substantial. Considerations include procurement of observer

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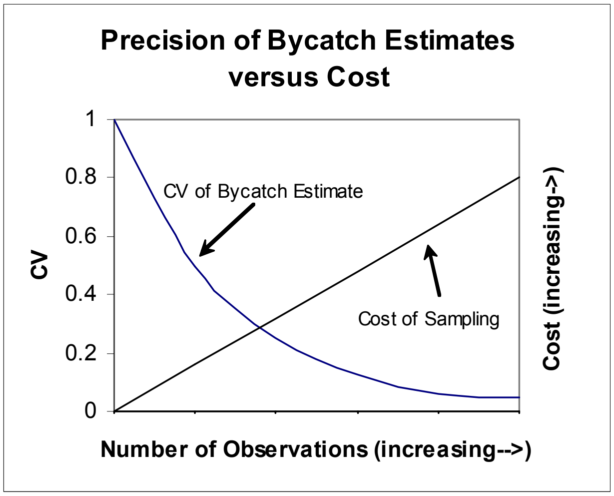
3. Some programs also provide a food allowance to the observer or the vessel while the observer is deployed at sea ($20-25/day). Indirect expenses include the salaries and benefits of NOAA Fisheries employees that oversee the largely-contracted workforce, sampling design and data analytical support, data entry, and database design and maintenance.

services, observer training, moving observers around, minimizing down time, and deployment of observers in highly mobile fisheries or fisheries operating out of many ports. Experience in deployment of observers can minimize logistical difficulties.

Table 3.4.4Trade-offs between precision (CV) and cost in observer programs.



The precision of a bycatch estimate is related to the cost and sampling rate of an observer program. The measure of precision commonly used in reference to observer programs is the coefficient of variation, or CV, associated with the estimate of bycatch (the lower the CV, the greater the level of precision). However, at some level of sampling, only incremental decreases in CV may be obtainable despite large increases in sampling (as illustrated in the figure below). As the number of observers or observations increases, the costs increase. The precision of bycatch estimates also increases, but the rate of improvement is slower.

Observer programs are a reliable method for estimating bycatch. The quality of the data and the precision and accuracy associated with bycatch estimates are determined by sample size and the design and execution of a robust sampling scheme. Identification and accounting for sources of bias is critical, as are measures to increase both cost effectiveness and safety of observers.

On the West Coast, NOAA Fisheries and the states of Washington, Oregon, and California conduct at-sea observations of various groundfish fisheries. The at-sea whiting observer program is a well-established, mature program while others are considered pilot or developing programs (Table 3.4.6). The shore-based whiting fishery has been observed both at sea and on shore, and in 2004 video monitoring (EM) is being tested.

NOAA Fisheries West Coast Groundfish Observer Program. Onboard fishery observers collect information on fishing activities and help provide accurate accounts of total catch, bycatch, and discard associated with different fisheries and fish stocks. The West Coast Groundfish Observer Program (WCGOP) includes the NWFSC Observer Team and collaborators from the Pacific States Marine Fisheries Commission that direct the program, train new observers, and manage and analyze the bycatch data. The NWFSC's two programs deploy observers on vessels in three of the nine West Coast commercial fisheries (at-sea whiting, groundfish bottom trawl, non-trawl gear groundfish). As part of this program, fisheries observers are placed on commercial fishing vessels to monitor and record catch data, including species composition of retained and discarded catch. Observers also collect critical biological data such as fish length, sex, and weight. The data collected are used in combination with state-collected logbook and fish ticket information to estimate the bycatch in the these West Coast fisheries.

Observers collect information on total catch, species composition of the catch (including any protected resources and seabirds), age structure data from several species and the fishery's interactions with species of concern. This fishery is a major source of salmon bycatch on the coast. Under the Biological Opinion on the effects of the groundfish fisheries on endangered and threatened salmon stocks, the at-sea whiting fishery is anticipated to take up to 11,000 chinook salmon per season as bycatch. With close to 100% of the hauls in the fishery sampled, the program closely monitors the number of chinook taken. The majority of the annual cost of the deploying the observers is paid for by industry. The cost of training, in-season support and debriefing observers is supported by NOAA Fisheries. Currently the annual cost of the program is approximately $535K ($500K paid for by industry).

The WCGOP[4/] began deploying observers on groundfish vessels in August 2001. The focus of this program is to collect total catch and discard data (including protected resources and seabirds) from commercial groundfish trawl and non-trawl gear (longline, pot, etc.) vessels. The program is designed to provide estimates of fleet-wide discards in commercial fisheries; fish tickets are the mandated landings accounting mechanism. As the program is currently designed, logbook data must be available to fully utilize observer data. This is because observers initially record hail weights (i.e., at-sea estimates) and logbook data for retained catch, and these values must be adjusted by fish ticket information to achieve total catch estimates. Observers in this program collect species composition of the discard and data on target fisheries interactions with species of concern. Observers also collect critical biological data such as fish length, sex, and weight. The observer program's data is already being used in the bycatch model that guides West Coast groundfish fisheries management. The WCGOP initially targeted the trawl and non-trawl limited entry fleets for observer coverage. Observer coverage initially extended to about 10% of the West Coast limited entry fleet effort, but increased to about 20% by the summer of 2002 (Elizabeth Clarke, NMFS NWFSC, pers. comm.). The program currently deploys about 40 observers coast wide on the limited entry trawl and fixed-gear groundfish fleet, as well as on some open-access vessels operating off California. Given the skewed distribution of bycatch in West Coast groundfish fisheries, many observations in each sampling strata (i.e. target effort by gear type by area)

4. see Appendix A for the first two annual reports

are needed to estimate representative bycatch rates of overfished groundfish species. The seasonality of bycatch is an important management consideration.

Table 3.4.6. Survey of fishery-specific bycatch observation programs, enhancements and bycatch vulnerability in West Coast groundfish fisheries. (From *Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs* NMFS 2003c)

Fishery	Target Species	Gears	Observer Program Status	Next step in design	Vulnerability to fish bycatch	Vulnerability to Marine Mammal Bycatch	Vulnerability to other ESA species bycatch and Seabirds
At-sea Whiting Fishery	Pacific whiting	pelagic trawl	mature	maintain	Moderate (e.g., widow and canary rockfish)	Low	High (salmon)
Shorebased Whiting Fishery	Pacific whiting	pelagic trawl	pilot	maintain	Moderate (e.g., widow and canary rockfish)	Low	High (salmon)
Bottom Trawl Fishery	flatfish, rockfish, roundfish, various sharks/skates	bottom trawl	developing	mature	High (e.g., canary rockfish, darkblotched rockfish, bocaccio)	Low	Moderate
Non-trawl Fishery	sablefish, rockfish, lingcod, various roundfish	hook-and-line, pot, setnet	developing	mature	High (e.g., canary rockfish, lingcod, bocaccio, cowcod)	Low	Low

Next, the program may expand to also cover open access vessels operating off Oregon in 2004, pending revisions to state regulations. Few vessels land open access groundfish into Washington ports and this fleet and has been covered on a limited basis.

Overall costs of this program, averaged over the number of days observers spend onboard West Coast groundfish fishing vessels, results in a daily cost of about $900. This includes equipment, transportation, some training and data analysis, and other costs. The cost of observer coverage excluding support and data analysis is about $300 per day. Currently (2004), every at-sea processing vessel carries at least 2 observers at the vessel's expense. Vessels operating under certain exempted fishing permits (EFPs) also pay the expenses of observers required under the terms of the permits, as these observers are generally in addition to those provided by NOAA Fisheries.

The WCGOP stresses that observers are intended for scientific data collection only, and do not have any enforcement role. The information they collect is essential for a clear understanding of the amount and distribution of bycatch of all species.

At-Sea Pacific Whiting Observer Program Since the inception of the U.S. whiting fishery in the late 1980s, all at-sea processing vessels have carried observers. Initially, this was a voluntary program, but now it is part of the NWFSC observer program. Since its beginning, this data reporting program has provided fishery managers the catch data necessary for managing the fishery on a real time basis, allowing each sector of the fishery to take its full allocation. This data set has not only provided valuable information in the management of Pacific whiting, but has also provided an extensive amount of information on bycatch species. Observer catch and bycatch data have been used for the assessment of widow rockfish, although changes in management and operation of the fleets has reduced the value of this data source. (Widow rockfish and Pacific whiting are co-occurring species, which means that significant bycatch of widow rockfish may occur in the midwater trawl nets used for Pacific whiting.)

To increase the utilization of bycatch that is otherwise discarded as a result of trip limits, Amendment 13 to the groundfish FMP implemented an increased utilization program on June 1, 2001, which allows catcher/processors and motherships in the whiting fishery to exceeded groundfish trip limits without penalty, providing specific conditions are met. These conditions include provisions for 100% observer coverage, non-retention of prohibited species, and donation of retained catch in excess of cumulative trip limits a bona fide hunger relief agency or processing of excess catch into mince, meal, or oil products. These provisions have allowed the at-sea Pacific whiting fishery to operate efficiently while meeting management goals, and have continued to provide scientists, through the observer coverage, with important biological information.

Shore-based Pacific Whiting Observation Program The shoreside whiting observation program (SWOP) was established in 1992 to provide information for evaluating bycatch in the directed Pacific whiting fishery and for evaluating conservation measures adopted to limit the catch of salmon, other groundfish and prohibited species. Though instituted as an experimental monitoring program, it has been continued annually to account for all catch in targeted whiting trip landings, enumerate potential discards, and accommodate the landing and disposal of non-sorted catch from these trips. In 1995, the SWOP's emphasis changed from a high observation rate (50% of landings), to a lower rate (10% of landings) and increased collection of biological information (e.g., otoliths, length, weight, sex, and maturity) from Pacific whiting and selected bycatch species (yellowtail rockfish, widow rockfish, sablefish, chub (Pacific) mackerel (Scomber japonicus), and jack mackerel (Trachurus symmetricus)). The required observation rate was decreased when studies indicated that fish tickets were a good representation of what had actually been landed. Focus shifted again due to 1997 changes in the allocation of yellowtail rockfish and increases in yellowtail bycatch rates. Since then, yellowtail and widow bycatch in the shoreside whiting fishery has been dramatically reduced because of increased awareness by fishermen of the bycatch and allocation issues involved in the SWOP program. The SWOP is a cooperative effort between the fishing industry and state and federal management agencies to observe and collect information on directed Pacific whiting landings at shoreside processing plants. Participating vessels apply for and carry two EFPs issued by NMFS. Permit terms require vessels to land unsorted catch at designated shoreside processing plants. Permitted vessels are not penalized for landing prohibited species (e.g., Pacific salmon, Pacific halibut, Dungeness crab), nor are they held liable for overages of groundfish trip limits. Participants in the SWOP are mid-water trawlers carrying EFPs, designated shoreside processing plants in California, Oregon, and Washington, the Council, the NMFS, PSMFC, ODFW), CDFG, and WDFW. (Excerpt from latest ODFW on the shore-based Pacific Whiting program review (Wiedoff and Parker 2002), for the complete report go to: http://hmsc.oregonstate.edu/odfw/reports/hake.html).

Since 1997, an EFP has been adopted annually that allows suspension of at-sea sorting requirements in the shore-based whiting fishery enabling full retention and subsequent port sampling of the entire catch. However, EFPs are intended to provide for limited testing of a fishing strategy, gear type, or monitoring program that may eventually be implemented on a larger fleet-wide scale. They are not a permanent solution to the monitoring needs of the shore-based Pacific whiting fishery. Results of the shore-based Pacific whiting EFPs indicate that it is feasible to retain and appropriately monitor the incidental take of salmon and groundfish other than Pacific whiting in the shore-based Pacific whiting fishery. A permanent monitoring program for the shore-based Pacific whiting fleet is being developed because of it is called for in the Pacific Coast salmon and groundfish fishery FMPs and the 1992 Biological Opinion analyzing the effects of the groundfish fishery on salmon stocks listed under the Endangered Species Act

(ESA). The issue of salmon retention in the groundfish trawl fisheries was brought before the Council in 1996 in the form of Amendment 10 to the Pacific Coast Groundfish FMP and Amendment 12 to the Pacific Coast Salmon FMP. Based on an Environmental Assessment drafted to analyze these amendments, the Council recommended the EFP process be used temporarily until a permanent monitoring program could be developed and implemented in the shore-based Pacific whiting fishery.

NOAA Fisheries is preparing a preliminary draft Environmental Assessment that includes a range of alternative monitoring systems for the shore-based Pacific whiting fishery. The alternatives currently focus on three major issues: 1) staffing the monitoring program (i.e., federal observers, state monitors, video cameras, or a combination thereof); 2) tracking and disposition prohibited species and groundfish overages; and 3) funding of the monitoring program. Implementation of the permanent monitoring program is anticipated to occur in 2005. NOAA Fisheries and the GMT have expressed concerns about the current EFP program and its adequacy of ensuring full retention and total catch accounting. This is particularly a concern in regards to the rebuilding of widow rockfish. NOAA Fisheries is testing onboard video cameras in the summer of 2004 as a means of verifying total retention.

WDFW Groundfish At-Sea Data Collection Program The WDFW at-sea data collection program was initiated in 2001 to allow fishery participants access to healthier groundfish stocks while meeting the rebuilding targets of overfished stocks, and to collect bycatch data through an at-sea sampling program. The data collected in these programs could assist with future fishery management by producing valuable and accurate data on the amount, location and species composition of the bycatch of rockfish associated with these fisheries, rather than using calculated bycatch assumptions. These data could also allow the Council to establish trip limits in the future that maximize fishing opportunities on healthy stocks while meeting conservation goals for depleted stocks.

Over the past four years, WDFW has implemented its at-sea data collection program through the use of federal EFPs. In 2001, 2002, 2003 and 2004, WDFW sponsored and administered a trawl EFP for arrowtooth flounder and petrale sole, and in 2002, WDFW also sponsored a midwater trawl EFP for yellowtail rockfish. The primary objective for these experimental fisheries was to measure bycatch rates for overfished rockfish species associated with these trawl fisheries. Fishery participants were provided access to healthier groundfish stocks and were constrained by individual vessel bycatch caps. Samplers collected rockfish bycatch data on a per tow basis and ensured that each vessel complied with its bycatch cap; every vessel participating in the EFP was required to have 100% sampler coverage.

Initially, WDFW used federal Disaster Relief funds to defray most of the costs associated with these sampling programs. When the funds were exhausted, the industry began paying the majority of the costs. In 2003 and 2004, the average cost to participants was approximately $4,000-4,500 per month observed (for sampler salaries, safety equipment, and sampling supplies). Additional program costs are incurred by WDFW for staff time to administer, monitor, and oversee the sampling program, and to analyze the data.

Samplers/monitors have been hired as temporary employees of the WDFW and assigned to a duty station based on the vessel's home port. Each sampler is required to complete a two-week training course, consistent with the NOAA Fisheries Observer Training Manual. Samplers receive U.S. Coast Guard safety training–including survival suit immersion test and vessel safety– and WDFW training on fish identification, random sampling theory, data collection methods, current groundfish management issues, and additional safety measures. WDFW fishery managers and biologists were involved in hiring and training the samplers as well as administering and monitoring the program. WDFW scientific technicians sampled the catch dockside, collected biological data, and entered the data into an electronic database. Research scientists have analyzed the preliminary data from the 2001, 2002, and 2003 EFPs, and have finalized summary reports.

Tribal Observer Program The tribal whiting fishery is a cooperative venture between Makah midwater trawl vessels and a floating processing ship. As with the catcher-processor and mothership whiting fisheries, the processing vessel carries two observers at all times. Tribal vessels actively communicate information on areas of known interactions with species of concern. Makah trawl vessels often participate in paired tows in close proximity where one vessel has observer coverage. If landings on the observed vessel indicate higher than anticipated catches of overfished species, the vessels relocate and inform the rest of the fleet of the results (Steve Joner, Makah Fisheries Management, pers. comm., February, 2004). Trip limits for tribal nontrawl vessels are intended to constrain directed catches while allowing for small incidental catches. Tribal directed groundfish fisheries are required to retain all rockfish. Thus, bycatch (discard) of rockfish is minimized.

3.4.11 Other Fisheries that Affect Groundfish (Open Access Non-groundfish Fisheries)

This section is provided so the reader will have a more complete picture of the West Coast fisheries that affect the groundfish resources and groundfish fisheries. These are other fisheries that may take groundfish as bycatch, but are not managed by the groundfish FMP.

Many fishers catch groundfish incidentally when targeting other species, because of the kind of gear they use and the co-occurrence of target and groundfish species in a given area. To distinguish landings and vessels from fisheries that target species other than groundfish but take groundfish incidentally from the directed open access fishery for groundfish, the following criterion is used. If revenues from groundfish represent less than half of total revenue for a vessel landing some amount of groundfish, those landings are considered incidental, and the corresponding vessel can be classified as having made a landing in the incidental open access sector.

These incidental open access fisheries may also account for substantive amounts of bycatch, especially for overfished groundfish species. A range of fisheries, identified by the target species, comprise this sector. These include ocean (pink) shrimp, spot prawn, ridgeback prawn, California and Pacific halibut, Dungeness crab, salmon, sea cucumber, coastal pelagic species, highly migratory species, and the gillnet complex. A summary description of these fisheries follows.

3.4.11.1 California Halibut Fishery

The commercial California halibut fishery extends from Bodega Bay in northern California to San Diego in Southern California, and across the international border into Mexico. California halibut, a state-managed species, is targeted with hook-and-line, setnets and trawl gear, all of which intercept groundfish. Trawling for California halibut is permitted in federal waters (3-200 nm from shore) using trawl nets with a minimum mesh size of 4.5 inches. Trawling is prohibited within state waters (0-3 nm) except in the designated California halibut trawl grounds, which encompass the area between Point Arguello (Santa Barbara County) and Point Mugu (Ventura County) in waters beyond 1 nm from shore. Bottom trawls used in this area must have a minimum mesh size of 7.5 inches and trawling is closed here from March 15 to June 15 to protect spawning adults. Also, California requires a nearshore trawl bycatch permit to land shallow nearshore rockfish, California scorpionfish, California sheephead, cabezon and greenlings. An open access trawler with a bycatch permit has been allowed to land a maximum of 50 pounds per landing of these species in recent years.

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.

3.4.11.2 Dungeness Crab Fishery

The Dungeness crab fishery is divided between treaty sectors, covering catches by Indian Tribes, and a non-treaty sector. The crab fishery is managed by the states of Washington, Oregon, and California with inter-state coordination through the Pacific States Marine Fisheries Commission. This fishery is managed by season, sex and size of crab. Only male crabs may be retained in the commercial fishery (thus protecting the reproductive potential of the populations). The fishery has open and closed seasons, and a minimum size limit is imposed on commercial landings of male crabs. In Washington, the Dungeness crab fishery is managed under a limited entry system with two tiers of pot limits and a December 1 through September 15 season. In Oregon, 306 vessels made landings in 1999 during a season that generally starts on December 1. 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. Distinct fisheries occur in Northern and Central California, with the northern fishery covering a larger area. 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.

3.4.11.3 California Gillnet Complex Fishery

The gillnet complex is managed by the State of California and comprises two gear types. Fishers use setnets to target California halibut (discussed above), white seabass, white croaker, and sharks. Driftnets are used for California halibut, white croaker, and angel shark. Most of the commercial catch is sold in the fresh fish market, although a small amount is used for live bait. Currently, the only restriction on catches of white croaker off California is a small no-take zone off Palos Verdes peninsula. In the early 1990s, California's set gillnet fishery was subject to increasingly restrictive state regulations addressing high marine bird and mammal bycatch mortality. This forced the fleet into deeper water where shelf rockfish became their primary target. However, as open access rockfish limits became smaller, there was a shift from targeting shelf rockfish with setnets to the use of line gear in the more lucrative nearshore live-fish fishery. Thus, many fishers that were historically setnet fishers have changed their target strategy in response to increasing restrictions and changing market value.

3.4.11.4 Pink Shrimp Fishery

The pink (ocean) shrimp fishery is managed with uniform coastwide regulations by the states of Washington, Oregon, and California. The Council has no direct management authority. The season runs from April 1 through October 31. Pink shrimp may be taken for commercial purposes only by trawl nets or pots. Most of the pink shrimp catch is taken with trawl gear with a between-knot mesh size ranging from 3/8 inch to one inch between knots. In some years the pink shrimp trawl fishery has accounted for a significant share of canary rockfish incidental catch. Since canary rockfish was designated as overfished, all canary rockfish harvests have been greatly restricted. To reduce bycatch of canary rockfish in the shrimp trawl fishery, the states have mandated the use of finfish excluders.

3.4.11.5 Pacific Halibut Fishery

Pacific halibut harvest levels and gear restrictions are set by the International Pacific Halibut Commission (IPHC), with implementing regulations set by Canada and the U.S. in their own waters. A license from the IPHC is required to participate in the commercial Pacific halibut fishery. Commercial halibut fishers use bottom setline gear; any halibut caught in trawls or traps must be released. The commercial sector off the West Coast, IPHC Area 2A, has both a treaty and non-treaty sector. The directed commercial fishery in Area 2A is confined to south of Point Chehalis, Washington, Oregon, and California. In the non-treaty commercial sector, 85% of the harvest is allocated to the directed halibut fishery and 15% to the salmon troll fishery to cover incidental catch. When the Area 2A total allowable catch (TAC) is above 900,000 pounds, halibut may be retained in the limited entry primary sablefish fishery north of Point Chehalis, Washington (46°53'18" N latitude). In 2001, the TAC was above this level for the first time, and 56% (47,946 pounds) of the allocation was harvested. Area 2A licenses, issued for the directed commercial fishery, have decreased from 428 in 1997 to 260 in 2003.

3.4.11.6 Salmon Troll Fishery

The ocean commercial salmon fishery, both non-treaty and treaty, is under federal management with a suite of seasons and total allowable harvest. The Council manages fisheries in the EEZ while the states manage fisheries in their waters (within three nm). All ocean commercial salmon fisheries off the West Coast states use troll gear. Chinook and coho are the principal target species with limited pink salmon landings in odd-years. However, commercial coho landings fell precipitously in the early 1990s and remain very low. Reductions in landings are mainly due to diminished opportunity as salmon populations have declined. Many natural salmon runs on the West Coast have been listed under the ESA. Ocean fisheries are managed based on zones that 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.

3.4.11.7 Spot Prawn Fishery

Spot prawn trawling is now prohibited coastwide under state regulations. Prior to the prohibition, the prawn trawl fishery was categorized in the groundfish open access (exempted trawl) sector. California had the largest trawl prawn fishery with about 54 vessels operating from Bodega Bay south to the U.S./Mexico border. The State of California has banned the use of trawl gear for this species due to concerns over bycatch of overfished groundfish and other species. Standard gear was a single-rig shrimp trawl with roller gear, varying in size from eight-inch disks to 28-inch tires. Washington and Oregon have also phased out its trawl fishery by converting their trawl fisheries to pot/trap fisheries. In California, area and season closures for the trawl fleet were previously implemented to protect spot prawns in the Southern California Bight during their peak egg-bearing months of November through January. These closures, along with the development of ridgeback prawn, sea cucumber, and other fisheries, and also greater demand for fresh fish, kept spot prawn trawl landings low and facilitated growth of the trap fishery with a live prawn segment. The fleet operates from Monterey Bay - where 6 boats are based - to Southern California, where a 30 to 40 boat fleet results in higher production. In both fishing areas traps are set at depths of 600 feet to 1,000 feet along submarine canyons or along shelf breaks. Between 1985 and 1991 trapping accounted for 75% of statewide landings; trawling accounted for the remaining 25% (Larson and Wilson-Vandenberg 2001). Landings continued to increase through 1998, when they reached a historic high of 780,000 pounds. Growth in participation and a subsequent drop in landings led to the development of a limited entry program. Other recent regulations include closures, trap limits, and an observer program.

3.4.11.8 Ridgeback Prawn Fishery

The ridgeback prawn fishery is managed by the State of California. In 2003, California has also prohibited trawling for this species due to concerns about bycatch of overfished groundfish and other species in this fishery. Ridgeback prawns occur from Monterey, California to Cedros Island, Baja, California, at depths ranging from less than 145 feet to 525 feet. According to Sunada *et al.* (2001) this fishery occurs exclusively in California, centered in the Santa Barbara Channel and off Santa Monica Bay. In 1999, 32 boats participated in the ridgeback prawn fishery. Traditionally, a number of boats fish year-round for both ridgeback and spot prawns, targeting ridgeback prawns during the closed season for spot prawns and vice versa. Most boats typically used single-rig trawl gear.

Prior to the trawl prohibition, the fishery was closed during June through September to protect spawning female and juvenile ridgeback prawns. An incidental take of 50 pounds of prawns or 15% by weight was allowed during the closed period. During the season, a maximum of 1,000 pounds of other finfish could be landed with ridgeback prawns, of which no more than 300 pounds per trip could be groundfish, per federal regulation. Other regulations included 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.

3.4.11.9 Sea Cucumber Trawl Fishery

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

Two species of sea cucumbers are fished in California: the California sea cucumber, also known as the giant red sea cucumber, and the warty sea cucumber. The warty sea cucumber is fished almost exclusively by divers. The California sea cucumber is caught principally by trawling in southern California , but is targeted by divers in northern California. In 1997 the state established separate, limited entry permits for the dive and trawl sectors. Permit rules encourage transfer to the dive sector, which now accounts for 80% of landings. There are currently 113 sea cucumber dive permittees and 36 sea cucumber trawl permittees. Many commercial sea urchin and/or abalone divers also hold sea cucumber permits and began targeting sea cucumbers more heavily beginning in 1997. At up to $20 per pound wholesale for processed sea cucumbers, there is a strong incentive to participate in this fishery.

3.4.11.10 Coastal Pelagic Species (CPS) Fisheries

CPS include northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel and market squid. They are largely landed with round haul gear (purse seines and lampara nets). Vessels using round haul gear are responsible for 99% of total CPS landings and revenues per year. The southern California round haul fleet is the most important sector of the CPS fishery in terms of landings. This fleet is primarily based in Los Angeles Harbor, along with fewer vessels in the Monterey and Ventura areas. The fishery harvests Pacific bonito and tunas as well as CPS. The fleet consists of about 40 active purse seiners averaging 20 m in length. Although these fisheries are concentrated in California, CPS fishing also occurs in Washington and Oregon. In Washington, the sardine fishery is managed under the Emerging Commercial Fishery provisions as a trial commercial fishery. The target of the trial fishery is sardines; however, anchovy, mackerel, and squid are also landed. The fishery is limited to vessels using purse seine gear. It is also prohibited inside of three miles and logbooks are required. Eleven of the 45 permits holders participated in the fishery in 2000, landing 4,791 mt of sardines. Three vessels accounted for 88% of the landings. Of these, two fished out of Ilwaco and one out of Westport. In Oregon, the sardine fishery is managed under the Developmental Fishery Program with annually-issued permits; 15 permits were issued in 1999 and 2000 and 20 in 2001. Landings, almost all by purse seine vessels, have rapidly increased in Oregon: from 776 mt in 1999 to 12,798 mt in 2001. The number of vessels increased from three to 18 during this period.

The Council manages these fisheries under its CPS FMP. Because stock sizes of these species can radically change in response to ocean conditions, the CPS FMP takes a flexible management approach. Pacific mackerel and Pacific sardine are actively managed through annual harvest guidelines based on periodic assessments. In 2003, the Council established an interim management line for allocation of the annual Pacific sardine harvest guideline. The management line splitting the northern and southern components of the fishery occurs now at Point Arena (~39° N latitude). Northern anchovy, jack mackerel, and market squid are monitored through commercial catch data. If appropriate, one third of the harvest guideline is allocated to Washington, Oregon, and northern California (north of 35°40' N latitude) and two-thirds is allocated to southern California (south of 35°40' N latitude). An open access CPS fishery is in place north of 39° N latitude and a limited entry fishery is in place south of 39° N latitude. The Council does not set harvest guidelines for anchovy, jack mackerel, or market squid.

3.4.11.11 Highly Migratory Species (HMS) Fisheries

HMS include tunas, billfishes, dorado and sharks. Management of HMS is complex due to the multiple management jurisdictions, users, and gear types targeting these species. Adding to this complexity are oceanic regimes that play a major role in determining species availability and which species will be harvested off the U.S. West Coast in a given year. The states have regulated the harvest of HMS in the past, but the Council recently approved an FMP for fisheries prosecuted in the West Coast EEZ and by vessels originating from West Coast ports fishing beyond the EEZ. There are five distinctive gear types used to harvest HMS commercially, with hook-and-line gear being most common. Other gear types used to target HMS are driftnet, pelagic longline, purse seine, and harpoon. While hook-and-line can be used to take any HMS species, traditionally it has been used to harvest tunas. Drift gillnet for swordfish, tunas and sharks off California and Oregon is most likely to intercept groundfish, including spiny dogfish and yellowtail rockfish.

Albacore is commonly caught with troll gear. The majority of albacore are taken by troll and jig-and-bait gear (92% in 1999), with a small portion of fish landed by gillnet, drift longline, and other gear. These gears vary in the incidence of groundfish interception depending on the area fished, time of year, as well as gear type. Overall, nearly half of the total landings of albacore (millions of pounds coastwide) were landed in California. Other gear includes pelagic longline, used to target swordfish, shark and tunas; and harpoon for swordfish off California and Oregon. Some vessels, especially longliners and purse seiners, fish outside of the U.S. EEZ, but may deliver to West Coast ports.

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4.0 Impacts of the Alternatives

4.1 Introduction

In this chapter, the potential impacts of the six alternatives, including no action, are analyzed by evaluating seven types of effects required by NEPA: direct and indirect, cumulative, short and long term, and irreversible and irretrievable effects.

Each of the six alternatives would establish a bycatch mitigation program, including mitigation policies and the types of measures that would be used to reduce bycatch and bycatch mortality as much as practicable.   Each alternative also would establish the bycatch reporting methodology necessary to support the bycatch mitigation program.

Bycatch mitigation effects fall into four broad categories:

- Avoid catching fish that will not be kept and avoid catching other animals
- Reduce the mortality of fish and other animals that are caught and released
- Reduce the waste of fish that are caught and are dead or will die as a result of being caught
- Avoid unobserved mortality of fish and other animals that directly results from fishing gear.

In addition, there are social and economic effects. The highest priority of bycatch mitigation is to reduce the capture of any marine plant or animal that is unintended or unwanted. The goal is to harvest desired groundfish with the minimum impact on all other fish and animals. The second priority is to minimize damage to fish and animals that should or would not be caught in a perfectly selective fishery.

To evaluate the effects and effectiveness of various mitigation tools, it is useful to understand some basic relationships and linkages. The amount of catch of any fish or other animal is related to the amount of fishing effort, the selectivity of the gear, and the number of animals present. To reduce catch, any or all of these three factors can be modified.

The complicated relationships among these factors become evident when one considers more than one species at a time. No gear is equally selective for two species because of differences, however small, in species shape, size and behavior. Also, species abundance and distribution are never identical. This means that with any amount of fishing effort, the catch of two species will never be the same. The extent of geographic overlap affects the co-occurring catch, as does the degree of similarity in size and shape. While overall averages can be computed, those ratios may not provide the necessary information to develop comprehensive solutions.

We describe the capture methods of the various fishing gears, including selectivity features and placement factors (that is, where and in what conditions can they be used?). We identify non-gear related regulations that can be used, such as harvest specifications, allocation, retention limits, catch/mortality limits, time/area management, and limiting access (reducing fleet size). Collectively, we refer to these management measures as the bycatch mitigation toolbox. Potential effects of each tool are then described. Next, we rank the effects and effectiveness of each tool, and then apply those ranks to each alternative. In this stepwise process, we provide the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes.

We describe in some detail the effects of each tool, focusing on effectiveness, collateral/side effects, etc. We also discuss the economic factors that influence fishing behavior, including costs of capturing unwanted fish and of avoiding their capture.

Recognizing that each alternative is a combination of objectives, emphasis, and mitigation tools, we then describe the combined effects of each alternative. Synergistic and antagonistic effects are identified and described to the extent possible.

Next, we rank the alternatives as to how well they achieve the desired results, noting the administrative and user costs associated with each. The bycatch mitigation programs described in each of the alternatives have differing levels of practicability and/or costliness. Each of the alternatives is rated for its practicability in terms of its effects on management and enforcement costs.

The emphasis, levels of effects, and degree of impacts on biological and fishing communities vary among the different alternatives. One objective of this analysis is to illustrate this tension and evaluate pros and cons, benefits and costs of each alternative. Impacts of alternatives to groundfish, non-groundfish, ecosystem and habitat, and social/economic environment will be evaluated. As this EIS is programmatic in nature, critical comparative methods will be used. Possible analytical methods that might be used to quantify impacts of more specific plans to reduce bycatch, bycatch mortality, and to improve accountability are described. Cost estimates of alternative monitoring programs, where available, are provided.

4.1.1 How this Chapter is Organized

##Revise this after you've figured out the end sections##
This section generally follows the organization of Chapter 3. This chapter outlines available bycatch mitigation tools and general impacts of their application. The methods used to evaluate alternatives are described next. Each alternative is presented with corresponding tools used to mitigate for bycatch, bycatch mortality, and to address bycatch accountability. Direct and indirect effects are

described in Sections 4.2 through 4.11 Impacts to physical environment are outlined in Section 4.2. Impacts of the seven alternatives on the biological environment are described in Section 4.3. Detailed effects of alternatives on groundfish are contained in Appendix B. Section 4.4 provides analysis of impacts on the social and economic environment. Section 4.5 summarizes impacts of each alternative proposed monitoring program. Section 4.6 summarizes impacts to the biological environment. Section 4.7 describes socioeconomic impacts.

4.1.2 Description of Critical Comparative Methods Used: The Ranking System

Fishing has both intended effects (catching desirable fish) and unintended effects. The costs and benefits of these effects can rarely be measured or evaluated precisely, and are often subjective, based on the perspective of the observer. Bycatch and bycatch mortality of living resources are unintentional side effects of fishing; they can be viewed as collateral damage to other living marine resources. These effects can broadly be described as direct effects, indirect effects, and cumulative; short-term and long-term; reversible and irreversible. Some effects equate to irretrievable costs, meaning permanent change that cannot be undone, or would require such a huge investment that attempted retrieval/correction would be futile.

Fisheries data reporting and monitoring are human activities to determine the effects of fishing activities. Some can be accomplished by the fishers themselves; other monitoring is most effectively done by professionals trained in data recording and/or monitoring. Often it is impossible for the fisher or vessel crew to perform both fishing activities and data activities simultaneously; it requires additional manpower. Some data collection and monitoring can be done on shore, some can only be done at-sea. Enforcement programs are also an element of an effective management plan.

The fishery management tools chosen to mitigate intentional and unintentional effects of fishing, such as bycatch and bycatch mortality, are compared for each alternative. In addition, different approaches to fishery monitoring used to estimate total catch and improve accountability are compared.

A numerical ranking scheme is used to help evaluate differences and determine significance of direct, indirect, and cumulative effects. This ranking scheme also contributes to a practicability analysis; that is, it will help determine how practicable a particular tool or alternative may be. The ranking scheme uses ranges of scores. A narrow range (a scale of 1 - 2) is used where there is little difference in effects across alternatives and species, or where the distinction is very clear. For example, the effect either occurs or does not occur, and there is no median. A broader range (for example, a scale of 1 to 5) is used where the tools (or their application) have a wider range of effects on bycatch, bycatch reduction, and accountability. This is useful where there is a gradation of effects or effectiveness. Anticipated costs are also ranked (high or low). The analysts assigned the ranks based on documented research, previous analyses, personal experience and best professional judgement. In each case these are qualitative judgements, and the ranking are not intended to be viewed as objective measurements or calculations. A lower numerical score (for example, 1) indicates the tool has a greater effect on reducing bycatch, bycatch mortality, or it increases accountability compared to the status quo alternative and possibly other alternatives.

The following example of catch limits uses a scale of 1 - 4. The example is provided to help clarify the ranking system. Differences in ranking between alternatives are due to differences in degree of effectiveness in the application of a tool (See Section 4.1.5).

Catch limits in various forms may be used to reduce bycatch of groundfish species (see Tables 4.3.1 - 4.3.12 in Section 4.3). For Alternatives 1-3, the Council would use a score card approach to keep track of soft allocations or divisions of a total catch OY, but reaching a predicted value does not trigger sector closure. Alternative 4 uses individual vessel caps for overfished species and hard sector caps; these do trigger closure either for individual vessels or for the entire sector. Alternative 5 uses a combination of individual fishing mortality limits (called RSQs in this document), a 100% retention requirement for overfished species, and IFQs for other groundfish. Individual vessels must stop when they reach a quota. Alternative 6 combines no-take marine reserves, RSQs, IFQs, and a 100% retention requirement for all groundfish. Alternative 7, the preferred alternative initiates sector based catch limits outlined in alternative 4 and contemplates future use of IFQs described in alternative 5.

Soft sector score cards are less effective at controlling bycatch, in part because there is no retention requirement. A catch cap with a retention requirement is a more effective tool for reducing bycatch. This is especially true when combined with a higher level of monitoring, incentives to keep the catch, or means to purchase additional catch share. Ranking of the catch limit tool for each alternative, therefore, is influenced by the specific application of the tool and by other tools that act as catalysts, increasing or decreasing the effectiveness of the tool.

In this example, Alternatives 1, 2 and 3 each receive a score of 4 (lowest effectiveness) because they use soft sector score card catch limits; that approach is less effective at reducing bycatch and bycatch mortality compared to other bycatch mitigation tools. Sector caps in Alternative 4 receive a rank of 2 (moderately effective) for overfished groundfish and 3 (less effective) for other groundfish. For Alternatives 5 and 6, the application of catch limits as RSQs and IFQs receive a rank of 1 (most effective) at controlling bycatch and bycatch mortality for overfished species. Alternatives 5 and 6 have different ranks for other groundfish because the retention requirements are not the same. Alternative

7 receives a rank of 1 for overfished groundfish and 2 for other groundfish as increased monitoring and full retention requirements are phased in.

The following steps are used to evaluate the tools and alternatives that employ them:

- **Identify bycatch factors** - Bycatch and bycatch mortality are the products of several factors related to stock status, past and present management strategies, fishing strategies, fish behavior, and other biological characteristics. In combination, these factors make fish more or less vulnerable to bycatch and bycatch mortality. Key factors and characteristics affecting bycatch and bycatch mortality are summarized at the beginning of each species section.
- **Rationalize the mitigation effect** - Each tool has a way (or ways) of reducing bycatch, bycatch mortality, or improving accountability. Where possible, direct and indirect effects for different tools are justified or rationalized. Rationale is based on literature, case studies, and testimony of experts familiar with bycatch issues.
- **Identify direct and indirect effects** by bycatch issue, and species impacted, for the various tools - Different application of a tool may reduce bycatch in different way or to a different degree.
- **Rank the effects of tools and alternatives** - Some tool alternatives are explicit in terms of level of effect anticipated. If a tool/alternative can reasonably be expected to have significant impact compared to status quo, it would be ranked higher than status quo. If a tool/alternative has a significant impact compared to status quo and another alternative, it would be ranked higher than status quo and the other alternative. Rankings are based on evidence provided in literature, reports, or best professional judgement. Impacts of the various alternatives and tools on groundfish species are summarized in section 4.3.1. Impacts on non-groundfish species are summarized. This EIS describes methods that could be used to quantify measures where possible.
- **Rank the effects of approaches used to improve accountability** - Data reporting, recordkeeping, and monitoring approaches are also evaluated for each alternative. Each alternative is then ranked as to its relative effect at improving a particular bycatch accountability issue.
- **Summarize cumulative and indirect effects**.
- **Rank the tools and alternatives** - Mitigation effect, rationale, and scores are summarized for tools within each alternative and between alternatives. First, the tools are ranked by alternative as to their relative ability to reduce bycatch, bycatch mortality, and improve accountability. A lower number indicates better performance in reducing bycatch or improving fisher accountability. Ranking includes summary effects of different monitoring approaches used by each alternative. Next, each alternative is ranked for its relative effect at addressing a particular bycatch issue. Relative ease of enforcement and anticipated compliance costs are ranked for each alternative as well.

4.1.3 Bycatch Mitigation Tools

Management measures, referred to here as mitigation tools, are the rules and requirements to control fishing activities and to mitigate the effects of fishing on fishery resources and other components of the natural environment. Management measures are the tools used to achieve the goals and objectives of a management program. In the context of this EIS, they are the means for reporting, monitoring, and reducing bycatch and bycatch mortality. Their purpose is to contribute to achievement of the bycatch management strategy.

Table 4.1.1 Bycatch Mitigation Tools: The Mitigation Toolbox

Harvest Levels		ABC/OY
		sector allocations
		trip (landing) limits
		catch limits
		individual quotas
Discard Caps (limits and prohibitions)		
Gear Restrictions		
	Trawl	mesh size
		footrope diameter/length
		net height
		codend mesh and dimensions
		design: on-bottom or pelagic
		bycatch reduction devices (BRDs)
	Line	number of hooks
		hook size
		line length
		retrieval requirements
	Pot/trap	number of pots
		pot size
		escape panel in net/pot
		retrieval requirements
	Other	setnets (gill and trammel nets)
Time/Area Restrictions		seasons
		area closures
		depth closures
		marine reserves
Capacity (number of participants)		permits/licenses/endorsements
		limited entry
Capacity (Vessel Restrictions)		vessel size
		engine power
		vessel type
Monitoring/Reporting Requirements		permits/licenses
		registrations
		Fish tickets (commercial landings/ sales receipts)
		Vessel logbooks
		Surveys
		Punch cards/tags (recreational)
		Port sampling/on-shore observers
		On-board observers
		Vessel monitoring systems (VMS)
		Onboard video recording devices
		Enforcement

4.1.3.1 Establishing Definitions to Characterize Management Strategies

In analyzing the utility, effects, practicability and effectiveness of various management measures, it is necessary to understand the cause and effect relationships as well as the linkages between tools, toolboxes, objectives, policies and goals. Tools and toolboxes are most easily described by their function, along with a specific vocabulary for function-related characteristics. For example, we can describe a wrench as a tool used to tighten or loosen nuts. Although it could also be used to pound, pry, and dig, it does not do those activities as effectively as other tools would. Similarly, we can describe a hammer as a tool used to pound nails, flatten metal, align parts, and separate attached components. Combined with a chisel, it can be used to shape objects. Incorrect or careless use of a hammer or management tool can result in unintended results; thoughtful or imaginative use can result in several desired effects simultaneously.

4.1.3.2 Description of Bycatch Mitigation Tools

The primary components of a fishery that can be managed are gear, vessels, harvest levels, times and areas fished, and capacity (number of vessels and potential effectiveness of those vessels). Other management tools include monitoring/ reporting requirements. Bycatch mitigation tools, or measures, are the means used to manage these components. The following is a description of the different tools.

Harvest Level Specifications: Groundfish harvest specifications are the first level of conservation and management to ensure that harvest stays within sustainable levels. Harvest specifications are typically set biennially[1/] and are based on stock assessments whenever possible.[2/] Assessment scientists follow rigorous scientific procedures throughout the stock assessment process, taking into account as many factors as possible to determine the past, present and future condition of the stock. A harvest rate is applied to the best estimate of current stock abundance, taking into account age structure of the population, anticipated reproduction in future years, and other information on stock condition. Different species are capable of sustaining different harvest rates; typically, fast growing species that reproduce rapidly can be harvest at higher rates than slow growing species that reproduce slowly or sporadically. Many rockfish species fall into this second category, while flatfish are more prolific.

Assessment scientists apply the appropriate rate to the biomass estimate to calculate an *ACCEPTABLE BIOLOGICAL CATCH* (ABC). For stocks below 40% of their unfished population size (biomass or productivity level), the FMP harvest control rule adjusts the harvest downward to encourage population growth; this harvest level is the *OPTIMUM YIELD* (*OY*) for the stock. In the case of an *OVERFISHED* stock (one that is below 25% of its unfished population estimate), OY is set to rebuild the stock to the 40% level, according to a rebuilding plan. The default formula for calculating OY is described in detail in the FMP and SAFE document, and is commonly referred to as the *40-10 OY* adjustment. OY can apply to total catch of a single species or species group; it can apply throughout the entire region or to smaller management areas. Estimated bycatch (discard) levels are also taken into account so the best estimates of total catch do not exceed the intended levels.

[1/] Historically, the Council has set harvest specifications on an annual basis. Amendment 17 to the FMP introduced a biennial process and the first two-year fishing period will be 2005-2006.

[2/] The stock assessment process is described in detail in the groundfish FMP and SAFE documents. Comprehensive stock assessments have been prepared for only about 20 species due to data limitations. In some cases, harvest specifications are based on historical harvest levels.

In some cases, the calculated OYs of species in an assemblage are out of proportion with the typical catch ratios in the fishery. This is especially true in assemblages that include overfished stocks. In those cases, harvest rates for abundant stocks may need to be restricted in order to protect the weak stock(s). In such cases, the OY for an abundant stock may be reduced to reflect the expected smaller harvest.

OYs for several stocks are subdivided and allocated among Tribal, recreational and commercial fisheries. The commercial allocation is typically further subdivided between the *LIMITED ENTRY* and *OPEN ACCESS* sectors. In a few cases, most notably sablefish and whiting, a limited entry allocation may be further subdivided.

Trip Limits, Bag Limits, and Catch Limits: *Trip limits* are retention and landing limits (by species or species complex) that apply to individual commercial fishers, vessels, permits, gear groups, or other defined groups in a given area for a given period of time. *Bag limits* are the equivalent for recreational fishers. Any groundfish captured beyond a specified trip or bag limit are classified as bycatch (if discarded) or a violation (if retained). Trip and bag limits, as they have traditionally been applied, do not require fishers to stop fishing when the specified limit has been reached. As long as the fisher/vessel does not retain more fish than the limit, additional fishing is allowed. The intention of trip and bag limits is to remove the incentives to catch more fish. Any fish beyond the limit must be released or discarded, even if it is dead. This creates an incentive to avoid catching the fish, or, conversely, a level of disincentive based largely on the cost of sorting and extra handling, or a feeling of being wasteful. The incentive/ disincentive is not a specified monetary amount, and is not equal in all individuals. On the other hand, failure to release or discard excess groundfish (or other species) is a fishing violation. Each fisher has (potentially) the same monetary incentive to discard, which may be stronger than the incentive to avoid catching.

Over the years, the Council and NMFS have revised the definition and use of trip limits, partly in response to fishermen's concerns about discard and waste of useable fish. Fishers and managers realized that waste would occur and, as a policy decision, the FMP acknowledged a level of discard was inevitable and acceptable. This was reflected in the definition of OY, which originally included only those fish that could be captured and retained under the gear and retention limits adopted each year. The public ethic concerning fisheries waste has changed over the years, as reflected in the 1996 *SUSTAINABLE FISHERIES ACT* mandate to minimize bycatch to the extent practicable.

Initially, trip limits were designated as per-trip limits, and sometimes the number of trips was also restricted (for example, not more than one trip per week might be allowed).

Catch limits, on the other hand, restrict the amount of fish that may be *caught*, whether landed or discarded. Catch limits require fishers to stop fishing when a limit is reached. Catch limits have not been used in the federal groundfish management program but are included in three of the alternatives under consideration in this EIS.

INDIVIDUAL QUOTAS (IQS)**,** sometimes referred to as *INDIVIDUAL FISHING QUOTAS* or IFQS, are a tool that can be set up to be driven by market/economic incentives. IQs can be allocated to an individual, group, corporation, or vessel. IQs can be transferable (ITQs) or non-transferable. They can be based on a share of the total OY, or a specified amount of fish. They can grant ownership, or grant an opportunity to catch.

IQs can be defined as landing limits or as catch limits. If they are applied as catch limits, fishermen still have the option to discard unwanted fish, but those fish would count against their quota. This would increase the incentive to keep the fish rather than use them as bycatch. It would also mean the quota holder would have to stop fishing immediately upon reaching any quota limit or acquire additional quota share.

It may be useful to distinguish categories of species based on their stock status or other factors. For example, overfished species would likely be more restricted than healthy stocks. A designation such as *RESTRICTED SPECIES QUOTA* (*RSQ*) might be useful to distinguish overfished groundfish stocks from prohibited species. Catch limits applied to prohibited species are typically called prohibited species catch (PSC) limits or caps.

Discard Caps (limits and prohibitions): Discard caps (sometimes called discard limits in this EIS) have not been used in managing the West Coast groundfish fisheries. However, vessels participating under an Exempted Fishing Permit in the shorebased Pacific whiting fishery are prohibited from sorting and discarding fish at sea. This could be interpreted as a discard cap of zero. As discard caps might be applied more generally, they would place a limit on the amount of any species that could be discarded after it is captured. Two general purposes have been identified for discard limitations. First, under the Magnuson-Stevens Act, fish are only considered bycatch if they are discarded. By limiting (or prohibiting) the amounts that may be discarded, bycatch can be directly reduced or eliminated. Second, discard prohibitions (caps set at zero) can facilitate shore-side observations of bycatch instead of shipboard observations. In order to be effective, some method of verification is necessary.

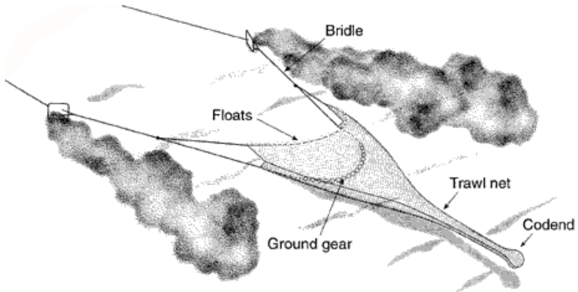
Few groundfish captured near the seafloor in deep water (for example, water deeper than 100 fathoms (600 feet)) survive the trauma of temperature and pressure change, crushing and abrasion (in trawl nets), and other physical effects. Notable exceptions are sablefish and lingcod, both of which lack an air bladder susceptible to excessive expansion. Pacific halibut is another species that appears to be less vulnerable to these effects, although survival of trawl-caught halibut is only about 50% at best. Bycatch mortality rates of these species would increase if discard caps were established. Rockfish, on the other hand, are particularly susceptible to barotrauma; essentially all shelf and slope rockfish brought from depth to the surface die. Discard caps on these species would not increase mortality rates.

Discarded groundfish, other fish and offal from fishing vessels are scavenged by a variety of marine animals, including seabirds, marine mammals, and various fish and benthic invertebrates. The contribution of discard to these trophic levels has not been assessed quantitatively. Reduction of discarded groundfish and other species would likely have unquantifiable adverse impacts on such species.

Discard caps and prohibitions would require that bycatch be delivered to shore and sold or retained for personal use. For commercial fishers, this would mean delivery and sale to a processing facility. For recreational fishers, it would mean retention until the fisher returns to shore. Commercial fishers would have to find a willing buyer to purchase fish that may not be desirable to established or typical markets. Failing to find a purchaser that would purchase and use these species, a commercial fisher would need to dispose of that bycatch either on shore or at sea.

Gear Definitions and Restrictions: West Coast groundfish fishermen are allowed to use 4 basic gear types to catch groundfish: *TRAWLS*, *HOOK-AND-LINE*, traps (*POTS*), and, in part of California, set nets. (Recreational fishers may also use spears.) These gears capture fish in different ways, and fishermen know how their gear catches fish, what types of fish the gear catches better, and how to best operate the gear to maximum advantage. Every commercial fisherman's intent is to catch fish to make money, and each has an idea of how to make more money at less cost. Catching unwanted species creates costs of sorting the wanted from the unwanted. Fishing in an area with many seafloor hazards can increase costs through damaged or lost gear; refining the gear by adding protective components or tuning it can reduce the risks. Gear definitions, requirements and restrictions can be effective in achieving some management objectives, often at the expense of harvest efficiency. Much of the history of fishing and fishery management is the result of fishermen's efforts to improve their catching efficiency and management trying to reduce their efficiency.

Trawl: West Coast commercial fishers use a variety of otter trawl types. This diversity of gear types is a result of the diversity of fisheries (fishing strategies) and bottom types in the region. The specific gear design used is typically a result of the target species complex (whether they are on the seafloor or higher in the water column) and whether the seafloor is smooth or rough, soft or hard.



Otter trawls are not just simple sieves used to collect everything in their path; they are actually very complex systems designed to target specific types of fish in specific conditions. Trawl gear has several components, including the doors (otter boards), bridles, *FOOTROPE* (ground gear), and the net body, including the *CODEND*. Trawl doors can be of various sizes and designs to match the target strategy and net. Their purpose is to help sink the net to the desired depth, hold the mouth of the net open, and help move fish towards the net. Bridles connect the doors to the net and can be chain, bare wire, or covered wire. The footrope is attached to the bottom front of the net and can include chain-wrapped wire, rubber cookies, rollers, bobbins, and tickler chains.

Bottom trawls are designed to capture fish that are on or near the seafloor, such as *FLATFISH* (flounders). Fish herding is an important aspect of trawl design and depends upon the hydrodynamic forces of the doors and the sediment clouds generated by the ground rigging and footrope. In *BOTTOM TRAWLS*, the footrope is designed to get the fish up off the bottom. The net body can vary based on the head rope height, the amount of overhang, and the mesh sizes of the various net panels. The top of the net typically has floats attached to help hold it open. The doors, ground rigging behind the doors, and the footrope can come into contact with the seafloor. With the exception of the doors, trawl gear must be relatively light on the bottom to maintain its shape and effectiveness. The net itself typically does not drag along the bottom but may sometimes contact the seafloor, especially when there are obstructions. Chafing gear, a protective covering fastened to the underside to prevent abrasion, tearing, and other damage, may be attached to protect the underside of the net from snagging and tearing.

In a cutback trawl, the floats are behind the footrope (ground gear) or the top of the net above the footrope is constructed of wide meshes (or open) so that any fish can escape by swimming upward. This type of net will be required for nearshore fisheries use north of 40°10' N. lat. beginning in 2005. The gear has been tested and shown to be successful at avoiding rockfish, which typically are slightly off-bottom or swim up when startled. Flatfish tend not to swim as far upward, and therefore may not escape as readily.

MIDWATER (*PELAGIC*) *NETS* are used to target Pacific whiting. Smaller mesh (3 inch minimum) is used, compared to 4½ inch mesh used for bottom trawls. Prior to about 1987, midwater nets used for whiting were smaller than those typically used since then. Midwater nets use the doors, bridles, and large mesh to herd fish towards the codend, rather than sediment clouds, and typically do not come into contact with the seafloor.

BYCATCH REDUCTION DEVICES (BRDs) are typically not used in West Coast groundfish trawls but are used by groundfish trawlers in Alaska (to reduce bycatch of Pacific halibut) and by West Coast shrimp and prawn trawlers (to reduce groundfish bycatch).

Potential tools for mitigating trawl gear bycatch deal with several components of a typical trawl that address selectivity and/or placement: mesh size, type of footrope, net size and shape, chafing gear, type or design (on-bottom or off-bottom/pelagic), and use of bycatch reduction devices.

Mesh size - The size and shape of a net's mesh are related to the size and shape of fish it will capture, and these can be adjusted to select for fish of different sizes and shapes. Larger mesh increases the chances for small fish to escape. Smaller trawl mesh catches more small fish along with the larger fish. Mesh selectivity can never be perfect, but much research over the years has been conducted to improve the catching efficiency and selectivity of trawl gear. For the past several years, regulations have specified 4½ inches as the minimum mesh size in West Coast groundfish bottom trawls and 3 inches minimum in midwater trawls. The minimum mesh size in bottom trawls was increased in the early 1990s from 4 inches to 4½ inches to increase escapement of small fish, especially those below marketable size.

Footrope diameter- The footrope of a bottom trawl is the line (a cable, for example) along the bottom front edge of the net that contacts the ocean floor. The footrope is important in making sure the trawl stays in contact with the seafloor but does not dig into the mud or snag on rocks or other structures. The diameter of the footrope can be increased by attaching rollers or bobbins; larger diameter footropes tend to move over the seafloor more smoothly and easily. Larger diameter footropes allow trawls to be used in areas where the seafloor is rough, such as rock piles. Without the protection of large rollers, trawls cannot be fished effectively in those areas. This relationship between footrope diameter and fishing location has been used since 2000 to reduce trawl fishing in rocky areas where overfished rockfish tend to be concentrated. Based on an industry proposal, the Council and NMFS reduced trip limits for most species for vessels that used footropes over 8 inches in diameter. This would reduce trawl encounters with fish species in rocky, high relief areas, especially on the continental shelf.

Trawl size/configuration - Trawls range in size from relatively flat, small, bottom trawls to very wide, tall midwater trawls. The catching capacity of a trawl is related to the dimensions (width and height) of the net; a small net cannot catch as much as a large net. Taller nets cover more of the water column; in bottom trawls, they tend to catch species (such as some rockfish) that hover above the bottom or try to escape upwards. ODFW has been testing a flat-body selective flatfish trawl net. It has had experimental success at avoiding rockfish bycatch. NMFS is proposing to require its use in nearshore trawling north of 40°10' N. lat., beginning in 2005. One way to reduce catching capacity would be to limit net size. This could be accomplished by restricting the maximum length of the footrope, which must match the width of the net.

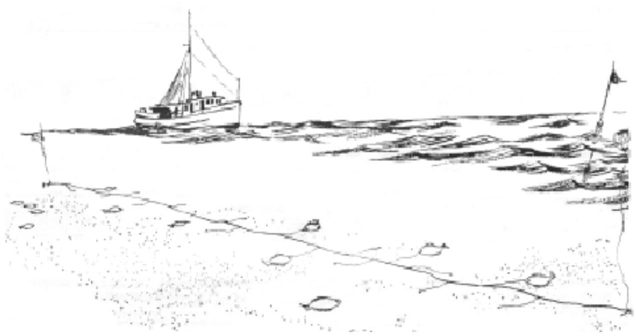
The size of the codend is related to the amount of fish that can be captured and held at any one time. In the early years of the whiting joint venture fishery (e.g., with the USSR and Poland), the processing ships produced fillets and headed/gutted products. Both the size of deliveries and the rate of delivery were controlled to match the processing rates. Production rates were limited by the equipment to prepare these products, and bruised, crushed whiting were too difficult to cut. American catcher vessels were required to make small deliveries using relatively small codends (compared to those used later by vessels delivering to processing ships that produced surimi). In an attempt to keep the high-volume surimi operations out of the whiting fishery (in order to maintain a longer season), some U.S. fishers proposed setting a limit on the size (volume) of codends that could be used. The suggested regulation was not approved for several reasons including the allocative effects and impact on economic efficiency. Effects of small trip limits, need for reduced harvest of overfished stocks, and bycatch reduction requirements may provide justification to consider adoption of size restrictions for bottom trawls.

<u>Chafing gear</u> - Chafing gear is used to protect the underside (belly) of the net, including the codend. The types of material used for chafing gear are restricted by regulation to prevent reducing the effectiveness of minimum mesh regulations (i.e., reducing selectivity). Currently, further restrictions are placed on chafing gear in conjunction with the small footrope requirement to reduce the use of trawls in rocky, rough-bottom seafloor areas.

<u>Bottom versus pelagic</u> - Bottom trawls and pelagic/midwater trawls have different uses and selectivities that can be used to achieve certain bycatch reduction objectives. For example, a requirement to use pelagic trawls (which must have unprotected footropes and no chafing gear) would greatly reduce the encounter with animals that live on or in the seafloor. However, the use of large midwater nets could increase the encounter rate with pelagic species that should be avoided.

<u>Bycatch reduction devices (BRDs)</u>- Bycatch reduction devices, as they apply to trawls, are mechanisms that guide or force unwanted species or sizes out of the net and reduce the likelihood they will be captured. They are gear selectivity devices. BRDs have been effective in reducing catches of halibut in certain groundfish trawl fisheries in Alaska. BRDs are also used in other regions to mitigate trawl bycatch of turtles, finfish and other animals. In particular, they are used in West Coast trawl fisheries for pink shrimp and prawns to reduce bycatch of canary and other rockfish. Often BRDs reduce catch rates of the target species, but in some cases fishers can improve gear performance with experience and practice. BRDs have not been investigated in the West Coast groundfish trawl

fishery. However, development of effective rockfish excluder devices could result in increased catches of other species.



Hook-and-Line: West Coast commercial and recreational fishers use a variety of hook-and-line gears. This diversity of gear types is a result of the diversity of fisheries (fishing strategies) targeting various species in the region. The specific hook-and-line gear design used is typically a result of whether the target species or species complex lives on the seafloor or higher in the water column and whether it is sedentary or mobile. Many commercial groundfish vessels are included in the federal groundfish limited license program for stationary (fixed) longline gear. Another name for this is setline gear. Vessels typically fish this gear along the ocean floor for sablefish (blackcod) and/or Pacific halibut, but may take other groundfish and non-groundfish species also.

Other hook-and-line gears are considered OPEN ACCESS which means any commercial fisher (including limited entry vessels) may use them in accordance with state or federal regulations. (Fixed longline gear may also be used by any commercial groundfish vessel, but harvest levels are restricted). Some hook-and-line gear is pulled (trolled) through the water; other longline gear extends vertically from the surface towards the bottom and may drift with the current. Rod and reel is included in the hook-and-line category; this is the typical recreational gear type.

Potential tools for mitigating hook-and-line gear bycatch include the number of hooks, whether the gear is stationary (fixed), pulled (trolled) or free-drifting, the type and size of hooks, how the fixed gear is marked/labeled, maximum length of the line, and how long it may be left unattended. In addition, bycatch reduction devices (BRDs) have been found to reduce bycatch of seabirds in other fisheries by making baited hooks less available or less attractive to birds feeding nearby.

Number of hooks - For the recreational fishery, limits on the number of hooks have been used to reduce the potential catch of overfished rockfish. This is not a selective method to protect any particular species, but rather it reduces the potential catch of all species that might be taken. It may be used in combination with other restrictions, such as the amount of weight that may be attached to the line, and the number of fishing rods an individual may use.

Stationary (setline) versus mobile gear - Mobile gear is being defined here as all hook-and-line gear that is not anchored at both ends, and it includes a variety of configurations. The distinction is used primarily for setting separate trip limits for limited entry and open access sectors. However, these gears often have substantially different selectivity and applicability. For example, setline gear cannot be effectively used to catch many pelagic (off-bottom) species. It can be fished throughout the water column and need not contact the seafloor, although some mobile line gear does contact the bottom (for example, dingle bar gear typically is bounced along the seafloor). Vertical longlines (sometimes called Portuguese longlines) are multi-hook lines, weighted at the bottom, that hang vertically from a vessel or a float, drifting with the current. Fly gear is trolled nearer the surface. Also, a variety of hook-and-line gear is used to catch nearshore (shallow water) groundfish and other species for the live fish market.

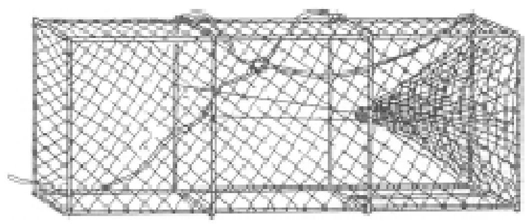
Type and size of hooks - Hook size and type can affect selectivity. For example, commercial sablefish fishers now use circle hooks because they tend to retain more fish and to hook the fish more in the lip rather than deeper in the mouth. In earlier years, the J-hook was the primary gear. The use of small hooks can increase selectivity for small-mouth fish (such as sand-dabs, a type of flatfish) and avoid larger-mouth rockfish. Also, barbless hooks are required in some (non-groundfish fisheries) to improve survival of fish that must be released. Where the species suffer from *BAROTRAUMA* (pressure change), barbless hooks have little utility.

Gear marking (identification) requirements - Federal regulations require that fixed-longline gear be clearly and visibly marked at both ends with the vessel or fisher's identification and with a flag, or radar reflector. (Other line gears do not have this requirement because they are not left unattended.) Marking requirements serve both a safety and enforcement function. The safety requirement is that the gear be marked so it does not present a navigation hazard (collision or entanglement). The identification is so the owner of any lost or illegal gear can be identified. These requirements have little if any affect on bycatch other than to aid in recovery of lost gear.

Gear retrieval requirements - Baited setlines continue to fish as long as any hooks remain baited. At the end of the fixed-gear sablefish season, vessels may be required to stop fishing at a specific time. Retrieving gear is a fishing activity, so a stop fishing order means any gear must be left in place. Typically, after a specified period of time, the gear may be retrieved, although it may be necessary to release any fish. Any fish that must be released are considered bycatch. To prevent excessive bycatch of this type, gear must be retrieved within a specified period of time, unless the vessel is incapable of retrieving it (for breakdown, weather or safety reasons).

Bycatch reduction devices (BRDs) - Bycatch reduction devices, as they apply to longline fisheries in other regions, are devices that deter seabirds from chasing baited hooks as the gear is set. One method is to deploy the gear through a tube that extends below the water surface; another method is to use flags or other objects that intimidate birds from chasing the bait. Thus, the BRDs reduce the likelihood seabirds will be killed. This is particularly important for listed species such as short-tailed albatross. Seabird deterrents devices have been effective in reducing seabird bycatch in Alaska groundfish longline fisheries and Pacific Ocean pelagic longline fisheries. The need for seabird BRDs has not been investigated in the West Coast groundfish longline fishery. The NMFS Observer Program records information on groundfish longline-seabird interactions; that information will be evaluated to determine the number of seabird mortalities and the need for BRDs.

Pot/Trap: The words "pot" and "trap" are used interchangeably to mean baited cages set on the ocean floor to catch various fish and shellfish. They can be circular, rectangular or conical and may be set out individually or fished in strings. All pots contain entry ports that allow fish to enter. Current regulations require that all pots used for groundfish must have biodegradable escape panels or fasteners that are intended to disable the trap if it becomes lost or abandoned. Otherwise, lost traps could continue to capture fish, a condition known as *GHOST FISHING*. Individual groundfish pots must be marked at the surface; strings of pots must be marked at each terminal end with a pole and flag and a light or radar reflector.



Traditionally, groundfish pots have been used on the West Coast primarily to target sablefish. Commercial groundfish pot gear is included in the federal groundfish limited licence program for stationary (fixed) gear. Vessels typically fish this gear along the ocean floor for sablefish. Pots are also considered an open access gear, which means any commercial fisher (including limited entry vessels) may use them in accordance with state or federal regulations. Trap gear is also used to target live fish.

Potential tools for mitigating pot bycatch include size and shape, mesh size, number of pots, how the gear is marked/ labeled, requirements to prevent ghost fishing if the trap is lost, and how long gear may be left unattended (retrieval time requirements).

Size and shape - Larger pots potentially can capture and hold larger numbers of fish, but typically would not affect the species mix. Setting a maximum pot size would thus not affect selectivity but would affect harvest capacity. There are no groundfish pot size restrictions at this time.

Mesh size - The mesh size of a trap is related to the size of fish the trap will retain. Mesh size can be adjusted to select for fish of different sizes. Larger mesh increases the chances for small fish to escape. Smaller trawl mesh catches more small fish along with the larger fish. There are no mesh size restrictions at this time.

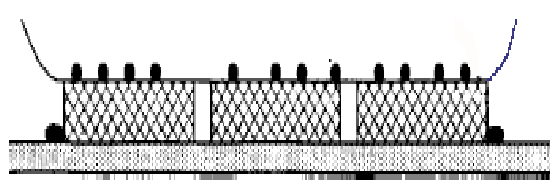
Number of pots - A maximum number of pots an individual fisher or vessel may use can be specified. The effect of pot limits is to reduce individual and/or fleet capacity. This can be useful in highly overcapitalized fisheries to slow the pace of the race for fish and to reduce bycatch during closed seasons (for example, after the season closes). There are no groundfish pot restrictions at this time.

Escape panels - Escape panels create an opening in the pot to allow fish to escape. This is important because a pot can continue to ghost fish as long as it remains in the water. The size of the opening can be regulated, as can be the material that creates the opening. For West Coast groundfish, the federal regulation specifies the use of biodegradable twine (sometimes called "rotten cotton") that should disintegrate if the pot remains in the water too long.

Gear marking (identification) requirements - Federal regulations require that groundfish pots must be clearly and visibly marked at both ends with the vessel or fisher's identification and with a flag, or radar reflector. (Other line gears do not have this requirement because they are not left unattended.) Marking requirements serve both a safety and enforcement function. The safety requirement is that the gear be marked so it does not present a navigation hazard (collision or entanglement). The gear identification is so the owner of any lost or illegal gear can be identified. These requirements have little if any affect on bycatch other than to aid in recovery of lost gear.

Gear retrieval requirements - Baited pots continue to attract and catch fish as long as they maintain their structural integrity. At the end of the fixed-gear sablefish season, vessels may be required to stop fishing at a specific time. Retrieving gear is a fishing activity, so a stop fishing order means any gear must be left in place. Typically, after a specified period of time, the gear may be retrieved, although it may be necessary to release any fish. Any fish that must be released are considered bycatch. To prevent excessive bycatch of this type, gear must be retrieved within a specified period of time, unless the vessel is incapable of retrieving it (for breakdown, weather or safety reasons).

Unbaited pots may also attract fish because they may provide structure. Pots left on the grounds after the end of the season will continue to ghost fish unless they are de-activated by leaving an open escape route such as an open door or escape panel. Any fish left in a closed trap eventually die and become bait for other fish. By requiring that pots be removed soon after the end the season, this can be minimized.



Setnet (Gill and Trammel Nets): [The Groundfish FMP recognizes setnets as legal groundfish gear only in California south of Point Reyes (near San Francisco). Regulations controlling their configuration and use are implemented by the State of California. The FMP does not allow the use of drift nets for taking groundfish, nor does it allow the use of setnets in other areas. Potential management tools are listed below but are not described.]

Setnets are flat, rectangular nets that hang vertically in the water from a buoyed cork line and weighted along the bottom with a lead line. Setnets must be anchored, and they hang fairly vertically in the water column. They tend to bulge under the effect of currents. The nets are intended to be slack rather than taut, because fish swimming into a taut section of webbing tend to bounce away rather than become entangled. Nets are made of a lightweight multi-filament nylon or monofilament strands with certain specific mesh sizes to select the catch. Mesh size of gillnets is selected so the heads of the desired fish go through the mesh, but their bodies do not. When a fish tries to escape it tends to become entangled in the net.

A trammel net is a net made with two or more walls joined to a common float line. The inner net is made of smaller mesh and hangs deeper than the outer webbing. Fish pass through the outer webbing, strike the inner webbing and carry through to the larger webbing on the opposite side. Fish thus become trapped in the pocket formed by the intertwined webbing.

Potential tools for mitigating setnet bycatch include mesh size, size (height and length), number of panels, how the gear is marked/labeled, how long gear may be left unattended, and where it may be used.

Time/Area Restrictions (including closures, marine protected areas and reserves): Closures, as a management tool, have both a spatial (area) and temporal (time) dimension. Some area closures are long term to address a long term problem or condition. Examples of this would be to protect areas with special habitat, historical significance, or scientific or other value. Marine reserves are an example of a long-term area closure where all or certain activities may be restricted, depending on the objective and designation. Short term closures may be for an entire region (such as a season) or for a more localized area (such as a spawning area to protect eggs and/or young when they are present).

In recent years, area closures based on depth contours have been used to reduce the likelihood certain overfished groundfish species might be caught. This approach may be especially effective for species (cowcod, for example) that are relatively sedentary, that move only short distances. Often, however, juveniles concentrate at different depths or habitats than adults, and in some cases may be caught in different fisheries or by different gear types. Some species migrate seasonally; a permanent area closure would have to consider the entire migratory range, while a seasonally-adjusted or moving closure might provide a similar degree of protection while allowing greater fishing opportunities for other species. Also, where multiple species are in need of protection, the individual distributions must be taken into account.

NMFS regulatory guidance on EFH suggests time/area closures as possible habitat protection measures. These measures might include, but would not be limited to: closing areas to all fishing or specific equipment types during spawning, migration, foraging, and nursery activities; and designating zones for use as marine protected areas to limit adverse effects of fishing practices on certain vulnerable or rare areas/species/life history stages. To the extent that such an identified species or assemblage is taken as bycatch in the groundfish fishery, area closures may be an effective bycatch reduction approach.

Capacity Limits: Capacity limits are used to restrict access to the fish resource. Tools to limit capacity include permits and licenses and are intended to restrict the number of participants in a fishery. (They also serve as a mechanism to monitor participation in the fishery.) The maximum number of commercial longline, pot and groundfish trawl vessels participating in the limited entry fisheries was set by the license limitation program that took effect in January 1994.

Fishing power is also a term sometimes used to describe capacity that is managed with the use of gear restrictions and other tools. Permits and licenses can be used in a number of ways to limit capacity. A permit can specify the type of vessel or gear that may be used, the amount of fish that may be caught or retained, or who may do the fishing. That is, permits can apply to vessels, gear or fishers, and the number of permits can be limited. All groundfish limited entry permits designate the maximum length overall (LOA) of the vessel. Permits may be combined and applied to a larger vessel in accordance with a formula established in the limited entry regulations. Once combined, permits cannot be separated.

Once the number of permits has been limited, as in the West Coast groundfish fishery, it may be necessary to reduce the number of participants in a fishery. This can be accomplished through a buyback program, by the government cancelling or revoking permits, or by requiring participants to obtain multiple permits (for example, buying them from other fishers/vessels or joining into cooperatives). A trawl buyback program was completed late in 2003, resulting in the elimination of 91 trawl permits and vessels, roughly 35% of the trawl fleet. This result is less than the 50% reduction called for in the Council's Strategic Plan, and it addresses only the trawl fishery.

Vessel Restrictions: Restrictions on the type, size and/or power of a fishing vessel can be used as a management tool, typically to address fishing capacity. In the West Coast groundfish fishery, only vessel length is restricted. Vessel restrictions in themselves often have limited effect on capacity or fishing power, and many potential vessel restrictions are rarely used because they are easy to circumvent. Combined with other tools, they may be an effective means of achieving a particular management goal, although the effectiveness may be difficult to predict.

Data Reporting, Record-keeping, and Monitoring Requirements: Monitoring and reporting requirements are essential fishery management tools. Without monitoring and reporting, there is no effective measure to either ensure compliance with the tools used or to determine if the bycatch mitigation tools have been effective. Monitoring and reporting tools include permits/licenses, registration, fish tickets, logbooks, port sampling/onshore observers, on-board observers, *VESSEL MONITORING SYSTEMS* (VMS), onboard video recording devices, surveys, punch cards/tags, and enforcement activities. The current federal reporting requirements include permits/endorsements for the limited entry sector of the commercial fleet, reporting requirements for the at-sea whiting fleet (catcher/processor and mothership/processor vessels), an onboard observer (scientific data collection) program, and a VMS program beginning in 2004. Federal licenses are not required for the commercial open access sector or for the recreational sector. The current fish ticket and commercial logbook reporting requirements are conducted by the states.

Permits/licenses/endorsements - Permits and licenses confer permission to conduct specified activities. For fisheries, they may be a registration of vessel, gear, species, or amounts. There may or may not be a limited number of licences/permits available, and there may or may not be a cost to obtain them. In the groundfish fishery, trip limits apply to vessels rather than to permits. Endorsements are added to permits to provide specific conditions or permissions. For example, each limited entry permit includes a vessel length and gear endorsement. Also, a sablefish endorsement was created to identify those longline and pot vessels eligible to participate in the primary season and the amount of sablefish they may harvest during the season.

Registration - Vessels may be required to report in advance their intention to fish in a certain area, fishery, or time period. This provides a record of intention and may confer permission. NMFS published (in 2003) a final rule to require that operators of any vessel registered to a limited entry permit and any other commercial or tribal vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to declare their intent to fish within a conservation area specific to their gear type, in a manner that is consistent with the conservation area requirements. That is, the vessel must notify NOAA Fisheries before it enters an area closed to fishing.

Fish tickets (commercial landings/sales receipts) - Fish tickets are a record of the amount and species of fish landed by a commercial fishing vessel. They are required by each state, and the information required may differ among states. Typically, fish tickets may also indicate gear used, area fished and other specified information. This information is entered into an electronic data system and transmitted to a centralized database (PacFIN, maintained by PSMFC).

Vessel logbooks - Logbooks are a vessel's record of activities and estimated amounts of fish caught and retained. The trawl logbook program is conducted by the states (with the help of PSMFC). Vessels are required to complete and submit these records as specified by state regulation. Fishing location is required, as well as amounts of fish retained in each set/haul/tow. Currently, only retained catch is recorded. Selected logbook information is keypunched into an electronic database and compared to fish ticket records. Although states require some non-trawl vessels to fill out logbooks, only trawl logbook information is entered into the federal data system. Electronic logbooks are used in some fisheries.

Surveys - Surveys are a series of questions, verbal or in writing, designed to collect useful information. Surveys may be conducted in person (as in a port sampling survey), by phone (as in the survey of recreational fishing), or by mail. Typically, participation in a survey is voluntary.

Punch cards/tags (recreational) - Punch cards and tags may serve as a license/permission and as a catch record. There are no federal requirements at this time for West Coast groundfish.

Port sampling/on-shore observers - When a vessel or fisher returns to port, he/she may be met by an official surveyor who collects specified fishing-related information. This may be biological information about the fish, fishing locations and methods, ocean conditions, marine animals observed, or other scientific information. Species information may be incorporated into the data system to provide more specific information than recorded by other methods. For example, a fish ticket may not record the weight of each species or even a complete list of species, but a port sampler/observer may provide that information. Port sampling is typically conducted by the states, in conjunction with *PSMFC*.

On-board observers - Commercial vessels fishing for groundfish are required to allow an agency-certified fishery observer aboard to collect scientific information. The current federal observer program for the West Coast groundfish fishery has resources to observe about 10% of the commercial (limited entry) groundfish fishing trips. Currently, the West Coast observer program focuses on discarded fish, recording amounts, species, and some biological information about the fish. Other information, such as time, location, and gear may also be recorded. Observers can also record observations or measurements of seabirds and marine mammals and other useful scientific information. The federal observer program is not intended or designed to be a compliance or enforcement program.

A compliance monitoring program could be established, as in conjunction with an individual fishing quota program, to help ensure vessels maintain appropriate records and comply with the fishery management program requirements. For example, a compliance monitor could record discarding activities and fishing location.

Vessel monitoring systems (VMS) – A mobile vessel monitoring system (VMS) is a tool that allows vessel activity to be monitored in relation to geographically defined management areas (PFMC 2003e). VMS transceivers automatically determine and report the vessel's position using Global Positioning System (GPS) satellites. Generally, the vessel's position is determined once per hour, but the position determinations may be more or less frequent depending on the fishery. VMS transceivers are designed to be tamper resistant. In most cases, the vessel owner is not aware of exactly when the unit is transmitting and is unable to alter the signal or the time of transmission. VMS is a technological tool that can be used to improve bycatch management by providing location data that can be used in conjunction with observer data collections. (See the 5/22/03 *Federal Register* "Proposed Rule for a Vessel Monitor System" for additional information.)

Onboard video recording devices, sometimes called Electronic Monitoring, are used in some areas to monitor vessels' fishing activities. Cameras mounted on vessels can record fishing times and provide a general view of catch, as well as certain fishing-related activities. Limited bycatch (discard) and species composition information can be obtained by this method. (See Appendix C for additional information.)

Enforcement activities include a variety of data collection methods and information. Traditional techniques used to monitor marine fisheries include monitoring from air and surface craft. Monitoring from aircraft provides fishing location, vessel counts, and other general information. It could provide only limited bycatch information, such as whether discarding has occurred (such as visible, floating fish).

4.1.4 General Effects of Bycatch Mitigation Tools

Catch is related to fishing effort, selectivity of the fishing gear and methods, and species abundance. Reducing unwanted catch is the highest priority in a bycatch mitigation program. Bycatch mitigation tools or management measures vary in their application and effect at reducing bycatch, bycatch mortality and in improving catch accountability. Few tools have only one effect, and thus it is often a case of choosing tools that effectively address a variety of goals. Likewise, it is important that the chosen tools work in harmony to achieve the objectives, rather than work in opposition to each other. In theory, an optimum management program would use a few tools that work together synergistically to achieve the desired effects. In this EIS, traditional tools and some new tools never before used in managing West Coast groundfish fisheries are evaluated.

4.1.4.1 Tools and Their Linkage to Species Associations

The utility, effects, and effectiveness of various management measures are linked to key attributes of species we seek to manage. Some tools are more effective at reducing bycatch of rockfish than flatfish for example. Other tools designed to reduce the bycatch of one species may have different impacts on another species. In this EIS, example groundfish species have been highlighted for the analysis. These include all of the overfished groundfish species and selected emphasis groundfish species representing a sample of the over 80 groundfish species managed under the Groundfish FMP. These species represent a cross section of groundfish, and have differences in stock status, behaviors, life history, and habitat associations.

Several other important non-groundfish emphasis species have also been chosen for the analysis.

Knowledge of species attributes is key to understanding if a tool can be used to reduce bycatch and how effective it will be. For example, several of the overfished groundfish species are rockfishes that have a high degree of association with rocky-bottom shelf habitat (see Table 4.1.1). Some of these habitats are well defined areas on the continental shelf. Area management tools (such as MPAs or the current GCAs) may be very effective at controlling vessel encounters with concentrations of canary rockfish and cowcod. However, canary rockfish also occur outside of present GCA boundaries in lower concentrations, and thus area management alone may not minimize incidental encounter with them. A combination of area

Table 4.1.2. Species Associations and Attributes Important to Application of Bycatch Mitigation Tools

Overfished
- **Canary rockfish**
- **Lingcod**
- **Yelloweye rockfish**
- **Bocaccio**
- **Cowcod**
- **Widow rockfish**
- **Pacific Ocean perch**
- **Darkblotched rockfish**
- **Pacific whiting (in review)**

Rocky-bottom shelf habitat
- **Canary rockfish**
- **Lingcod**
- **Yelloweye rockfish**
- **Bocaccio**
- *Yellowtail rockfish*
- *Chilipepper*

Non-rocky shelf habitat
- *Dover sole*
- *English sole*
- *Petrale sole*
- *Arrowtooth flounder*

Slope
- **Darkblotched rockfish**
- **Pacific Ocean Perch**
- *Dover sole*
- *Sablefish*
- *Shortspine thornyhead*
- *Longspine thornyhead*

Pelagic or Semi-pelagic
- **Widow rockfish**
- **Pacific whiting**
- *Yellowtail rockfish*

Nearshore
- *Black rockfish*
- *cabezon*

Migratory
- **Pacific whiting**

Longevity
- Rockfishes - longest
- Flatfishes - intermediate
- **Lingcod** and *cabezon* - intermediate
- **Pacific whiting** - shortest

Productivity Index
- Rockfishes - very low
- Flatfishes - low
- **Lingcod** and *cabezon* - low
- **Pacific whiting** - low

Handling survivability
- Rockfishes, Pacific whiting - little or no survival
- Flatfishes - some survival escaping from mesh
- **Lingcod**, *cabezon*, sablefish - some survive release

Overfished species - **Bold**, Emphasis species-*italic* management and other tools may be more effective in minimizing incidental canary rockfish catch.

Lingcod is another overfished species that is associated with rocky-bottom shelf habitats and partially overlaps canary rockfish distribution. However, lingcod are also found in non-rocky bottom and nearshore habitats. Area management tools designed to protect canary rockfish will reduce encounters with lingcod within the canary management area, but to minimize lingcod bycatch, additional measures (or area) would be necessary.

Many species have a much broader distribution across shelf and slope habitats. Generally, younger fish settle in shallow water areas and gradually move offshore as they mature. Others make small scale seasonal migrations to feed on the shelf during the summer or spawn offshore in the winter. Lingcod move inshore to spawn during the winter.

Flatfishes as a group are broadly distributed, while Pacific whiting make extensive migrations between southern and northern limits of their range. Because they are so broadly distributed, area management tools would have to be extremely broad and greatly reduce areas for fishing for other species. Gear restrictions, on the other hand, could be used to for flatfish, and seasonal restrictions on Pacific whiting to do so.

Another important attribute to be considered in designing and applying bycatch mitigation tools is a species' sensitivity to handling. Rockfishes have swim bladders that expand to the point of bursting when they are brought to the surface from seafloor depths greater than a few fathoms. Few rockfish survive this kind of trauma. Thus, regulations that require release of rockfish will likely result in near 100% bycatch mortality. Species that lack swim bladders, such as lingcod and cabezon, appear to be more durable and may be less traumatized by capture and release. Size, bag and trip limits may not contribute to high bycatch mortality rates for these species.

4.1.4.2 Effects of Bycatch Mitigation Tools

The primary components of bycatch that can be managed are through harvest levels, gear, who, when and how many (that is, which vessels, times and areas, and capacity (number of vessels and characteristics of those vessels). Other tools include monitoring/ reporting requirements. These tools have different effects on mitigating for incidental catch, bycatch, bycatch mortality, and accountability . The following is a description of the range of effects for different management tools.

Harvest Level Specifications: Harvest specifications (such as ABC, TAC, MSY and OY) are the first level of conservation and management to maintain sustainable fisheries. For West Coast groundfish, harvest specifications are set to either maintain or rebuild various stocks. When stocks are not equally available (or available in the same proportions), specified harvest levels may not match the relative abundance (ratios) of all the species. OYs are the annual harvest targets for groundfish. Other management measures are designed to achieve but not exceed those targets. OYs provide the basic framework for management, but the fishery management measures to achieve them have more direct relationships to incidental catch and bycatch.

A relatively small OY for an incidental species, in conjunction with larger OYs for target species, may generally result in an increased probability and level of regulatory induced discard. Exceptions to this have to do with the distributional characteristics of the species and other management measures that might be applied. A widely dispersed species with a small OY is likely to have a higher encounter rate when fishers target other co-occurring species. Most of an OY would likely be used as incidental catch allowance for fisheries directed at co-occurring species.

Allocations of OY at the highest level (to major limited entry gears, open access, and recreational fishers) will also have potential impacts on bycatch due to differing selectivity of gears involved.   Other tools, discussed below, may be used to mitigate for fishing impacts of small OYs.

The balance of OY and fleet size/capacity is critical to bycatch. If a stock is very abundant, and few vessels or anglers fish for it, there is unlikely to be any regulatory discard. However, any abundant stock that is underutilized is likely unmarketable. A large stock biomass in conjunction with a large (but not overcapitalized) fleet can also result in very low regulatory discard. Even a small stock in conjunction with a small fleet may not have much regulatory discard. However, if that stock is mixed with abundant but unwanted species, the level of economic (non-regulatory) discard may be excessive.

And finally, a species may have a large ABC but also have harvest constraints to reduce impacts on a small OY species. The result would likely be a large regulatory discard. This is a result not of the OY directly, but rather the management measures to achieve two or more OYs that are out of balance. This is the case with species such asyellowtail rockfish that have large OY levels but which have their catch constrained by co-occurring species with a smaller OYs such as canary and widow rockfish.

For other species with relatively large OYs, bycatch may not necessarily decrease, as there are many non-regulatory sources of bycatch that are proportional to the size of catch. Some non-regulatory sources of bycatch are related to market limits on fish size, quality, and quantity. Another different set of tools may therefore be needed to reduce non-regulatory forms of bycatch that are associated with species having high OYs.

Trip Limits, Bag Limits, and Catch Limits: *Trip limits* are retention and landing limits (by species or species complex) that apply to individual commercial fishers, vessels, permits, gear groups, or other defined groups in a given area for a given period of time. Bag limits are the equivalent for recreational fishers.

In a study of West Coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch *et al.* 1988). Restrictive limits may therefore result in a higher catch and bycatch mortality of overfished species compared to alternatives that provide larger trip limits, or alternatives that use a different set of management tools. Vessel trip limits for overfished species are typically designed to allow for retention of small, non-targeted amounts that are caught incidentally. In a few cases, limited target fishing for some overfished species may be allowed with some gear types during part of the fishing year, such as for Pacific whiting, widow rockfish, and lingcod. Cumulative 1 or 2 month limits are used to help minimize regulatory discard.

Trip limits are often structured to preserve a ratio of catches reflective of a fishing strategy that results in a particular mixture of species. Often times the mixture contains one or more species that is either overfished or under precautionary management. Catches are constrained so that the ratio is preserved and the overfished or precautionary species OY is not exceeded. Fishers may attempt to develop strategies to maximize value of joint catches of the mixture. If actual fishing experience on the grounds and optimal values for a species mixture matched the average ratios applied when trip limits are set, regulatory bycatch should be minimized. Catches of individual species tend to be highly variable, leading to a significant tow-by-tow and trip-by-trip variation in ratios. Although rare, there are times when an encounter with an isolated school of rockfish can lead to bycatch that is several times larger than the incidental catch limit. This problem (which is sometimes referred to as a “disaster tow”) can be significant for overfished rockfish with a trip limit set at a low level.

In an analysis of Oregon *ENHANCED DATA COLLECTION PROGRAM* (EDCP) observer data, a small percentage of the trips were found to be responsible for a large fraction of discard (Methot *et al.* 2000). Similar variability in bycatch rates of darkblotched rockfish occurs in the shoreside based whiting fishery. The rare disaster tow can have 2,000 times the low end of the range of variability of darkblotched bycatch (PFMC 2003d). This high degree of variability is related to the aggregating nature of some of the species in the mixture (see above discussion on species associations).

In addition, market forces stemming from price, quantity, and size may result in fishers seeking an alternative mixture of species. Catch of undersized or lower valued species can, therefore, be coupled with regulatory limits leading to discard. This problem generally increases with smaller limits. In the same analysis of EDCP observer data, predicted discard was found to be an increasing function of the amount of DTS complex landed and a decreasing function of the remaining limit available for that species (Methot *et al.* 2000).

Some fishing strategies do not take significant amounts of overfished species. The amount of overfished species varies between strategy, target species, and overfished species (See Tables D-5 through D-13 of Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2004 Pacific Coast Groundfish Fishery (PFMC 2003d)). Trip limits on some species of groundfish may not result in significant regulatory discarding, as many of the trips fall short of the cumulative limits. On the other hand, market factors such as size, quantity, quality and price limitations may also lead to discard if fishers continue to fish for other more valued species.

During three years of the EDCP study (1997-99), onboard observers attempted to record the reasons for discarding a species. “Market” was listed 66% of the time, followed by “regulations” at 24% and “quality” 10% of the time (Saelens and Creech 2003), for all species discarded. Regulations were cited as the primary reason for discarding overfished species, whereas market conditions were cited as the primary reason for discarding other emphasis species except for sablefish and shortspine thornyheads. Regulations were given as the primary reason for discard of these two species (Table 4.1.3).

Table 4.1.3. Reasons given for discard during three years (1997-99) of the Oregon Enhanced Data Collection Project (EDCP). Percentages based on recorded reasons for discard of species (market, quality, or regulation). Species discarded for an unspecified or unknown reason were not included in record count. Enviroment refers to classification given for species used in EIS analysis, not necessarily the location where the reason for discard was determined by the EDCP observer. Overfished species in bold and emphasis species in italic. Species below MSY and under precautionary management are noted with (p).

		1997-99			
Environment	**Species**	**Number of EDCP Records**	**Market**	**Quality**	**Regulation**
Northern Shelf	**Canary rockfish**	31	0%	3%	97%
	Lingcod	309	6%	2%	93%
	Yelloweye rockfish	0			
	Yellowtail rockfish	66	20%	9%	71%
	Arrowtooth Flounder	115	91%	9%	0%
	English sole	214	74%	25%	0%
	Petrale sole	29	100%	0%	0%
Southern Shelf	**Boccacio**	0			
	Cowcod	0			
	Chilipepper	12	100%	0%	0%
Slope	**Darkblotched rockfish**	0			
	Pacific Ocean Perch	3	0%	33%	67%
	Dover sole (p)	645	58%	16%	25%
	Sablefish (p)	1,163	9%	8%	83%
	Shortspine thornyhead (p)	514	39%	7%	54%
	Longspine thornyhead	336	82%	11%	7%
	Unsp. thornyhead	208	50%	16%	34%
Pelagic	**Widow rockfish**	41	37%	0%	63%
	Pacific whiting	962	88%	11%	2%
Nearshore	*Black rockfish*	0			
	Cabezon	0			
Grand Total		4,648	48%	11%	41%
All Species Total Including Non-GF		8,920	66%	10%	24%

Since the EDCP study, cumulative limits and depth based management have significantly altered fishing conditions. Current information on the reasons for discard are not available. We make the following simplifying assumptions with regard to trip limit effects based on the discussion and past studies cited above:

- Trip limits affect the amount of trawl discard in particular, resulting in higher discard rates as trip limits decline. Such bycatch is more likely to be regulatory discard. Overfished species tend to have more restrictive trip limits. Therefore, we assume much of the overfished species bycatch becomes regulatory discard.
- Trip limits also regulate the catch of other groundfish in order to control the annual harvest goal or OY or to minimize impacts on overfished species. Fishers may optimize value while minimizing incidental take of a constraining species above the overfished level, or an overfished species. We assume a mixture of regulatory and market induced discard results in bycatch of these species.
- Some OYs and trip limits are liberal enough that fishers are primarily limited by market conditions. We assume that those species having liberal trip limits that can be taken without taking a high percentage of a constraining species are primarily discarded due to economic or market limiting reasons.
- Finally, trip limit management for West Coast groundfish has a 20 year history. We assume that there has been some amount of regulatory discard for any trip limit level. Some alternatives may result in increased trip limit size. While this may reduce regulatory discard, it will not eliminate it.

Bag and size limits in recreational fisheries contribute to regulatory discard. In nearshore (shallow) waters, bycatch mortality of rockfishes due to the effects of barotrauma are lessened. Some species subject to bag limits and size limits, such like lingcod and cabezon, can tolerate effects of hooking, handling, and release better than rockfish.

Catch limits (or fishing mortality limits) restrict the amount of fish that may be caught or killed, whether landed or discarded. These limits require fishers to stop fishing when a limit is reached. Catch limits have not been used in the federal groundfish management program because they would require extensive and expensive monitoring.

Catch limits, when effectively monitored and enforced, provide a very high incentive for vessels to develop methods to avoid restricted species. Vessel catch limits would apply either annually or to specified 2-month periods; sector limits would likely be annual. These limits may or may not be transferable, and trip/catch limits may or may not expire at the end of each period.[3/]

[3/] Under current definitions, trip limits apply to vessels rather than permits, and trawl vessels may have only one permit. By assigning trip/catch

At the September 2003 Council meeting, trawl and environmental representatives made a presentation on British Columbia's Individual Vessel Quota (IVQ) program. Prior to implementation of the IVQ program, harvest capacity and effort were increasing, which resulted in smaller trip limits for groundfish and high levels of unreported discard (Larkin *et al.* 2003). The presenters wanted to provide the Council, NMFS and other attendees with a clear description of an effective management program that resolved many economic and bycatch problems. Alternative 5 in this draft PEIS is modeled in large part on that Canadian program. The term *RESTRICTED SPECIES CAP* or *QUOTA* (*RSQ*) is used to designate an individual vessel quota for overfished species; an individual vessel quota for other groundfish called an *INDIVIDUAL FISHING QUOTA* (*IFQ*) or simply an individual quota (IQ). Generally, individual quotas allow managers to eliminate or minimize the use of trip limits as a management tool or to restrict fishing when quotas are reached. This has the potential to reduce regulatory induced discard, especially for overfished species. IQ programs generally work best in conjunction with extensive monitoring to ensure accountability in a catch accounting system. This typically means 100% observer coverage or other reliable catch verification system. When effectively monitored, catch limits (or catch mortality limits) increase the incentive to keep any useable fish.

A clear distinction must be made between retention quotas and catch or mortality quotas. Retention quotas are much less effective at reducing incidental catch, bycatch and discard. This is especially apparent where the value of different sized fish is substantial. In that case, high-grading would be likely, as a fisherman (who is in the fishing business for his economic and financial benefit) will seek to maximize his profit. Retention limits can be effectively monitored on shore through landings receipts and sampling deliveries. Catch limits, on the other hand, must be monitored at sea. The exception to this is if discarding is prohibited; in that case, an onboard video system would be relatively effective in monitoring discard activities, but would not be effective in distinguishing which species are discarded.

Establishment of transferable IQs typically results in some level of industry consolidation. For example, a groundfish trawl IFQ program would likely result in fewer trawl vessels participating in the groundfish fishery. Some trawl quota share holders would likely elect to sell (or lease) shares and switch to some other fishery or stop fishing. Each of the remaining vessels would have a larger share of the resource on average. The impacts of this scenario are less easily resolved. By acquiring more quota shares of overfished species (that is, RSQs), a trawl fisher could increase his access to other groundfish.

limits to permits and allowing vessels to have multiple permits, vessels could increase their catch amounts. This process is called permit stacking. Without this or some method of transferring catch limits between vessels, a trawler could be required to stop fishing after even a single dirty tow.

Gear Restrictions: Gear regulations are often intended to reduce the efficiency of the various gear types. Gear regulations can also be used to change the gear's selectivity. Gear selectivity is related to catch and bycatch, and thus selectivity can be adjusted to mitigate for the effects of fishing and reduce bycatch. Unobserved bycatch mortality may still occur even though bycatch as measured through observer programs is reduced. Gears can be modified to reduce the take of undersized fish, change the species composition, reduce the take of prohibited species, decrease overall efficiency, or force the gear to be used in particular habitats. Through the *EXEMPTED FISHING PERMIT* (*EFP*) process, fishers, agencies, and gear manufacturers are actively experimenting with modified gears designed to reduce the take of overfished species.

Trawl: West Coast commercial fishers use a variety of otter trawl types. Bottom trawls are used to fish for rockfish, flatfish, and sablefish. Gear restrictions on bottom trawl gear have had a significant impact on bycatch rates and amounts of overfished and other groundfish species. The minimum mesh size for trawl gear was increased from 4 inches to 4½ inches in 1995, based in large part on a mesh size study conducted in the late 1980s. The study demonstrated reduced retention of small, unmarketable groundfish. Larger mesh reduces the catch of undersized fish that would otherwise be sorted and discarded at sea. Changes in the type and use of chafing gear is also believed to have increased escapement of juvenile rockfish, flatfish and sablefish. However, there is likely to be some level of bycatch mortality for fish escaping through the meshes (Davis and Ryer 2003).

Large diameter roller gear has permitted bottom trawls to be used in hard bottom areas preferred by shelf rockfish species. Beginning in 2000, restrictions on the use of rollers larger than 8 inches effectively reduced directed rockfish fishing on these rocky-bottom shelf areas.   A study by Hannah (2003) showed that trawlers avoided rocky reef areas on the shelf as a result of the regulation, and that encounter rates of overfished species were reduced.

EFPs are currently being used to test the selectivity of special flatfish trawls designed to reduce rockfish catches. These nets have large, cut-back sections of net in the upper panel of the trawl and reduced trawl height compared to conventional trawls. Preliminary results from an ODFW study using this experimental trawl in 50-180 fm indicated a 61% reduction in canary rockfish catch with an increase in flatfish catch rates (Parker 2003).

Other regulations could be used to change selectivity and efficiency of trawl gear. Smaller trawls could reduce bycatch by reducing the area swept by the trawl, which in turn would reduce bottom disturbance and catch. If navigation methods were sufficiently accurate, smaller trawls may be able to reduce contact with sensitive habitat species. Reduced trawl net height would reduce the capture of rockfish distributed in the water column above the bottom.

Most rockfish species do not survive after being brought to the surface after capture with trawl gears. Sablefish, cabezon, lingcod, and flatfishes (including halibut) lack swim bladders and have a better chance at survival. Thornyheads do not have a swim bladder, but are usually badly descaled due to contact with other fish and trawl webbing.

In addition to catching other non-groundfish marine finfish, all bottom trawls have some contact with the sea floor that results in the bycatch of benthic epifauna and shellfish. Marine plants, corals, sponges, sea urchins, and sea stars are taken as bycatch, some of which is unobserved. Bottom trawl doors, bridles and footropes also disturb rocks and sediments. Indirect impacts of this type of disturbance are poorly understood but are thought to reduce or modify fish habitats.

Midwater (pelagic) nets are used to target Pacific whiting and can be used to target semi-pelagic species such as widow and yellowtail rockfish. Pelagic trawls typically have lower bycatch rates of benthic organisms than bottom trawl gear.

Bycatch reduction devices (BRDs) are typically not used in West Coast groundfish trawls but are used by groundfish trawlers in Alaska (to reduce bycatch of Pacific halibut) and by West Coast shrimp and prawn trawlers (to reduce groundfish bycatch). Studies by the ODFW show a significant reduction in the bycatch of finfish species when fish excluders are used in shrimp trawls (Hannah *et al.* 1996). States currently manage the shrimp fishery and require the use of excluder devices to help reduce the take of canary rockfish.

Hook-and-Line: Hook-and-line gear refers to both stationary longlines (setlines) and mobile or trolled hook-and-line gear. The gear may extend vertically or horizontally, and be on-bottom or off-bottom. Fish harvested with hook-and-line gear typically have minimal physical damage from the gear itself. Puncture wounds from hooks are often limited to the mouth and may result in relatively low mortality rates in released/discarded fish. Swallowed hooks result in higher mortality rates. De-scaling is a less typical effect, compared to trawl capture. Hook size and shape also affect the degree of injury. Physical stress resulting from rapid decompression, temperature change, exposure to air and physical handling result in some level of mortality.

West Coast commercial and recreational fishers use a variety of hook-and-line gears, with sablefish being the one of the most popular target species. Levels of discard or sablefish are currently being evaluated by the NMFS observer program. Sablefish is a relatively hardy species, but some hooking mortality occurs in released fish. Small fish or fish damaged by sand fleas or bites from predators typically make up the discard. A study of the Alaskan sablefish fishery indicated that sablefish bycatch as discard including bycatch mortality was less than 12% of the total allowable catch (TAC) (Richardson and O'Connell 2002). In a comparison of sablefish pot and longline gear survey methods, Pacific rattail made up more than half of the total catch of all species in gear placed in deep water (600 fm) (Matteson *et al.* 2001). Most longline gear is fished shallower than this, and low bycatch rates were observed in this study.

Open access and recreational fishers use a diverse array of hook-and-line gears. Each gear type and configuration has its own selectivity characteristics, which results in catches of different species mixtures. Fishers typically discard small fish and those with specified trip limits. Fish taken with hook-and-line gear, when released, have some chance of survival, depending on the species, depth fished, and other factors. Barotrauma (resulting from rapid depth decompression) inflicts high mortality rates for rockfish taken in deeper water. A study of different handling methods showed no significant difference in survival rates between quillback rockfish vented with a hypodermic needle or brought more slowly to the surface compared to un-vented fish or those brought more rapidly to the surface. Survival was significantly improved if fish were rapidly returned to depth (Berry 2001). Similar findings for black rockfish were observed by ODFW researchers (Rankin 2003). Mortality rates for lingcod, cabezon, and sablefish are less as they do not have swim bladders. However, ultimate survival of all of these species handled in such a manner is poorly understood.

Little information is available on encounter rates with marine bird species, and BRDs have not been required in the West Coast groundfish longline fishery. The NMFS Observer Program will provide better information on encounter rates. BRDs have been successfully used in longline fisheries in Alaska and elsewhere to reduce seabird mortality.

Pot/Trap: Pot gear causes minimal physical damage to fish. However, some level of predation (including cannibalism) occurs within the traps. In addition, physical strain resulting from rapid decompression, temperature change, exposure to air and physical handling result in some level of mortality.

Pot or trap gear is principally used to target sablefish in the West Coast limited entry fixed gear groundfish fishery. It is highly selective for sablefish. Bycatch in the commercial fishery is made up of undersized fish. A pilot survey study conducted by the ODFW comparing pot and longline gears indicated that sablefish made up more than 99% of the pot gear catch over a broad range of depths (Matteson *et al.* 2001). West Coast traps are typically equipped with 3½ inch mesh allowing escapement of some small fish. Some fishers use larger mesh in order to target larger sablefish that command higher exvessel prices.

Little is known about the mortality of released sablefish. Some studies indicate that bringing sablefish through an abrupt temperature change, such as the thermocline present offshore during the summer, can lead to stress and mortality (Davis and Ryer 2003).

Pot gear is also used by open access and limited entry participants in nearshore live fish fisheries. These small pots facilitate handling of fish and reduce injury so that fish will have a higher rate of survival when transported and held in the market place.

There is no limit on the number of pots that may be used in the limited entry fixed gear fishery. However, the State of Oregon limits the number of pots used by the only nearshore fisher holding a developmental fisheries pot permit for nearshore species to constrain effort.

Some ghost fishing can occur with lost pots and traps. To minimize losses gear is marked so it can be found and biodegradable lacing is required to disable any lost pot by creating a large hole as the lacing dissolves. Mortality due to lost gear is not well understood or documented.

Setnet (Gill and Trammel Nets): Mitigation tools used by the State of California for managing setnets are similar to those used for other nets. California placed observers onboard many vessels using setnets during the 1980s. Based on those observations, the State uses area restriction as a primary bycatch mitigation tool. Setnets are prohibited in areas where bycatch of marine mammals and seabirds was observed, especially in nearshore areas and feeding grounds. In addition, mesh size restrictions are used to reduce bycatch of small fish. Tools for managing setnets are not discussed here because this gear is managed by the State of California.

Time/Area Restrictions (Marine Protected Areas, No-take Reserves, Seasons and Closures): Time/area closures reduce bycatch by reducing fishing in areas where restricted species are most abundant. If the designated time/area restriction coincides with the majority of the species' population, capture of that species can be greatly reduced. This tool can be especially effective for localized populations of sedentary species. Time/area restrictions are less effective for mobile or migratory species and for species that are broadly distributed over large geographic areas.

Large scale, depth-based marine protected areas (MPAs), designed to protect several overfished species, are now in effect. Federal regulations refer to the suite of MPAs intended to protect overfished groundfish species as "Groundfish Conservation Areas" or "GCAs." GCAs include species-specific closures like the Yelloweye Rockfish and Cowcod Conservation Areas, as well as the coastwide gear-specific closures known as "Rockfish Conservation Areas" or "RCAs." While these closures and restrictions have not been designated as permanent, they are likely to remain in effect for several years as integral tools in strategies to rebuild overfished shelf rockfish. Little marine habitat is set aside as no-take marine reserves or research reserves, which are typically designated as long-term (permanent) areas closed to most or all fishing activities. Fishing activities in the

GCAs, in particular on-bottom fishing, are restricted; fishing with certain gear types is still allowed.

Protected areas are best used when the migratory range of species is limited and species have strong site affinity for specific habitat types that can be identified and isolated through regulatory means. Protected areas have significantly reduced the bycatch of overfished canary rockfish, bocaccio, and cowcod. Seasonal restrictions can afford similar protection to species that aggregate during spawning migrations. Winter closures have been effective at reducing the catch of lingcod in nearshore spawning areas for example.

MPAs affect other species, both inside and outside of the boundaries. Catch of co-occurring species within an area is eliminated if the area is closed to all fishing activities. If some fishing is allowed, the amount of catch will be proportional to the effort, gear selectivity and abundance of the various species. If such an area encloses the majority of a species' population, only a small number of fish would be present outside the area. For that species, even if effort increases substantially the catch will remain very small. However, increased effort outside the closed area would result in increased catch of other species, again depending on selectivity and abundance.

Capacity Limits: Capacity limits are used to restrict access to the fish resource. Reducing capacity is a goal of the Council's *Strategic Plan for Groundfish*. Generally, capacity reduction in most forms reduces the need for other controls that may lead to regulatory induced bycatch in particular. Non-regulatory bycatch may also be reduced if there are fewer boats to supply market demands.

Capacity reduction is intended to reduce fishing effort; in the catch equation, if effort is effectively reduced, there is a proportional reduction in catch (if other factors remain constant). The problem is there is only a vague relationship between the number of vessels or fishers (or other standard effort measure) and the level of effective effort. Fishers, both commercial and recreational, tend to fish harder, change gear, change location, and learn from experience. Thus, few methods are good at reducing effective effort, especially to a predictable degree.

IQ programs typically have a direct effect of reducing capacity if fishers sell their shares and leave the fishery. Impacts would be similar to other capacity reduction methods that consolidate vessel permits into a smaller fleet. By defining quotas as catch or mortality limits, catch is directly controlled regardless of other factors. Effective individual quota programs require close monitoring. However, this should be kept in perspective: <u>any</u> truly effective management program requires close monitoring.

Vessel Restrictions: The links between vessel size and fishing efficiency and capacity are very indirect, and thus size restrictions are not an effective tool for mitigating either bycatch or bycatch mortality. Likewise, horsepower and other vessel restrictions are similarly ineffective.

Data Reporting, Record-keeping, and Monitoring Requirements: Monitoring and reporting requirements are essential fishery management tools. Accountability and accuracy of these programs is proportional to the amount of observer coverage and catch verification that can be accomplished. Higher levels of monitoring will yield more complete, accurate, and timely estimates of total catch including bycatch. Direct benefits would include in-season adjustments based on current season data and higher compliance rates. Indirect benefits would include improved stock assessments and tracking of rebuilding plans.

4.1.4.3 Summary of Tool Effects and Rationale for Direct and Indirect Effects

The rationales for each tool used to describe direct and indirect effects are summarized in Tables 4.1.1 and 4.1.2. The rationales are based discussions above and on past studies and PFMC documents.

The potential impact of a tool on reducing bycatch and bycatch mortality may be due to direct or indirect effects. Effects and commensurate impacts vary according to tool and by species. These effects are summarized by tool, species association, and potential effective use in Table 4.1.3.

Bycatch and bycatch mortality reduction strongly and directly affected by the tool are indicated by 'D'. A lesser but still indirect effect is indicated by 'd'. Likewise, strong or less pronounced indirect effects are indicated by 'I' or 'i' , respectively.

4.1.5 General Economic Factors and Effects: Economic Dimensions of the Bycatch Issue

4.1.5.1 Incentives and Disincentives to Discard

Before trying to analyze the effectiveness of measures to reduce bycatch it is important to understand the reasons why discarding occurs and why it may become a problem. Fish are discarded for a number of reasons, but the Magnuson-Stevens Act definition of bycatch suggests that the driving forces behind the practices of discarding can be divided into two major categories: economic and regulatory. In this document, non-regulatory discards by recreational fishers is often included with economic discards and referred to as *NON-REGULATORY DISCARD*.

The process of discarding is often an economic activity associated with other commercial fishing activities (Pascoe 1997). There is an economic incentive to discard those fish for which the price received does not compensate the vessel

operator for the costs involved in their catching, handling and sending to market (Pascoe 1997). From a production perspective, unintended catches and discards are simply an input to the production of fish that are retained and marketed.
In short, it is often a business decision to discard. Fish may have a low market value or be completely non-marketable for several reasons: they may be of the wrong species, size or sex; they may be damaged (caused by gear, predation in nets or mis-handling); or they may be incompatible with the rest of catch (e.g., slime, abrasion or rapid spoilage could cause damage to target species) (Clucas 1997).

Within the category of economic discards there are two distinctly different types (Clucas 1997). So-called "trash fish" sometimes caught in trawling operations are an example of the first type. Such fish are almost invariably of little or no value and therefore typically discarded whenever caught. For example, spiny dogfish sharks caught in commercial bottom trawl nets typically are several times less valuable than other groundfish species. This category of discards also includes marine life generally considered inedible, such as corals and sponges.

The other type of discarding for economic reasons, often called *HIGH GRADING*, is more situation-specific and occurs when certain attributes of a fish (size, sex or physical condition) make it more marketable and therefore more valuable than another. In general, high grading occurs when the price differential between high- and low-valued fish is greater than the cost of discarding and replacing the catch. For example, there is an incentive to high grade if a landing limit forms a binding constraint on the quantity of fish that maybe retained and sold. It is rational in such cases to discard low-valued sizes species in order to fill the landing limit with more valuable fish. The incentive to high grade is enhanced if the cost to catch additional fish is very low. For example, if an operator chooses to high-grade by discarding 25% of his marketable catch, he will end up having to catch 33% more fish than he would have if he did not engage in high-grading. The incentive to high grade may vary from trip to trip and even within a trip, depending on the various catch rates and catch compositions. For some trips, it may not be rational to discard at all if the landing limit is not reached. However, some fishermen may discard part of their catch early during the trip in anticipation of catching more valuable fish later. In other cases, fishermen may chose to store lower valued fish and discard these only when the landing limit is reached.

Related to high grading, commercial fishers may not have a market for all the fish they catch, even when the fish are of sufficient quality. This occurs when processing plants impose market limits to prevent market gluts or to match their processing capacity. For example, a processor may have too few or inexperienced filleters to handle larger quantities or certain species. A commercial fisher who catches more than his market limit may high grade if there is a price differential, or may simply dump the entire excess regardless of size or other factors.

Table 4.1.4. Direct effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Harvest Levels					
ABC/OY	Low OYs often require management measures such as low cumulative landing limits under some alternatives that made lead to discard. On the other hand, higher OYs may result in higher levels of effort and catch. Depending on alternatives, higher discard may also result.	Many species limited by markets do not reach OY limits, due to the market limit and other constraints placed on fisheries by overfished species OYs.	If OYs are reduced, regulatory bycatch mortality may increase for some species if trip limits are reduced. If overall effort is reduced due to restrictions, overall bycatch and bycatch mortality may be reduced.	Lower OYs should reduce fishing effort. Reducing effort should result in reduced habitat impacts.	Lower OYs required for rebuilding of some species may make it difficult to accurately track total catch under some alternatives.
Sector allocations 1/	Distributed OY may have a postive effect in reducing bycatch. Risk and consequences of encountering a "disaster tow" can be spread out among several boats within the sector.	Early attainment of overfished species limits within a sector may result in reduced overall effort due to fishery closures. Overall catch of species having primarily non-regulatory bycatch (market limited) may be reduced as a result. Non-regulatory bycatch may be reduced due to	Under a given OY, catch is allocated and distributed to fishery sectors in some alternatives. Distributed OY may have a postive effect in reducing bycatch mortality to the degree risk of bycatch can be spread and managed by the sector.	Allocating OY to specific sectors would not have habitat effects except in cases where:a) allocations are made on a geographic basis; b) allocations are shifted from higher habitat-impact gear sectors to lower habitat-impact gear	Sector allocations would work best with a robust monitoring program. With increased monitoring, There would be less incentive to discard allocated fish, as it would count against the allocation.
Trip (landing) limits 2/	If landing limit increases, bycatch is reduced. Studies have shown that as trip limits decline or cumulative limits are approached, bycatch increases. As cumulative limits are reached, there are stronger incentives to keep higher valued fish and discard species that are close to the limit in order to continue fishing for species	Economic factors such as price, demand, and minimum fish size needed for processing often determine market limits on the amount of fish landed. These factors can lead to discarding of fish after a market limit is reached.	If bycatch is reduced due to increased landing limit, bycatch mortality is also reduced. If limits are increased due to larger OYs, bycatch and bycatch mortality may increase due to higher harvest levels.	For restricted access sectors, landings limits variations are not likely to affect habitat. Where access is not restricted, higher landings or bag limits may bring more participants into the fishery, increasing the effect of those fishery sectors on habitat.	If landing limits increase, regulatory induced discard is reduced. Reducing discard increases accuracy of estimating total catch at lower levels of fishery monitoring.
Catch limits	Vessel catch limits reduce bycatch when fishing ceases and/or there is a retention requirement. Effect is enhanced when limit is on individual boat, when applied to all groundfish, and monitoring is robust.	If all groundfish catch is retained (Alternative 6), vessel catch limit will have no market induced bycatch, although discards (disposal) on land would increase.	Vessel catch limits should reduce bycatch mortality as there is less need to compete to catch fish (no derby fishery). Same pattern of effect as with regulatory bycatch.	Vessel catch limits may reduce hours trawled through incentives and efficencies to maintain strict catch caps under some options. Reducing trawl hours should reduce habitat impacts.	Catch limits may provide more flexibility by relaxing or eliminating landing limits and reducing discarded catch of those species that are not market limited. Thus, accountability is improved, if full retention is required and/or observer coverage is significantly increased.

Table 4.1.4 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Gear Regulations 4/	Regulatory induced bycatch may be reduced by allowing modified gear or alternative gear types that are more selective for non-overfished species and less selective for overfished species.	Allowing modified or alternative gears that are more selective for marketable species may reduce market induced bycatch. Gear changes to select against overfished species may interact with market induced bycatch both positively and negatively.	Making gears less efficient or more selective may result in some species or sizes being avoided, thus reducing bycatch mortality.	Gear modifications may reduce impacts to habitat. Smaller roller gear requires fishers to avoid high relief habitat. Other alternatives allow use of fixed gear to take unused portions of OY. In the latter case, habitat interactions are different, but likely	Flexible gear regulations may permit experimentation, and use of alternative and more selective gears to access unused portions of OY. Coupled with observers, species selective gears should reduce discarded fish and improve
Time/area restrictions 5/	Time/area closures eliminate regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, regulatory bycatch could increase outside the closure.	Time/area closures eliminates non-regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, non-regulatory bycatch could increase outside the closure.	Bycatch mortality would be reduced within the closed area. Bycatch mortality could increase outside of the closed area if fishing effort increases.	Habitat impacts would be reduced or eliminated within closed areas. Habitat impacts could increase outside of closed areas if effort increases outside the closure.	Accountability would be increased through VMS verification of fishing location
Capacity Reduction	Capacity reduction could occur through a buyback program or through sales of IQs. Reduced effort should allow more flexibility in vessel landing limits that would likely reduce regulatory induced bycatch.	If overall effort is reduced as a consequence of capacity reduction, bycatch of species with low or no value would be reduced. Fewer boats may induce buyers to relax market limits (supply and demand response) and effort could increase. Non-marketable or low valued fish would still	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished, possibly offsetting positive effects.	Reduced effort should reduce habitat impacts. Fewer boats could result in increased hours fished, possibly offsetting positive effects.	If number of fleet participants were reduced, currently available observer program funds could cover a greater percentage of the fleet's participants.

Table 4.1.4 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Data Reporting					
Observers	If observers are used as in current West Coast observer programs, as biologist-samplers, no effect. If observers are used as compliance monitors, observers could have deterrent effects on vessel operators in full-retention programs.	No effect.	The presence of observers on board a vessel may have a minimal effect on bycatch mortality, in that vessel operators may be more likely to use safe handling techniques in releasing prohibited species. Otherwise, no effect.	If observers are used as in current West Coast observer programs, as biologist-samplers, no effect. If observers are used as compliance monitors, observers could have deterrent effects on vessel operators	Increased observer coverage under some alternatives would increase accountability by ensuring retention, if required, or accurately accounting for discarded fish.
Vessel monitoring system 6/	VMS can directly reduce regulatory bycatch by improving compliance with area closures designed to protect overfished species.	No effect.	VMS can directly reduce regulatory bycatch mortality by improving compliance with area closures designed to protect overfished species.	VMS is a deterrent enforcement tool intended to monitor and deter potential fisheries incursions into closed areas. VMS can increase closed area compliance, thereby protecting habitat from gear impacts by fisheries prohibited from	VMS increases accountability by verifying fishing location.
Electronic monitoring	EM can reduce regulatory bycatch in full-retention fisheries by improving compliance with full retention requirements. EM can also act as a deterrent, similar to VMS.	No effect.	EM can reduce regulatory bycatch mortality in full-retention fisheries by improving compliance with full retention requirements. EM can also act as a deterrent, similar to VMS.	Unless specifically designed to monitor fishery participation in particular areas, no effect. Some EM devices can be programmed to have area-monitoring functions	EM directly monitors fishery participants, increasing accountability.

1/ PFMC, 2003d.

2/ Pikitch, 1988, Methot, 2000.

3/ Larkin, 2003.

4/ Hanna, 2003 and Davis, 2003.

5/ PFMC, 2001.

6/ PFMC, 2003e.

Table 4.1.5 Management tools and potential actions using each tool that have potential to reduce bycatch or bycatch mortality, and potential direct and indirect impacts of each action.

D = Direct effect d = minor direct I = Indirect effect i = minor indirect		Alternatives	Potential bycatch reducing actions:	Reduce catch in excess of vessel limits?	Reduce proportion of overfished species?	Reduce encounters with overfished species?	Reduce fishing in high relief seafloor areas?	Reduce catch proportion of on-bottom species?	Reduce catch proportion of off-bottom species?	Reduce catch proportion of small fish?	Reduce catch of unwanted finfish species?	Reduce potential for "ghost fishing"?	Reduce catch of marine mammals?	Reduce catch of seabirds?	How easily enforced/ monitored?	Compliance Costs (to vessel)
				Potential Effective Uses												
Species associations most impacted				Overfished	Overfished	Overfished	Overfished rockfish	Overfished rockfish and lingcod, some of flatfish	Widow rockfish and Pacific whiting, yellowtail rockfish	Flatfish, rockfish, sablefish	Halibut, salmon, skates, rays, and sharks	Sablefish				
Type of bycatch most impacted				Regulatory	Regulatory	Regulatory	Regulatory	Regulatory	Regulatory	Non-regulatory	Non-regulatory	Non-regulatory	Regulatory	Regulatory		
Harvest Levels																
	ABC/OY	1-6	larger OYs	i	I	d		d	d		i					low
	sector allocations	4		i	I	i		d	d	I	i	I				low
	vessel landing limits	1-4	larger trip limits	d	D	i	I	D	D	I	d				easy	med
	vessel catch limits	5,6	individual species caps	D	D	D	I	D	D	I	D				difficult	high
	individual quotas	5,6		D	D	D		D	D	I	D				difficult	high/low
Gear Restrictions																
Trawl	mesh size	1-6	increase mesh size	D						D	D				med	high
	footrope diameter/length	1-6	restrict large diameter	D		d	D	D	D						diff/med	high
	net height		lower net height	I	D	D			D		D				diff	high
	codend	1-6	Increase mesh size, restrict overall size	D											med	high
	design: on-bottom or pelagic		require pelagic trawl		D	D	D	D	D		i				med	high
	bycatch reduction devices		require								D					
Line	number of hooks		reduce number	D		d					i	D			dif	low
	hook size	1	increase size/ decrease		d					D	D				dif	low

Table 4.1.5 Management tools and potential actions, continued.

Potential Effective Uses

D = Direct effect d = minor direct I = Indirect effect i = minor indirect			Potential bycatch reducing actions:	Reduce catch in excess of vessel limits?	Reduce proportion of overfished species?	Reduce encounters with overfished species?	Reduce fishing in high relief seafloor areas?	Reduce catch proportion of on-bottom species?	Reduce catch proportion of off-bottom species?	Reduce catch proportion of small fish?	Reduce catch of unwanted finfish species?	Reduce potential for "ghost fishing"?	Reduce catch of marine mammals?	Reduce catch of seabirds?	How easily enforced/ monitored?	Compliance Costs (to vessel)
Species associations most impacted				Overfished	Overfished	Overfished	Overfished rockfish	Overfished rockfish and lingcod, some of flatfish	Widow rockfish and Pacific whiting, yellowtail rockfish	Flatfish, rockfish, sablefish	Halibut, salmon, skates, rays, and sharks	Sablefish				
Type of bycatch most impacted				Regulatory	Regulatory	Regulatory	Regulatory	Regulatory	Regulatory	Non-regulatory	Non-regulatory	Non-regulatory	Regulatory	Regulatory		
Pot/trap	number of pots		reduce number	D		d					D	D			med	low
	pot size										i	D			med	med
	escape panel in net/pot	1-6	require								D	D			med	low
	soak time	1-6	retrieval requirement	I	i	d				i	i	D			Dif	low
Time/Area Restrictions																
	seasons	1-6	close sensitive time/area	d	d	d		i	i	d	D		d	d	easy	low
	area closures	1-6	depth based mgt.	d	D	D	D	i	i	d	D	D	D	D	med	high
	depth closures	1-6		d	D	D	I	i	i	D	D	I	d	d	difficult	high
	marine reserves	6	semi-permanant to permanent	d	D	D	D	i	i	d	D	D	D	D		high
Capacity/number of participants				d			I				i				easy	
	permits/licenses/endorsements	2	reduce number	I	I	d	I	I	I	I	i	D			easy	
	IQs	5,6	establish IQ system													
	limited entry	2	no open access	I	I	d					i	D			easy	
Capacity (vessel restrictions)																
	vessel size	1-6		I		N									Easy	high
	engine power			I		N	I				I				med	high
	vessel type			I		N	I								Easy	high

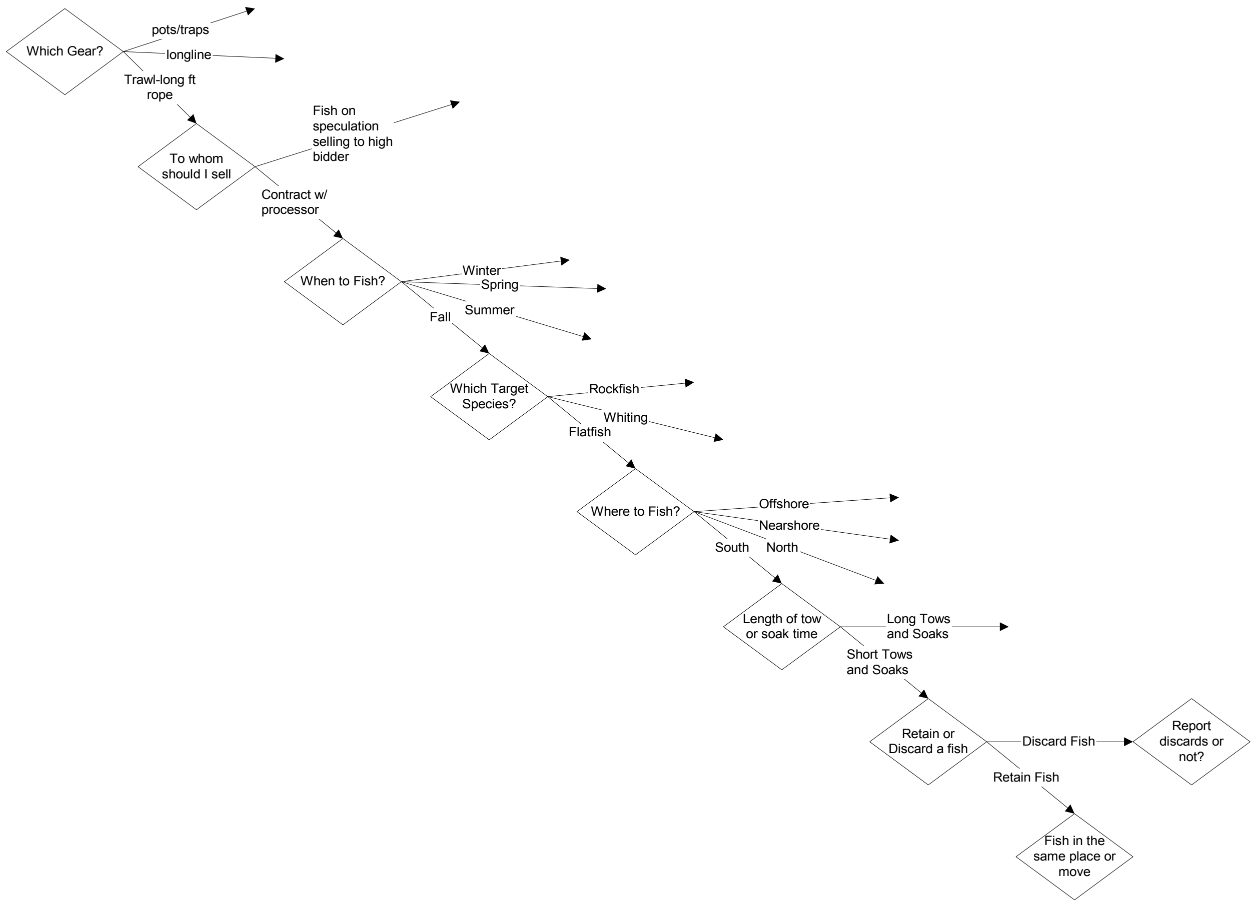
REGULATORY DISCARDS includes fish which, by regulation, fishermen are required to discard whenever caught. Such regulations remove the incentive to target the fish in question by eliminating the economic benefits. For example, it is unlawful for any commercial limited entry vessel to retain any species of salmonid caught with limited entry fishing gear, except in very limited circumstances. Also, State and federal regulations prohibit the landing of Dungeness crab incidentally caught in trawl gear off Washington and Oregon. Regulatory discards also include fish that could otherwise be legally retained and sold but have been caught in a closed season, by a prohibited gear, or in a closed area and therefore must be released or discarded. In addition, regulatory discarding occurs in multi-species fisheries where trip limits or bag limits do not match the actual composition of the catch (Clucas 1997). This means that a commercial vessel or recreational fishery may reach the limit for one particular species while there is still an unfulfilled quota or allowance of other species. As a commercial vessel approaches or has reached its landing limits for one species, there is a strong incentive for the vessel to high grade and discard that species as he continues fishing for other species to fill his remaining species allowances. This is the type of discard most often found in the West Coast groundfish fisheries.

The various incentives and disincentives to discard fish in the West Coast groundfish fisheries under the current management regime can be further clarified by identifying the various decisions that participants in those fisheries face. These decisions include the following:

Decision Point: Which gear should I use when I fish?
Decision Point: When should I fish?
Decision Point: For which species should I fish?
Decision Point: Where do I fish?
Decision Point: How long should I tow, or how much gear should I set?
Decision Point: Should I keep a particular fish or discard it?
Decision Point: Should I fish again in the same place or should I move to a different location?

This series of decision points is depicted graphically in Figure 4.1. Each decision point and the incentives and disincentives are described below in order to gain a better understanding of the behaviors of fish harvesters with respect to bycatch. While most of the discussion focuses on commercial fishing, similar decisions apply to recreational fishers.

Figure 4.1. Harvester decisions regarding bycatch (trawl used as example).



Decision Point: Which gear should I use when I fish? Catch is proportional to the amount of effort applied and the abundance or availability of fish, as modified by the effectiveness of the gear. Thus, all things being equal, the most effective gear would typically be chosen. However, fishers develop preferences and expertise with certain gears, and certain gears are more effective for different species. In addition, regulations place bounds on the types of gear that may be used. The commercial limited entry system largely determines which general gear type any commercial vessel is allowed to use. The limited entry system has produced the positive effect of limiting the amount of groundfish fishing effort (the number of vessels) and limiting the gear a vessel is authorized to use. However, this also reduces the opportunity fora given operator to try different gear types (e.g., switching from trawl to nontrawl gear) that might reduce unwanted catches. For example, there may be methods to selectively harvest abundant rockfish species with hook-and-line gear while having little catch of overfished rockfish species, but trawl gear may not be capable of selectively catching these species. Within the category of trawl gear, however, different configurations and variations can effectively catch flatfish with minimal incidental catch of rockfish. Overall, however, the negative effect of the constraint on changing gears on bycatch is likely to be smaller than the positive impact derived from the limited entry systems restrictions on the amount of gear being used.

Cumulative trip limits have greatly reduced the race for fish in all sectors of the groundfish fishery where they have been applied. Because fishers do not have to compete against each other for a share of the fleet-wide harvest quota during any given period, they do not necessarily place themselves at a competitive disadvantage by adopting fishing practices that reduce the catch of unwanted fish. Therefore, vessel operators may be more willing to modify their gears (within the constraints of specified gear regulations) to reduce unwanted catches. For example, a commercial trawl vessel could experiment with a smaller net (shorter footrope), flatter net (smaller vertical opening), or use large mesh escape panels. The decision to make these gear adjustments will primarily depend on how they affect the profitability of the fishing operation. Under the current conditions of extremely restrictive trip limits for overfished species such as canary rockfish, however, experimentation may be perceived as having greater risk of hitting a limit.

Decision Point: For which species should I fish (What is my target strategy)? Successful commercial vessel operators typically may employ a variety of fishing strategies. On an individual trip, the decision about target strategies depends on several factors. The most important is market demand, as identified by the buyers or processors to whom the fish will be delivered. There is typically some formal or informal coordination of targets between the operator and the processor, both before a trip begins and during the trip as fish are caught and identified. Other factors that drive the target strategy are the amounts of unharvested trip limits for various species and the catchability of various species in the particular area and time of year the vessel is operating.

Decision Point: When should I fish? Catch is related to the amount of effort and the abundance (or availability) of fish. Therefore, the time of highest abundance/availability requires the least effort. The current management system has a direct impact on timing decisions. Currently, the commercial fishing year is divided into 6 two-month periods, and trip limits are set for each period. If a vessel does not operate during a period, there is no opportunity to make up that lost revenue. Within each period, fishers have discretion of when to schedule their fishing operations. The Council develops trip limit recommendations for the entire year that take into account seasonality factors. The *GROUNDFISH ADVISORY SUBPANEL* (*GAP*) and *GROUNDFISH MANAGEMENT TEAM* (*GMT*) consult extensively to develop trip limits that will effectively spread harvesting opportunities over the year. The *BYCATCH MODEL* uses landings and bycatch data from previous years and anticipated co-occurrence rates by time, depth and area to calculate how much catch would occur under various alternative strategies. In an ideal situation, vessels and processors would focus on a particular species when the species generated the most value for both the processor and harvester, or when the greatest overall value could be achieved (within the constraints of rebuilding plans and overfished species limitations). For example, Dover sole that are aggregated to spawn during winter months can be harvested with relatively little incidental catch of canary rockfish, so the Dover sole trip limits are typically larger at this time. Petrale sole and other flatfish provide similar opportunities. In other cases, the value at that time may be higher depending on consumer preferences. Examples of this are the pre-Easter Lenten season and the Japanese holiday season. By spreading out fishing across the year, cumulative trip limits allow some targeting during these peak fishing periods. However, this approach is probably less than optimal with respect to avoiding overfished species, maximizing catch of other species, and maximizing total economic values.

Decision Point: Where do I fish? Catch is related to the amount of effort and the abundance (or availability) of fish. Therefore, the area of highest abundance/availability requires the least effort. The decision of where to fish depends on market demands and the costs of fishing a particular area. In the absence of regulatory constraints on fishing location, the area with the highest perceived potential net revenue will be chosen, which would typically be the area of highest *CATCH PER UNIT OF EFFORT* (*CPUE*) of desirable species and the area nearest home port or market. However, substantial constraints have been applied to reduce the likelihood of catching certain overfished rockfish stocks. Under these conditions, and the fact that cumulative trip limits have eliminated the race for fish, the area with lower probability of encountering overfished species is likely to be chosen, especially if an observer is aboard. In other words, under the current management regime harvesters are likely to take into account bycatch minimization in their decision of where to fish, although they may not necessarily give this factor the same weight as other economic considerations.

Decision Point: How long should I tow? Or, how much gear should I set? Catch is related to the amount of effort applied and the amount of fish present. Thus, the length of time (or distance) a unit of trawl gear is fished can have a significant effect on bycatch. Likewise, the amount on nontrawl gear used can affect bycatch rates and amounts. Long tows with trawl gear and large sets of fixed gear are more likely to increase the catch of non-target species as well as desirable species. Shorter tows and smaller sets provide the harvester with precise feedback on the type of fish being caught — feedback that cannot be attained with the best electronic sensors. The slower pace of fishing under cumulative trip limits increases the incentive for vessel operators to take the time to check their catch more often. Of course, checking catches more frequently can increase operating costs. Harvesters will weigh the negative effects of catching overfished species or other undesirable species against the additional costs of retrieving gear.

Decision Point: Should I keep a particular fish or discard it? The decision to discard or retain a fish may depend on a number of factors, including the value of the fish, trip limit amounts remaining, the presence of an observer and the likelihood that keeping the fish may affect future earnings. In general, fish caught in the groundfish fisheries can be categorized as follows:

1. Desirable Species - fish (including non-groundfish) that are not overfished, garner a sufficient market price and can be legally landed.
2. Overfished Species - fish from a stock or stock complex that has been determined to be below its minimum stock size (overfished/rebuilding) threshold.
3. Prohibited Species - species or species groups which must be returned to the sea as soon as is practicable with a minimum of injury when caught and brought aboard except when their retention is authorized by other applicable law.
4. Undesirable Species - fish that have no market value.

The decision to discard fish in categories 3 and 4 is straightforward — the law requires prohibited species to be discarded, while there is no economic reason to retain undesirable species. The decision to retain or discard desirable species is primarily a matter of available trip limit amounts. If a vessel’s landings of the species in the 2-month period are less than the cumulative trip limit, it is likely the catch will be landed. There may be cases where a vessel high grades fish of a desirable species. For example, larger fish may fetch significantly higher prices than smaller fish. If the price difference is large enough, the operator may be able to generate higher revenue by discarding lower value fish now and incurring the cost of catching additional fish later. The presence of an observer on board is likely to skew the decision toward retention, particularly if there is a possibility that the amount of observer coverage could increase if there is widespread evidence of high grading.

The decision to retain or discard overfished species depends on the specific situation. If the vessel has already landed the full trip limit for that species, the decision to discard is again straightforward. If the operator can land the fish within his or her trip limit and there is an observer on board, the reasonable decision is to retain the fish. Even if an observer is not on board, there are incentives to retain the overfished species: the fish typically has economic value and could increase the total revenue for the trip. In addition, a fisher may believe it is the right thing to do for the resource. On the other hand, there may be incentives to discard the overfished species. For example, trip limits for the species could increase (or at least stay the same) if no one else lands the species and catch estimates are skewed downward; if managers believe few of the species have been caught, trip limits for other species may be increased (or not reduced) later in the year, improving the possibility of higher revenues in the long run; the belief that everyone else in the fleet is doing it; and a low probability of being caught doing the wrong thing for the resource.

In general, the fleet as a whole is likely to be better off if everyone discards most (but not all) of their overfished species when observers are not present. If all overfished species are discarded when no observers are present, there would be clear evidence that the fleet was under-reporting.   However, if all vessels retain small amounts (i.e., amounts under trip limits but less than are actually caught), it may appear as though actual catches are less than they really are, and that could cast doubt on the accuracy of catch estimates of observers. If it appears that catches of an overfished species are reduced, there may be a greater possibility that OYs for cooccurring abundant species will be increased (or reduced less).

Decision Point: Should I fish again in the same place or should I move to a different location? After the gear is retrieved and the deck is cleared, a final decision faces the vessel operator — should the gear be redeployed in the same area or should the vessel be moved? Again, catch is related to effort and fish abundance/availability. This decision is influenced by the species composition of the last unit of effort, the likelihood that more optimal grounds can be located, and the estimated cost of moving to alternative areas. If there is a possibility that the catch of overfished or prohibited species is less in the alternative location and all other factors are equal, it is likely the vessel will move because cumulative trip limits have effectively eliminated the race for fish. Under an intense race for fish, moving to avoid bycatch is unlikely, as any time not fishing is revenue lost.

4.1.5.2 Costs of Bycatch

The economic losses or costs associated with the act of discarding can also be divided into a number of categories. The categories presented below are drawn largely from Clucas (1997) and Pascoe (1997). It is important to note that many of the costs listed are not unique to the problem of discarding — they would occur regardless if the fish are discarded or retained. For example, the costs associated with fishery interactions would not be eliminated if there were a total ban on discards. Consequently, the problem is more accurately framed as the costs of catching fish that are unwanted (for economic or regulatory reasons) rather than as the costs of discarding per se.

Costs associated with catching, sorting and throwing the unwanted or prohibited catch over board. Extra costs associated with capture and subsequent discarding include higher fuel consumption in active fishing operations (such as trawling), longer on-deck times for target species while the catch is sorted, leading to a reduction of quality and therefore value of the fish, employment of extra crewmembers required to sort and remove the unwanted catch from the target catch, and greater wear and tear on the fishing gear and vessels employed (Clucas 1997). For at-sea processors, lower factory throughput efficiencies and higher processing crew costs may occur due to the additional time required to separate discards from the retained catch. These various costs differ across fisheries and fishing operations. For example, the costs of removing fish from gear may be relatively small for trawl gear, as the fish typically do not need to be physically detached from the gear (Pascoe 1997). Moreover, estimating the economic costs of sorting and discarding fish is difficult due to the problems in determining the opportunity cost of the crew's time (Pascoe 1997). For example, the crew may be otherwise inactive if not sorting the fish.

Foregone catch as a result of mortalities imposed on recruits to the target fisheries. An economic loss also occurs where discard-induced mortalities affect immature individuals or non-legal sexes of the target species (Clucas 1997). The taking of undersized or juvenile fish can produce a number of negative economic effects (Pascoe 1997). Catching undersized fish results in potential *GROWTH OVERFISHING* and *RECRUITMENT OVERFISHING*. With growth overfishing, the juvenile fish could be taken at a later date at a larger, more valuable size. Hence, the overall potential yield of the fishery (and similarly, the value of the yield) is reduced. With recruitment overfishing, the taking of juvenile fish reduces the potential spawning stock size, resulting in lower levels of future recruitment. The lower level of future recruitment can be a direct cost to all participants in the fishery in the form of foregone income (Pascoe 1997).

Discarding over-quota fish (whether as the result of a global quota, individual quota or trip limit) also produces costs (Pascoe 1997). A proportion of these fish could have potentially been caught in the next year, reducing the costs of fishing in order to achieve next year's quota. These costs are again incurred by all fishers in the fishery, including the fisherman who discarded the over-quota catch.

Reducing the potential level of landings can also affect consumers through a reduction in consumer surplus (Pascoe 1997). *CONSUMER SURPLUS* is the area under the demand curve and above the price received. A loss in consumer surplus can occur through a reduced quantity of landings which increases the price to consumers. The loss is related to the responsiveness of price to quantity landed (the price flexibility). If prices are inflexible with respect to quantity landed, then varying the quantity landed will not affect the price received. Consumer surplus in such cases is zero for all levels of landing. However, if prices do respond to the quantity landed, then a reduction in landings will result in an increase in price and a loss of consumer surplus.

Foregone catch resulting from mortalities imposed on target fisheries by fisheries targeting other species. A third economic loss occurs when a fishery discards fish of economic importance to another fishery. The result can be an indirect cost to persons involved in the harvesting, processing, marketing or consumption of the species discarded by the target fishery (Pascoe 1997). This fishery interaction situation can be compounded by quota systems which permit individual fishermen to only land specific species (Clucas 1997).

It is important to note that discard mortalities induced by a fishery on species of value to other commercial or recreational fisheries are also often associated with high social costs. For obvious reasons, these sorts of mortalities often spawn bitter conflict between fishery participants and lead to political infighting over resource allocation and bycatch removal quotas (Alverson et al. 1994).

Costs of endangered or threatened species bycatch. Apart from the negative effects on the fishing industry and fish consumers, bycatch can have a negative effect on others in society who may value the species being discarded and therefore may experience some loss through the death of the animals following discarding (Pascoe 1997). If a bycatch species is severely depleted, threatened or endangered, the cost to society may be especially high. For example, where the species reaches a threatened status, there may be a loss of existence value as there is a possibility that the population may collapse and the species become extinct (consequently, this bycatch is referred to as “critical bycatch” (Hall 1995 cited in Pascoe 1997)). While the value of threatened or endangered species is difficult to measure, an indication of the non-market value of such species can be gauged by the reaction of individuals to their death as a result of any discarding.

Disruption of marine food chains and ecosystems. A fifth economic loss may occur when the bycatch of one species has a negative effect on the status of other species through predator, prey, or other biological interactions. These modifications of biological community structures in ecosystems can have indirect effects on fishery resources.

Ecosystem level impacts of bycatch (that is, both the catch and discard components of bycatch) can also negatively affect non-fishery resources. The result of the adverse effects of catch and discard on ecosystems and associated species may be that some members of society experience a loss of existence value and other values derived from the preservation of nature. It is important to note, however, that reduction of either component will not necessarily have a positive impact on marine ecosystems. For example, measures to reduce the discard component in some fisheries would reduce the food supply of scavenging seabirds and could have a severe impact on the ecological balance in wildlife communities (Furness 1999).

Bycatch monitoring costs. A sixth stream of costs associated with bycatch is the money that is spent each year on monitoring the level of incidental catches and discards. The main problem facing many fisheries managers is not the fact that discarding takes place per se, but that the level of discarding is not known (Pascoe 1997). Discarded fish represent catches that are not documented in landing statistics, but are nevertheless real removals from the stock (Pascoe 1997). In the case of unrecorded high grading, not only would actual mortality rates be higher than apparent mortality rates, but the age and size distribution of landed catch would be different from the size distribution of the initial harvest (prior to discards) (National Research Council 1999). Without information on discarded catch, it is difficult for fishery managers to calculate the size of a species' population and offer accurate advice toward the conservation of that stock. As a result, attempts to a manage a particular fishery may be based on incorrect assumptions and may allow unwittingly for the overexploitation of that resource. Under precautionary management standards, it is also possible to overestimate the amount of discarded catch, resulting in foregone catch.

Ethical concerns regarding waste in fisheries. From an economic perspective, the discarding of fish is a problem only if it precludes higher valued uses of those or other fish. It is important to note, however, that there may be societal concerns related to the discarding of fish that lie outside the economic-utilitarian paradigm. Specifically, some individuals may consider discarding fish to be wasteful and morally wrong. According to this viewpoint, fish that cannot be used should not be harvested. There are a number of variants of this philosophy. For example, some people may hold the view that nature has rights; to exploit nature is just as wrong as to exploit people (Nash 1989). Other persons may contend that non-human species are intrinsically valuable, independent of any use they may be to humans (Callicott 1986). The latter conviction may be related to religious principles, such as a belief in the sacredness of all or certain life forms. Still other individuals may simply have an undefined sense that uselessly killing life forms is improper behavior and should be avoided.

All of these moral arguments are inconsistent with the economic paradigm of trade-offs between money and preservation of species or ecosystems, because they present individuals with the moral imperative that we ought to preserve plants and animals (Stevens et al. 1991). While many of the costs associated with bycatch can be thought of as economic costs and can be quantified, at least in principle, the value that some people assign to eliminating waste in fisheries can not be expressed in monetary terms. These values are presented by their proponents as moral imperatives and, thus, do not lend themselves to analyses of economic tradeoffs. As Costanza et al. (1997) and Pearce and Moran (1994) note, concerns about the preferences of future generations or ideas of intrinsic value translate the valuation of environmental assets into a set of dimensions outside the realm of economics. Nevertheless, these ethical concerns can have economic implications. For example, it can be costly to harvesters and processors if consumers object to the waste and refuse to purchase related products. The importance of product differentiation in some fisheries through labels (such as the "dolphin-safe" labeling of canned tuna, "turtle-safe" labeling of boxes of shrimp, or the publication of "seafood watch" lists judging species abundance levels) is an indication of the economic effect these ethical standards can have (See Roheim (2003) for a discussion of the market impacts of eco-labeling of seafood).

4.1.5.3 Bycatch Costs as Externalities

Economic theory says a commercial fisher will continue catching and discarding unwanted fish up to the point at which the costs of this practice begins to have a negative effect on the profitability of his operation. However, under most management programs, an individual fisher does not bear all of all the costs discussed above. In fact, only the costs associated with catching, sorting and throwing the unwanted or prohibited catch over board are fully borne by the individual discarding the fish. While the act of catching juvenile fish affects the potential future benefit to the individual fisherman, it affects all other fishermen in the same fisheries as well. These costs are the product of the combined activities of all participants in the fishery and are therefore outside the control of the individual (Pascoe 1997). The individual vessel operator who chooses to invest in fishing gear and practices that reduce bycatch may be placing himself at a competitive disadvantage if others do not follow suit. The free-riders that do not minimize discards will likely increase their relative share of fleet-wide profits.

Nor does the individual fisher fully bear the other bycatch costs described above, if he bears any of them. Rather, the costs of catch and discard are transferred to other members of society as well. These costs are external to fishermen's accounting of costs in that they do not appear in their ledgers and, therefore, are not considered when fishermen calculate whether a particular fishing strategy is profitable. These circumstances, in which certain costs are external to (i.e., do not influence) the fisherman's production decision (Pascoe 1997), result in the individual fisher making inadequate efforts to control bycatch. What this means is that if an individual fisher does not recognize and take account of these *EXTERNAL COSTS*, he will receive signals or incentives that are inconsistent with society's values. That means his decisions will be viewed as wrong decisions from the perspective of society as a whole, and perhaps also from the perspective of the fishermen as a group (NMFS 1996). The result is that the level of bycatch will be higher than the socially optimal level.

Economic theory says that profit-maximizing operations will use an input up to the point that the cost for an additional unit of the input is equal to the revenue that additional unit produces.[4/] Since society has not developed a method to charge the fishing vessel for its use of discarded fish, the profit maximizing vessel operator will treat the unwanted fish as a non-binding constraint in his production. In other words, while the fishing vessel operator treats fish that are eventually discarded as a free good, society places a higher value on those fish, creating conflict between fishers and society.

From an <u>economic</u> perspective, the tendency of the fishing industry to discard fish is not so much a failure of the fishing industry to act responsibly as it is a consequence of the various costs and revenues tradeoffs that businesses make when determining how best to produce the goods that society values. The fact that discards often do not play an explicit role in the profit and loss calculation of fishermen is primarily a failure of society to organize its markets and regulations in a way that charges fishing operations a price that represents the value society places on that resource. This perspective can be used to develop solutions that could lead to changes not only in the way that fishing vessels treat their incidental catch, but also influence their decisions to avoid catching those fish at all.

4.2 Impacts to The Physical Environment

Changes to the physical environment from bycatch and any bycatch mitigation program are minimal and superficial when compared to the vast expanse of the physical marine environment. The basic geological structure and bathymetry of the seafloor would not be expected to be affected, nor the chemical properties of seawater, current patterns or climate.

Small scale changes to the seafloor surface, including surface sediments, have resulted from groundfish fishing activities in the past and are anticipated to continue under all the alternatives. These changes include movement of rocks, suspension and resettling of sediments, and movement, removal and destruction of corals, sponges and other structure-forming invertebrates. The amount and distribution of previous impacts is largely unknown, and the amount and distribution of future impacts is likewise unknown. Currently, NMFS is preparing an EIS for groundfish essential fish habitat that will compile all the available information on bathymetry, sediment distribution, and living structures. That EIS is also expected to identify which habitat features constitute essential habitat and which habitats are vulnerable to fishing operations.

In general, bycatch mitigation alternatives that reduce bycatch of benthic fishes such as corals, sponges and clams will tend to reduce impacts to the physical

[4/] For example, as long as each dollar invested makes some profit, it would be a prudent choice to continue increasing one’s investment there. When an individual gets back only one dollar for each additional dollar invested, it would be prudent to invest any additional money somewhere else.

seafloor. Specific bycatch mitigation tools that reduce these impacts include marine protected areas, and tools that restrict or reduce the amount of contact between fishing gears and the seafloor.

Natural and human factors and events affect the coastal marine environment (ecosystem) in a variety of ways. Large and small scale climatic factors sometimes cause dramatic changes in biological productivity, species abundance and biodiversity.

4.3 Impacts to The Biological Environment

Primary production (*PHYTOPLANKTON* abundance) and secondary production (zooplankton abundance) influence the abundance of higher trophic level organisms, including fish populations targeted by fishers. None of the alternatives, including the status quo (no action), is expected to impact either phytoplankton or *ZOOPLANKTON* abundance. Similarly, none of the alternatives is expected to impact vegetation, either positively or negatively. Kelp forests off the Washington, Oregon and northern California coasts are not expected to be affected, nor eel grass communities.

From an *ECOSYSTEM* perspective, human fishing activities might be viewed as large-scale predation that consumes species at a variety of trophic levels and may also affect other tropic levels directly or indirectly. Effects of fishing on species abundance, species diversity, community structure and physical environment have been described in numerous studies.

For example, top predators may be removed, resulting in increases of species lower in the food web. At the other trophic extreme, removal of large amounts of krill or other zooplankton can result in reduced productivity and mortality of higher trophic animals. Fishing practices can also affect habitats, community structure and biodiversity. The cumulative effects of 100 years of West Coast groundfish fishing (and fishing for other species) have helped shape present day ecosystem structure. Forage species (including groundfish and non-groundfish) captured in the course of groundfish fishing may be removed from the environment. Top level predator species may also be removed, resulting in increases of their prey species. Or, their competitors may increase, making it difficult to regain their previous position in the hierarchy. In either case, fishing increases the mortality rate of unfished populations. These and other changes could alter trophic dynamics, abundance and biodiversity of the ecosystem.   It is difficult, however, to separate many of these fisheries-related changes from environmental ones.

4.3.1 Impacts of the Alternatives on Groundfish Resources

This section lists, discusses and analyzes the impacts of the seven alternatives on groundfish resources. The analytical approach and techniques, including the ranking system, were explained in section 4.1.2.

Outside of environmental influences, fishing mortality accounts for the primary impact on groundfish resources. The Council controls fishing mortality through harvest management in order to attain the OY for each species. This is complicated by the fact that groundfish are caught in a suite of mixed species fisheries that correspond to ecological species groupings and reflect fishing strategies as well as stock condition of individual species components. The amount of groundfish taken results from the interplay between the OY specifications, management measures established for rebuilding some species, allocation among competing uses, and facilitating access to healthy stocks of groundfish.

Overfished species play a central role in the consideration of alternatives. Current stock levels reflect a combination of recent and poor environmental conditions leading to lower levels of recruitment and productivity, effects of management of groundfish in the absence of sufficient stock assessment and life history information, increases in fishing efficiency and effort, and unknown impacts of multi-species fishing strategies where discard has contributed to un-accounted for fishing mortality. Abundance of several groundfish species has declined below the overfishing threshold. Some species, such as canary rockfish and bocaccio are at very low stock levels and co-exist with a wide variety of groundfish species across broad latitudinal and bathymetric ranges. Rebuilding these species requires major constraints on harvests of other healthier stocks of groundfish - reducing overall OYs significantly.

Certain groundfish and non-groundfish species have been selected to represent a range of biological resources having significant and different bycatch issues. The application of different management tools can be tailored to address these issues. In our analysis, we attempt to look at how these tools address regulatory and non-regulatory bycatch for *OVERFISHED SPECIES* and select *EMPHASIS SPECIES* (Table 4.3.1)

- *OVERFISHED SPECIES* are the nine groundfish species (bocaccio, canary rockfish, cowcod, darkblotched rockfish, lingcod, Pacific whiting, Pacific ocean perch, widow rockfish, and yelloweye rockfish that have fallen below 25% of spawning biomass levels and have or soon will have rebuilding plans. Most of these species are long-lived rockfish that prefer rocky habitats and have behaviors that may concentrate them in time and space. In addition, rockfish have generally high market acceptance and in many cases high value. These characteristics have made them vulnerable to target fishing, contributing to their present overfished state. Rockfishes are subject to

BAROTRAUMA and typically do not survive capture. Much of the recent discard of rockfish has been regulatory due to fishers reaching trip limits. Dispersion of these species can be fairly broad and in lower concentrations than preferred habitats, making them vulnerable to capture as incidental catch in fisheries targeting other species. Tools that require retention of overfished species, increase trip limit size, or provide refuge areas tend to reduce bycatch of overfished species.

- *EMPHASIS SPECIES* include 11 species of groundfish from a broad range of habitats. While not overfished, some species are under precautionary management. Others are healthy but their catches are constrained by measures to limit the take of overfished or other species. Flatfishes as a group are also represented. They have a broad dispersion and several do not have significant regulatory bycatch issues. Bycatch in the form of economic discard for this group is often related to size and other market related restrictions. Tools that increase trip limit size for emphasis species constrained by trip limits, require retention, or eliminate the take of undersized fish tend to reduce bycatch of emphasis species.

The analytical methods are intended to reveal the effect of each tool in isolation from other tools, and in combination with other tools grouped together to form a distinct alternative.

Impacts of alternatives on groundfish resources are evaluated in a building block fashion with a special focus on overfished species as these tend to constrain healthier stocks of groundfish. Species under precautionary management, and those above target biomass levels will also be addressed in context with each environmental division and relationship to overfished species.

This EIS addresses the following interactions:

- Catch and bycatch - (direct effects)
- Predatory/prey interactions (indirect effects)
- Fishing strategy interactions (indirect effects)

The analysis of seven alternatives is done within an ecological and biogeographical framework as opposed to an individual species by species analysis of impacts. Direct and indirect effects of alternatives will reference keystone species, such as those under a rebuilding plan, other emphasis species of groundfish at or above MSY, and for other non-groundfish species. For purposes of this analysis we have identified the following ecological and biological groupings:

- Northern Shelf Environment
- Southern Shelf Environment
- Slope Environment

- Pelagic Environment
- Nearshore Environment

Analysis of overfished and emphasis species also reflects important latitudinal differences associated with species distributions along the coast (e.g. north and south of 40° 10' N. Lat.).

Impacts to groundfish are ranked by alternative and summarized in Tables 4.3.1 through 4.3.6.

4.3.1.1 Impacts of Alternative 1 (Status quo/ No Action)

Summary: The bycatch policy goal of Alternative 1 is to reduce bycatch of groundfish species by continuing fishery management as provided by the FMP and current groundfish implementing regulations. Relevant Council objectives include maintaining a year-round groundfish fishery, preventing overfishing, and rebuilding overfished stocks. Bycatch and bycatch mortality are minimized by limiting the number of commercial fishing vessels, restricting gear efficiency and usage, seasons and area management, including marine protected areas. Trip limits (which are based on previous years' observations of the encounter and discard rates of various groundfish species and fishing strategies), are used to discourage fishing in certain times and areas. Gear restrictions are used where possible to reduce potential bycatch rates. Marine protected areas are also used to reduce or prohibit fishing in areas of the continental shelf where certain overfished groundfish species are more likely to be caught. Management relies on catch monitoring and reporting through commercial landings receipts ("fish tickets"), trawl vessel logbooks, port sampling, and observer coverage of a portion of the groundfish fleet.

Tools Used: The following mix of management measures are applied to create Alternative 1. Tool ranks for Alternative 1 are summarized in Table 4.3.1.

Table 4.3.1. Summary of bycatch mitigation tools as applied in Alternative 1.

Harvest levels Total catch levels (ABCs and OYs) for groundfish are set based on science-based stock assessments. Overfished species OYs are set in accordance with rebuilding plans.
Trip limits Set at levels to maintain year round fishing, based on a variety of target species or strategies; trip limits vary by time (season), area, depth, gear, etc. The NOAA Fisheries "bycatch model" is used to determine target species catch levels for each fishing strategy.
Vessel catch limits Not used
Gear regulations Gear restrictions are used to reduce the take of undersized fish and overfished species, and to reduce bycatch and bycatch mortality
Time/area management Extensive use of MPAs to limit fishing in areas and times where overfished species are most likely to be encountered
Capacity reduction includes recent 35% reduction in trawl fleet
Data reporting, record-keeping, and monitoring 100% of the at-sea whiting fleet monitored by onboard observers; shore-based whiting landings observed on shore; approximately 10% observer coverage of commercial fleet. Trawl logbooks and state fish ticket programs provide much of the commercial catch data.

- <u>Harvest Levels</u> Total catch levels (ABCs and OYs) for groundfish are set from scientific stock assessments. Overfished species OYs are set in accordance with rebuilding plans. Harvest rates of overfished stocks must be lower than those of "healthier" stocks; a larger fraction of an overfished species population must be allowed to grow and reproduce in order for the stock to rebuild in a timely manner. OYs for overfished species are total catch (mortality) limits.[5/] These OYs, in combination with anticipated catch in various regions by various fisheries, are used to determine catches of non-overfished groundfish based on expected catch/bycatch ratios. In contrast to some of the alternatives in this PEIS, Alternative 1 applies these as 'soft' guidelines that are used primarily to keep track of expected catch in each of the various fishery sectors. This approach results in harvest opportunities for healthy stocks that may be lower than the total catch OYs for those species.

[5/] Rebuilding OYs are set below the ABCs; if catches unintentionally exceed OY, future catch may need to be reduced in order to "catch up" to the rebuilding schedule. Catches above ABC are defined as overfishing, which is not authorized except in very limited circumstances.

(Landings could be lower than landed catch OYs also, if landed catch OYs are established). The GMT monitors commercial fishery landings through the PacFIN quota species monitoring (QSM) program. Recreational catches are monitored through RecFIN and State monitoring programs. These catch statistics (inseason estimates) are periodically compared to the harvest guidelines, and the Council recommends in-season adjustments as needed to ensure overall catches do not exceed the OYs.

- <u>Vessel trip limits</u> Trip limits are used to keep catches and bycatch amounts within the specified OYs. Trip limits are currently defined as retention limits, and vessels may continue fishing after reaching a trip limit so long as they do not retain more than the specified limits. In order to provide opportunities for several fishing strategies, the Council develops trip limits based on a variety of target species or strategies; these trip limits vary by time (season), area, depth, gear, etc. Target species catch levels for each of those fishing strategies are determined with the help of the NOAA Fisheries bycatch model. Trip limits are used to constrain harvests of both overfished and non-overfished groundfish.
- <u>Vessel catch limits</u> Vessel catch limits are not explicitly used as a tool in this alternative.
- <u>Gear regulations</u> Gear restrictions are used to reduce the take of undersized fish and overfished species, and to reduce bycatch and bycatch mortality. Mortality and survival rates of fish that escape fishing gear is unknown. Exempted Fishing Permits (EFPs) are issued to provide participating fishers the opportunity to experiment with various gear modifications intended to reduce bycatch and bycatch mortality of overfished species in particular.
- <u>Time/area management</u> Extensive use of MPAs is intended to limit fishing in areas and times where overfished species are most likely to be encountered, thus reducing bycatch and bycatch mortality. Large areas of the continental shelf are closed to most directed groundfish fishing; some open access and recreational fishing may still occur within MPA boundaries.
- <u>Capacity reduction</u> Further capacity reduction is not explicitly considered under this alternative. The 2003 trawl buyback program has reduced the number of trawl permits by roughly 35%, including many top performers.
- <u>Data reporting, record-keeping, and monitoring</u> Under Alternative 1, 100% of the at-sea whiting fleet is monitored by onboard observers; shore-based whiting vessels are required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings are observed on shore; and approximately 10% of the remaining commercial groundfish fleet is monitored with on-board observers. Commercial landings data and observer data are used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish. These data are updated annually and used to change forecasts of OYs and trip limit impacts by fishery sector for the annual specifications process.

Summary of Impacts on Groundfish: Ranking of effects of Alternative 1 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are summarized in Table 4.3.1. Effects are ranked in comparison to the other alternatives. Smaller numbers indicate a greater effect.

Overfished groundfish: A major source of impacts to groundfish resources is regulatory discard of groundfish due to small trip limits. Primary species affected include (1) overfished groundfish and (2) high value groundfish that are constrained by limits on co-occurring overfished species. While current management is consistent with rebuilding strategies, a significant fraction of the overall groundfish OY is discarded or not harvested due to constraints on overfished species. Gear restrictions and MPAs are established to minimize fishing where overfished stocks are most at risk of being caught. By limiting fishing in those areas, fisheries outside the MPAs require less restriction because bycatch rates of those species are lower. However, target species catch rates may also be lower, and even low bycatch rates can result in unacceptably high catches of overfished species. The current GCAs have the added benefit of reducing bycatch of Pacific halibut and those benthic organisms that occur within the GCA boundaries. Pelagic trawling still occurs within the boundaries of GCAs, and there is measurable catch and/or bycatch of Pacific whiting, widow rockfish, and yellowtail rockfish.

Experimentation with gear designs and configurations may result in reduced observed bycatch of overfished species. Some level of unobserved bycatch mortality may occur to fish that encounter fishing gear but do not come onboard; the fate of fish excluded from fishing gears is largely unknown, and fish that escape are likely to suffer some level of bycatch mortality.

Emphasis species: Alternative 1 provides fishing opportunities outside the GCAs while conserving overfished groundfish. Cumulative trip limits are set to reflect ratios that protect vulnerable species while allowing harvest of healthier stocks. Ratio management under Alternative 1 tends to result in lower-than-OY catches of some species, and possibly an increased rate of bycatch/discard for other species. The Dover sole, thornyhead, and sablefish (DTS) complex reflects this dilemma. The DTS complex is managed in part to prevent overfishing of shortspine thornyhead. Under current management, Dover sole, sablefish, and shortspine thornyhead discard rates are often high. Catches of longspine thornyhead (and sometimes sablefish) may be below their OYs.

Midwater trawl fisheries continue to provide some fishing opportunity within RCA boundaries for the shelf dwelling yellowtail rockfish, a relatively pelagic (off-bottom) species.

Seaward and shoreward of the RCA boundaries, current management measures do not significantly affect economic discard/bycatch (bycatch resulting from discard of undersized fish or fish having low or no present market value).

Effects of Harvest Levels under Alternative 1: Groundfish harvest limits are established through annual specification[6/] of ABCs and OYs. Measures to protect overfished species constrain access to healthier groundfish stocks. An OY managed as a harvest cap, as it is for overfished species, may limit or mitigate bycatch and bycatch mortality when used in combination with other tools, such as time/area closures. The Council prepares a catch scorecard to track estimated mortalities by species and target strategy. These are not allocations, but rather pre-season estimates of fishing mortality. Performance of the various fishery sectors is measured against this scorecard during the fishing season using the best estimates of in-season landed catch and anticipated bycatch. No portion of any OYs is held in reserve. Fishery sectors may or may not be further restricted to keep from exceeding these scores. The no action alternative ranks the same as or lower than other alternatives with respect to effective performance standards, use of OY reserve, and application of sector limits. Observer data gathered in-season along with other fishery information such as logbook data are used to update estimated mortalities annually.

Effects on Overfished Groundfish: Most of the overfished groundfish species primarily inhabit the continental shelf and are referred to as shelf species" Under the no action alternative, overfished groundfish of the Northern and Southern Shelf Environments are expected to take decades to rebuild. Measures to reduce capture/bycatch of canary and yelloweye rockfish will constrain catches of other species in the Northern Shelf Environment for many years as these species rebuild. Measures to rebuild canary rockfish, cowcod, and bocaccio will constrain harvest of other groundfish within the Southern Shelf Environment. Lingcod, which is also an overfished shelf species, co-occurs with other overfished and healthier rockfish species. However, the lingcod OY is relatively large (that is, the northern portion of the stock is more nearly rebuilt to its MSY). Thus, it will not be a constraining stock, although lingcod catches are expected to remain well below OY.

Overfished species OYs are typically not allocated among all user groups, but harvest guidelines (“scorecard” values, as described above) are often established in order to accommodate incidental catch needs of various fisheries targeting healthier groundfish species. Most harvest guidelines are ‘soft’ limits, in the sense that they are pre-season estimates of amounts expected to be caught, and a fishery sector (or target strategy) may not be totally closed if it reaches the expected catch level. Measures may be adjusted to keep catches near these guidelines. Flexibility to adjust scorecard amounts is allowed if overall catches are projected to be below the OYs.

[6/] Beginning with 2005, ABCs and OYs will be set every two years rather than yearly.

Previous analyses for rebuilding plans and annual specifications have demonstrated that fisheries affectct stocks differently. For example, the recreational fishery tends to catch a larger proportion of juveniles of some species, compared to the commercial fishery. Canary rockfish is an example: a higher proportion of younger fish in the recreational catch results in a higher "per-ton" impact on rebuilding (PFMC 2003b).

Widow rockfish is an overfished pelagic environment species. In past years, widow rockfish OY levels were large enough to allow targeting with midwater trawl gear, and the midwater whiting fleet took a large proportion of the annual catch. Widow rockfish trip limits were structured to allow a significant portion of the OY to be taken in this way. OYs set to rebuild widow rockfish will be much lower than catch levels of the past decade, which means near future catches of widow rockfish will be far below recent years. In order to keep catches to those limits, it may become necessary to constrain the whiting fishery. However, without some form of allocation or specified harvest limit for widow rockfish, there may not be a basis for controlling the whiting fishery to control widow rockfish harvest.

Effects on Emphasis Species[7/] Emphasis species include abundant and important shelf groundfish such as yellowtail rockfish, chilipepper, and shelf flatfishes (such as arrowtooth flounder, petrale sole, and English sole). Important slope complex species include Dover sole, shortspine and longspine thornyhead, and sablefish (the 'DTS' complex).

Unless bycatch avoidance methods are developed, catches and landings of some groundfish species in the near future will be well below their OYs because fisheries are constrained to protect overfished species and species under precautionary management. These constraints have a significant and direct impact on fishing opportunities. Yellowtail rockfish catches are substantially below OY due to measures to reduce catch of canary rockfish and bocaccio. Harvest of the Dover sole, thornyhead, and trawl-caught sablefish (DTS) complex on the continental slope is constrained to prevent overfishing of shortspine thornyhead. DTS trip limits based on expected catch ratios of these species allow access to healthier Dover sole and longspine thornyhead stocks (see discussion on trip limits below). Ratio management may lead to regulatory discard of sablefish and shortspine thornyhead as fishers pursue attainment of Dover sole and longspine thornyhead OYs. Current catches of Dover sole and sablefish are their OYs. Shortspine thornyhead landings are typically near OY, while longspine

[7/] The term "emphasis species" is used in this EIS to designate non-overfished groundfish species that are particularly important to commercial, recreational and/or Tribal groundfish fishers. They are species for which information is available to support at least qualitative analysis of environmental impacts, and used as indicators of effects on the broader groundfish resource.

thornyhead landings are well below OY. Undersized and lower priced sablefish may be discarded in favor of larger more valuable fish– a practice known as "high-grading." .

In other cases, OY is underachieved due to existing market limits that are not linked to regulatory limits. For example, landings of English sole and chilipepper rockfish typically are well below their ABCs. Some level of bycatch and bycatch mortality is likely to occur for both of these species. Forgone catch may indirectly reduce bycatch and bycatch mortality, if OYs for overfished species result in reduced catch of other groundfish.

Effects of Trip Limits under Alternative 1: Trip limits for the trawl and other commercial fisheries are published each year in the Federal Register (for example, see NMFS, 2003). Trip limits are designed to slow landings rates to maintain year-round commercial fishing opportunities and to provide incidental catch allowances for non-target species caught with co-occurring targeted groundfish. Some trip limits for overfished species are very small to discourage any targeting. Most contemporary trip limits are cumulative 2- month period limits. Cumulative limits have the effect of minimizing regulatory bycatch/discard of groundfish (catches in excess of the limit) until the late in the period.

Recent analysis of 2002 observer data suggests that significant bycatch occurs in the form of both regulatory and non-regulatory discard, even when cumulative trip limits are based on ratios of anticipated bycatch (PFMC 2003d). Smaller trip limits are associated with higher bycatch/ discard rates (see discussion of Pikitch *et al* 1988, below). Alternative 1 has the smallest trip limits of the alternatives because the fleet is the largest and the season is longest. The application of trip limits in Alternative 1 is ranked 4 (not very effective) on a scale of 1 - 4 as a tool to reduce bycatch and bycatch mortality for most species, compared to other alternatives that do not rely on retention limits.

Effects on Overfished Groundfish Over time, trip limits have been modified to better match species associations and relative abundances as reflected in landed catches. Improved knowledge and understanding of depth distributions and associations has provided the basis for trip limits for sub-groups of co-occurring species. For example, trip limits were created for rockfish within the larger *Sebastes* complex to discourage targeting on overfished species. Species assemblages in nearshore, shelf and slope environments are managed more discretely than in past years. (See Table 2.1-12 of the 2003 Groundfish Annual SEIS (PFMC 2003b)). A high percentage of OY for the subgroup was left unharvested. Yellowtail rockfish is an example of a shelf rockfish species with a harvest well below OY due to recent trip limit constraints applied to shelf rockfish in order to protect canary rockfish (currently, area closures have the same consequence).

In 2000, reduced trip limits for shelf rockfish were coupled with restrictions on the size of trawl roller gear that could be used on the continental shelf. A study by Hannah (2003, In Press) showed that reductions in trip limits prior to 2000 already began reducing fishing effort in areas of 'prime trawlable rockfish habitat.' The same study also demonstrated that fishing continued adjacent to the harder bottomed, high relief, rockfish habitat areas. However, OY reductions in 2003 and application of species catch ratios resulted in to more restrictive management in 2003.

Trawl logbook and observer data are used to project expected catch ratios of overfished species to other target groundfish species. Individual trip limits are adjusted to keep overfished species OY from being exceeded. If actual ratios of overfished species to target species differ from estimated levels, regulatory bycatch and bycatch mortality are likely to result. If the actual proportion of overfished species is higher than expected, overfished species may be discarded. On the other hand, if the actual proportion of overfished species is lower than expected, target species may be discarded. However, in either case the rates are likely lower than those of past years because the NOAA Fisheries observer program has provided improved bycatch data.

In a study of West Coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits (Pikitch *et al.* 1988). Trip limits under Alternative 1 are expected to be smaller than all the alternatives. Therefore, this alternative could be expected to result in more catch and bycatch mortality of overfished species than alternatives that allow larger trip limits, or alternatives that use a different set of management tools. Vessel trip limits for overfished species are very restrictive under current effort levels and OYs, and are designed to provide for non-target incidental catch (although some target fishing is allowed for lingcod). Generally, restrictive landing limits can lead to higher regulatory bycatch and bycatch. Cumulative 1- or 2-month limits are used to help minimize discard. Under Alternative 1, regulatory discard/bycatch of overfished species would be higher in comparison with other alternatives that use other approaches to maintain catch within OY, encourage landing of more of the catch, or avoid take of overfished groundfish.

Effects on Emphasis Species As noted in the preceding section, regulatory discard/bycatch may be high if trip limits to protect a weak stock constrain the retention of more abundant co-occurring species. Much of the success using ratios to manage trip limits depends on the how well ratios reflect actual catch proportions. In addition, the target 'mixture' sought by fishers is sensitive to prices of various components of the catch. Currently, catch ratios are applied to the DTS complex to prevent overfishing of shortspine thornyhead. While the Dover sole harvest is usually near the OY, significant fractions of the longspine thornyhead and sablefish OYs may be left unharvested. Previous discard rates for Dover sole are thought to be related to undersized fish and are estimated to be 5% (Sampson and Wood 2002). Recent analysis of the 2002 observer data show that

Dover sole discard/bycatch may be a high as 17% (PFMC 2003d). However, the discard/bycatch rate of shortspine thornyhead is estimated to average 30%, and there is some evidence that sablefish discard/bycatch rates may be as high as 40%. This suggests that catch ratios may not be accurate, that high-grading may be occurring, or that ratio application does not take into account the degree of variability that occurs under actual fishing practices. Discard of small sablefish may be the result of high grading (i.e., economic discard/bycatch) because fishers receive a higher price per pound for larger fish, and the most recent assessment suggests a strong incoming year-class (and therefore a higher proportion of small fish in the population).

While regulatory discard of species such as English sole and other shelf and nearshore flatfish species may be low or absent, there may be economic reasons to discard. Trip limits for English sole are liberal under current effort levels and OY, and few vessels attain the trip limits. Market limits set by processors/buyers may result in economic discard/bycatch of large English sole. Undersized English sole are also a major component of discarded catch (See **Gear restrictions**, below).

With respect to the limited entry fixed gear (non-trawl) sablefish fishery, a permit stacking and cumulative limit program provides many of the effects of an individual quota program, including an extended season. In the past, the primary nontrawl sablefish fishery was managed as a competitive derby rather than as a year-round season. Trip limits were used to restrict fishing that occurred outside the primary season. The current program assigns eligible vessels/permits to one of three tiers that assures access to a set amount of sablefish. This program may reduce the need to discard fish compared to other sectors without IQs, as fishers have more time to move to areas with higher concentrations of marketable fish. However, it also provides more opportunity for vessels to high grade, keeping only larger, more valuable sablefish. A substantial fraction of sablefish that are caught and carefully released survive (see discussion of handling in the following section on **Gear restrictions**).

Effects of Catch Limits under Alternative 1: Vessel catch limits are not explicitly used as a tool in this alternative. Therefore this tool is ranked 4 (no effect) on a scale of 1 - 4.

Effects of Gear Restrictions under Alternative 1: The groundfish FMP and implementing regulations specify and describe gears that may legally be used by commercial and recreational fishers to fish for groundfish. Gear restrictions are specified to modify the selectivity and placement of fishing gears. Some restrictions, such as the minimum mesh size in trawl nets, are intended to minimize bycatch of small fish (juveniles, undersized target species, small species of fish with little market value, etc.); larger mesh allows more fish to escape. Smaller (3 inch) mesh is allowed in midwater trawls that seldom contacts the bottom. Restrictions on the maximum diameter of footropes used with trawl nets, coupled with depth restrictions, reduces the effectiveness of trawl gear in rocky areas of the continental shelf seafloor; this restriction eliminates the use of roller gear that is used to prevent the gear from snagging on rocks and other seafloor structures where rockfish congregate. These and other gear restrictions under Alternative 1 reduce capture/ bycatch of groundfish. This general application of the gear restriction tool is ranked 2 (moderately effective) on a scale of 1 - 3.

Effects on Overfished Groundfish Gear restrictions, modifications, and deployment practices can reduce bycatch and bycatch mortality of overfished species. The minimum legal size of trawl mesh in bottom groundfish trawls is set at 4½ inches to allow escapement of juvenile rockfish, small flatfish, and other small fish. Survival rates of fish that escape through the webbing are not known, however. Species such as lingcod that lack a swim bladder are more likely to survive than rockfish when caught with trawl gear. To protect overfished rockfish, the Council initially recommended very small trip limits for vessels using large footrope trawl gear (roller gear) on the continental shelf. Larger trip limits were established for trawl vessels fishing primarily for flatfish with small diameter footrope gear. A study by Hannah (2003) demonstrated that trawlers avoided rocky reef areas on the shelf as a result of the regulation, and that encounter rates of rockfish species were reduced. However, the Council and NOAA Fisheries further restricted fishing to reduce the likelihood that overfished shelf rockfish would be encountered by establishing large marine protected areas. This was necessary because even rare encounters with canary rockfish, yelloweye rockfish, and bocaccio could result in catches greater than the specified OYs. Gear restrictions outside these protected areas allow for targeting non-overfished species while maintaining relatively low bycatch rates. These measures have a direct effect of eliminating bycatch and bycatch mortality of all species, including overfished groundfish, inside the GCAs. However, increased fishing effort outside the GCAs creates challenges to keeping catches below overfished species OYs, even when encounter rates outside the GCAs remain very low. Geographic shifts in fishing effort outside of the GCA boundaries can also have a direct impact, increasing (or decreasing) bycatch and bycatch mortalities.

The States of Washington, Oregon, and California have recently required the use of fish excluder devices in shrimp trawl nets to reduce rockfish bycatch in that fishery. With use of fish excluders, the catch of rockfish and bycatch mortality in the shrimp trawl fishery should be lower in comparison with nets that do not use these devices, even though survival rates of fish excluded by these devices are largely unknown (Davis and Ryer 2003). Few fish caught in trawls without excluder devices can escape through the small meshes used in shrimp trawls, so most fish would be discarded when brought to the surface. Video observation of fish excluders has shown that many fish actively seek and find exits or are passively excluded from shrimp trawls, while the net is at fishing depth. Escaping rockfish avoid barotrauma associated with being brought to the surface and discarded. Studies have shown that time on deck (Parker *et al.* 2003) and temperature gradient (Davis and Ryer 2003) are important factors in survival of fishes without swim bladders, such as lingcod and sablefish. While these species may be more likely to survive when released at the surface, trauma inducing factors are avoided altogether when fish excluders are effective (Hannah 2003b). Some delayed morality may still occur. Laboratory studies have shown that direct mortality can still occur and behavioral impairment can cause additional delayed mortality (Davis and Ryer 2003). Under *status quo*, state requirements for excluder gear would have a positive and direct impact, reducing bycatch over gears that did not use these devices. Excluders and the selectivity effects of mesh size in general are likely to have a direct impact, causing an unquantifiable amount of bycatch mortality that is lower than would occur without these measures.

Catch of overfished species is expected to be low in fixed gear groundfish fisheries. Although 20 mt of lingcod may be taken by fixed gear limited entry fishers, the overall OY is not likely to be attained. Bycatch and bycatch mortality lingcod caught with fixed gear is related to the minimum size limit of 24 inches and handling effects on fish described above. Little is known about survival rates of fish escaping gear prior to it being brought on board.

Effects on Emphasis Species   Gear restrictions, modifications, and deployment practices can reduce bycatch and bycatch mortality of groundfish. The minimum 4½ inch mesh size aids in the escapement of juvenile or small sablefish and flatfish, although enough small fish are retained to contribute to significant size-related discard/bycatch. Sablefish lack a swim bladder and have a relatively high survival rate if quickly and carefully released.

Mesh size studies have shown that discard of undersized English sole may make up more than 50% of the catch in numbers (TenEyck and Demory 1975). Nearly all of the males and approximately 19% of the females were discarded. English sole have a prominent anal fin spine that has a tendency to catch on trawl meshes. The most recent English sole stock assessment used an assume rate of discard/bycatch of 12.4% during the period 1985-1992 (Sampson and Stewart 1993). Rates of survival of escaping fish are not known.

All trawls, including those using small footropes that are effective at fishing flatfish in non-rocky areas, are currently (2003) prohibited within the GCAs to reduce the incidental capture of overfished rockfish species. Trip limits are structured to effectively limit practical use of large footrope gears for deeper water species, seaward of RCAs.

The use of fish excluder devices and other state efforts to reduce canary rockfish catch in the shrimp trawl fishery also affect the catch of other groundfish species as well (Hannah *et al.* 1996). Survival rates of excluded fish are not known and there is no estimate of bycatch mortality (see discussion above under *Overfished Groundfish*). Direct impacts include reduced bycatch, reduced bycatch mortality for some of the fish, and some increased unobserved bycatch mortality of fish interacting with excluder gear.

ODFW, has sponsored trawl gear experiments, through the use of EFPs. Experimental net designs are intended to catch healthier groundfish stocks without catching overfished rockfish. Experiment results indicate that selective flatfish trawl nets effectively catch species that stay very close to the seafloor but allow other species to escape over the top. Future trawl gear modifications may allow greater catches of flatfish with minimal bycatch of overfished rockfish. Such gear modifications could have a net overall beneficial effect reducing bycatch and bycatch mortality of overfished species. NMFS is proposing to require the use of selective flatfish trawl nets in the nearshore area north of 40°10' N. lat., beginning in 2005. CDFG will experiment in 2004 and possibly 2005 to determine whether selective flatfish trawl gear is also effective at reducing rockfish bycatch south of 40°10' N. lat.

Gear restrictions or prohibitions are effective at reducing bycatch within the GCAs. Little is known about the fate of fish caught by trawl and fixed gears that manage to escape through meshes or become freed from hooks. Additional gear measures beyond those under Alternative 1 may be needed to reduce bycatch impacts outside of GCAs.

Sablefish caught by hook or pot gear are known to be susceptible to mortality due to sand flea infestation. Studies in Alaska have found this source of mortality to be small and that all sources of discard amounted to only 12% of the total allowable catch (TAC) in the directed fishery (Richardson and O'Connell 2002). Sablefish may be caught and escape from hooks or through meshes of traps. Survival rates of these fish are not known but are likely high. In addition, fixed gear fishers release undersized sablefish contributing to bycatch and bycatch mortality. In 2002, the Council recommended a reduction in size limit from 22 inches to 20 inches to minimize the amount of sablefish regulatory discard. Studies (cited above) indicate that temperature gradient may influence survivability of sablefish. Time of year fish are harvested therefore influences the potential impact of temperature gradients. The individual cumulative tier limits and the extended fixed gear sablefish season may contribute to a reduction in regulatory bycatch and bycatch mortality (see discussion above under **Trip limits**). However, high grading (economic bycatch) may be more prevalent than in past years.

Effects of Time/Area Management under Alternative 1: Marine protected areas and seasonal closures effectively reduce bycatch and bycatch mortality within the boundaries of the closed area (or closed period). This effect only applies to those fisheries closed or restricted from fishing during such time/area closures. Outside the MPA boundaries, bycatch and bycatch mortality may increase, if fishing effort shifts to open areas. Unless an MPA is designated as a no-take reserve, some fishing may be allowed depending on the specified restrictions. To the degree the authorized fishing gears and methods selectively avoid catching the species being protected, bycatch and bycatch mortality of those species would be reduced by such MPAs.   Reduced bycatch and bycatch mortality of other species in the area would also be expected.

Effects on Overfished Groundfish: The MPA strategy under Alternative 1 is to restrict or eliminate fishing activities (effort) where there is a high encounter rate of overfished species, and to redirect effort outside of the closed area where encounter rates are relatively lower. The specific application of GCAs under Alternative 1, are based on depth, time of year (seasonality), and gear restriction designed to minimize the likelihood of encountering canary and yelloweye rockfish in the Northern Shelf Environment, and cowcod and bocaccio in the Southern Shelf Environment. Because of the seasonal distributional behavior of rockfish, encounter rates and fishing patterns are monitored and adjustments are made to keep overall harvest within total catch OYs. Some rockfish have a wider distribution than others, or make seasonal movements, which would require the use of larger protected areas.

Canary rockfish are seasonally more abundant shoreward of the current RCAs boundaries, and trip limits are adjusted to reflect this seasonal distribution to minimize encounter rates. Seasonal mobility and aggregating behavior of canary rockfish within and outside of RCAs may affect ratios of incidental catch of this species to other groundfish. Under Alternative 1, adverse changes to ratios may not be accounted for until the end of the fishing season. Bycatch and bycatch mortality may increase as a consequence. Recent changes to the boundaries (depth limits) of the northern RCA are intended to reduce potential encounters with large concentrations of canary rockfish.

The cowcod conservation areas (CCAs) off the coast of southern California are smaller than the southern shelf RCAs. The cowcod protection areas are designed to protect mature fish that have a high site affinity for habitats consisting of rocky reefs with overhangs and sheltering caves. That is, they never move far and are rarely found away from this habitat.

The marine protected areas (RCAs/CCAs) under Alternative 1 effectively eliminate fishing in areas where overfished rockfish are concentrated.

Effects on Emphasis Species: RCAs may concentrate effort both shoreward and seaward of the boundaries. Seaward of the boundaries, catch, bycatch, and bycatch mortality of the DTS complex could increase due to effort shifting.

Several species of groundfish move onto the shelf during certain times of the year. The GCAs may reduce the vulnerability of these other species to harvest, thereby reducing bycatch and bycatch mortality, depending on the timing and application of the GCA.

Fishing for English sole and other shelf and nearshore flatfish with small footrope trawls is allowed in the North Shelf Environment shoreward of 50 or 100 fm (the inner RCA boundary), depending on time of year. The current RCAs restrict access to these flatfish to some degree, although a substantial proportion of the biomass is shoreward of 50 fm. If effort concentrates shoreward of RCAs, catch, bycatch, and bycatch mortality of these and other shallow water species may increase.

Effects of Capacity Reduction under Alternative 1: Further capacity reduction is not explicitly considered under this alternative. (The 2003 trawl buyback program has reduced the number of trawl permits by roughly 35%, including many top performers. The effects of this are estimated but actual results may differ.) As this tool is not used, it is assigned a rank of 3 (no effect) on a scale of 1 - 3.

Effects of Data reporting, Record-keeping, and Monitoring under Alternative 1: Monitoring and reporting requirements are essential fishery management tools. Accountability and accuracy of these programs is proportional to the amount of observer coverage and catch verification that can be accomplished. Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans. Under Alternative 1, 100% of the at-sea whiting fleet is monitored by onboard observers; shore-based whiting vessels are required to retain all fish brought aboard (as required by an EFP) and landings are observed on shore; and approximately 10% of the non-whiting commercial groundfish landings are monitored with on-board observers. Commercial landings data and observer data are used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish. These data are updated annually and used to change forecasts of OYs and trip limit impacts by fishery sector for the annual specifications process. This application of the tool is ranked 5 (least effective among the alternatives) on a scale of 1 - 5. Observer program data reports and analyses are provided as Appendix A of this FEIS.

Table 4.3.2 Effects of bycatch mitigation tools as applied in Alternative 1. Relative rank of the tools used to reduce bycatch and bycatch mortality. Overfished species in **bold** and emphasis species in *italic* . Species below MSY and subject to precautionary management are noted with (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			None	Yes	Soft sector scorecard	Pacific whiting EFP	Yes	None	RCAs	10% Observer coverage
Northern Shelf	**Canary rockfish**	1	3	4	4	2	2	3	3	5
	Lingcod	1	3	4	4	2	2	3	3	5
	Yelloweye rockfish	1	3	4	4	2	2	3	3	5
	Yellowtail rockfish	1	3	4	4	2	2	3	3	5
	Arrowtooth flounder	1	3	4	4	2	2	3	3	5
	English sole	1	3	4	4	2	2	3	3	5
	Petrale sole	1	3	4	4	2	2	3	3	5
Southern Shelf	**Boccacio**	1	3	4	4	2	2	3	3	5
	Cowcod	1	3	4	4	2	2	3	3	5
	Chilipepper	1	3	4	4	2	2	3	3	5
Slope	**Darkblotched rockfish**	1	3	4	4	2	2	3	3	5
	Pacific Ocean Perch	1	3	4	4	2	2	3	3	5
	Dover sole (p)	1	3	4	4	2	2	3	3	5
	Sablefish (p)	1	3	4	4	2	2	3	3	5
	Shortspine thornyhead (p)	1	3	4	4	2	2	3	3	5
	Longspine thornyhead	1	3	4	4	2	2	3	3	5
Pelagic	**Widow rockfish**	1	3	4	4	2	2	3	3	5
	Pacific whiting (incl.discard)	1	3	4	4	2	2	3	3	5
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3	5
	Cabezon	1	3	4	4	2	2	3	3	5
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

4.3.1.2 Impacts of Alternative 2 (Larger trip limits - fleet reduction)

Summary: The policy goal of this alternative is to minimize bycatch by reducing harvest capacity (specifically, reducing the number of limited entry trawl vessels) and increasing trip limits, while continuing to manage for year-round fishing and marketing opportunities and minimizing the costs of fishery monitoring. In this alternative, bycatch and bycatch mortality are mitigated in part by reducing effort and restricting gear efficiency.

Tools Used: The following mix of management measures are applied to create Alternative 2. Tool ranks for Alternative 2 are summarized in Table 4.3.4.

Table 4.3.3. Summary of bycatch mitigation tools as applied in Alternative 2.

Harvest Levels Same as Alternative 1
Vessel trip limits Used, expected larger than Alt 1
Vessel catch limits Not used
Gear regulations Same/ similar to Alternative 1
Time/area management Same as Alternative 1
Capacity reduction 50% reduction of the trawl sector relative to the 2002-2003 level (additional 15% reduction from 2002-2003 level).
Data reporting, record-keeping, and monitoring Increased observation rate due to smaller fleet compared to Alternative 1

- Harvest Levels (harvest policy, rebuilding) ABCs and OYs are assumed to be the same as under Alternative 1. Proportionately more catch would be available to each individual vessel remaining in the fleet compared to Alternative 1.
- Vessel trip limits Vessel trip limits are used and would increase under this alternative due to a 50% reduction of the trawl sector relative to the 2002-2003 level. Regulatory bycatch/discard of groundfish is inversely proportional to trip limit size; by increasing trip limits, this alternative would reduce bycatch and associated mortality. However, the relationship between trip limit size and bycatch is not directly proportional. That is, if trip limits are doubled, bycatch/discard would not be cut by half because other factors (such as relative abundance) influence catch rates.
- Vessel catch limits Vessel catch limits are not explicitly used as a tool in this alternative.

- Gear regulations Gear regulations under this alternative would be the same or similar to those in Alternative 1. It is not anticipated that capacity reduction of this alternative would permit the use of large footrope gear within current RCA boundaries.
- Time/area management The application of GCAs would be the same as Alternative 1. Large areas of the continental shelf would remain closed to most directed groundfish fishing; some open access and recreational fishing may still occur within GCA boundaries. This tool effectively reduces bycatch within the GCA but may result in concentrated fishing and higher bycatch of some species outside the area. A 50% reduction in fishing effort (from 2002-2003 levels) might allow redefinition of the timing and application of closed areas to provide more opportunities to access other groundfish resources within current GCA boundaries.
- Capacity reduction 50% reduction of the trawl sector relative to the 2002-2003 level. Catch is related to effort, selectivity and species abundance. Effort must be viewed in terms of effective effort, or effort that produces an average catch of groundfish per (trawl) hour fished. Trawl fleet reduction that reduces effective effort would allow trip limits to be increased and would increase the efficiency of other bycatch mitigation tools. However, *effective* effort is the causative agent, and the magnitude of net decrease in catch depends on the net decrease in effective effort.
- Data reporting, record-keeping, and monitoring. Catch reporting, record-keeping, and monitoring through the use of observers may improve over Alternative 1. Assuming the number of observer days remains the same, a higher proportion of total trips and catch would be observed due to the reduced fleet size, larger trip limits, and (perhaps) reduced total number of trips. If effort increases, trip limits may have to be reduced, and the level of observer coverage would be similar to Alternative 1.

Summary of Impacts on Groundfish: The effects ranking for Alternative 2 for reducing groundfish bycatch, bycatch mortality, and increasing accountability are summarized in Table 4.3.4. Effects are ranked in comparison to the other alternatives. Lower rank numbers indicate a greater effect.

Overfished groundfish This alternative is similar to Alternative 1 in that trip limits, gear restrictions, MPAs, and a relatively low cost sampling program would be used to reduce bycatch. Alternative 2 differs significantly in that trawl effort is reduced 50% relative to previous years and 15% compared to Alternative 1. The primary effect of effort reduction is that trip limit size would be increased. Reduced effort also tends to make other bycatch reduction tools work more efficiently. Studies have shown that regulatory bycatch rates and the size of trip limit are (roughly) inversely proportional. Because overfished species have the smallest trip limits, they would be expected to be most affected by larger trip limits. That is, larger trip limits would reduce bycatch/discard of these species the most. Thus, effects of trip limits on bycatch reduction on overfished species rank higher than for most emphasis groundfish species (see below).

<u>Emphasis species</u> Larger trip limits would reduce regulatory bycatch/discard of some groundfish species more than others. Species that are relatively unconstrained by current trip limits may be largely unaffected. Species such as chilipepper rockfish and many of the flatfishes would be included in this group. Bycatch/discard of these species is more economic than regulatory. Even if trip limits for overfished and other target species were increased, discard of such flatfish and small rockfish species would not change. For high-value target species that are constrained by trip limits, however, bycatch/discard would likely be reduced. That is because a higher proportion of the bycatch/discard is currently due to regulations, and relaxing the regulations would directly reduce discard/bycatch. Species such as longspine thornyhead, sablefish, yellowtail rockfish, and shortspine rockfish certainly fall into this category, and probably Dover sole, other large rockfish, and lingcod. In short, larger trip limits reduce regulatory bycatch more than economic bycatch. In fact, economic bycatch could increase if trip limits resulted in more catch of low value species.

Capacity reduction would have the greatest positive effects on shelf and slope species because most of the trawl effort occurs in those areas. The effects of increasing trip limits and capacity reduction would be less on nearshore groundfish such as black rockfish and cabezon, which are caught principally by the recreational and open access fisheries. (See gray shaded boxes under trip limit and capacity reduction columns in Table 4.3.4).

Effects of Harvest Levels under Alternative 2: ABCs and OYs are assumed to be the same as under this alternative. Proportionately more catch would be available to each individual vessel remaining in the fleet compared to Alternative 1. Although harvest level specifications can reduce bycatch, this alternative is no more effective than any other alternative. Therefore, this tool is ranked 3 (least effect) on a range of 1 - 3

Effects of Trip Limits under Alternative 2: Trip limits would increase, especially outside of GCAs, as a consequence of a 50% reduction in effective capacity of the commercial fleet. Effects of increased trip limits described above under General Effects of Fishery Management Tools are likely to be significant compared to *status quo* and are given a rank 2 or 3 on a scale of 1 - 4 scored for other alternatives, depending on the species. (Some alternatives are given a rank of 1 due to elimination of trip limits as a tool.)

Effects on Overfished Groundfish Increased trip limit size may have a direct and positive impact, making possible an increase in per vessel retained catch of overfished groundfish and reducing bycatch associated with regulatory induced discards. In a study of west coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch *et al.* 1988). All limits of overfished rockfish are low under *status quo* compared to historical levels. Reducing discard by increasing trip limit size would still depend on the appropriate application of RCAs and ratio management. A fine balance would be needed to allow more overfished species to be caught as incidental catch to other target strategies, without creating a trip limit large enough to encourage targeting of the overfished species.

The Council could elect to keep limits lower in an attempt to rebuild overfished species faster. Bycatch and bycatch mortality might be reduced in comparison to the above scenario due to a reduction in overall harvest opportunity. The smaller limits might offset this reduction due to the effect of smaller trip limits on regulatory induced bycatch.

Effects of increased trip limits result from capacity reduction. The alternative has a ranks of 2 in terms of ability of the trip limit tool to reduce bycatch and bycatch mortality of overfished species.

Effects on Emphasis Species Vessel trip limits could increase outside of RCAs boundaries as a consequence of a 50% reduction in effective capacity of the commercial fleet. Ratio management would allow more access to other groundfish as long as catch of overfished species did not exceed OY. Under status quo, several species of groundfish are harvested well below OY due to constraints on overfished species such as shortspine thornyhead currently under precautionary management. Under *status quo,* for example, there appears to be a lack of attainment of OYs for sablefish and longspine thornyhead at the same time there may be high discard rates of sablefish and shortspine thornyhead. A larger trip limit may help fishers gain access to OY and may reduce discarding.

Increased trip limit size should have little impact on some species that are more limited by markets than regulatory trip limits under status quo. For example, landings of English sole are limited by size and market limits, not trip limit size.

Because increased trip limit size may not result in a change in harvest for many emphasis species due to existing non-regulatory constraints such as undersized fish and market limits, the trip limit tool used in Alternative 2 is ranked 3 on a scale of 1 - 4.

Since it is assumed most of the capacity reduction would apply to the trawl fleet, this tool would have less impact on trip limits for cabezon and black rockfish compared to other species. Cabezon and black rockfish are caught primarily by commercial limited entry or open access hook and line fishers and the recreational fishery. The effectiveness of Alternative 2 trip limits on reducing bycatch and bycatch mortality for nearshore species such as black rockfish and cabezon is ranked 4 (little effect) on a scale of 1 - 4.

Effects of Catch Limits under Alternative 2: Vessel catch limits are not explicitly used as a tool in this alternative. Therefore this tool is ranked 4 (no effect) on a scale of 1 - 4.

Effects of Gear Restrictions under Alternative 2: Gear restrictions under this alternative would be the same as under *status quo*. Therefore, the Alternative 2 application of gear tools is ranked the same as for the *status quo*, or 2 on a scale of 1 - 3 (Table 4.3.4).

Effects on Overfished Groundfish It is not anticipated that the level of trawl fleet reduction under this alternative would allow the use of large footrope gear in MPAs or other liberal modifications. The effects on overfished groundfish is the same as Alternative 1.

Effects on Emphasis Species Current regulations prohibit fishing within GCAs by most gear types, including groundfish trawl gears, with the exception of pelagic trawls. A 50% reduction in effort may allow use of small foot rope trawl gears within the GCAs. An analysis of Oregon and Washington trawl logbook data showed that both trip limits and the 8 inch size restriction on trawl roller gear were effective in reducing or eliminating trawl effort over prime trawlable rockfish habitat (Hannah 2003). Current shelf RCAs have a significant amount of non-rocky ground still trawlable with small footrope trawl gears. If fishing with these trawls were allowed within GCAs, bycatch and bycatch mortality could increase for both overfished and healthy groundfish stocks.

Effects of Time/Area Management under Alternative 2: The timing, bathymetric limits, and gear restrictions associated with the current marine protected areas would remain the same as under *status quo*. These MPAs and seasonal closures effectively reduce bycatch and bycatch mortality within the boundaries of the closed area (or closed period). This effect only applies to those fisheries closed or restricted from fishing during such time/area closures. Outside the MPA boundaries, bycatch and bycatch mortality may increase, if fishing effort shifts to open areas. Unless an MPA is designated as a no-take reserve, some fishing may be allowed depending on the specified restrictions. To the degree the authorized fishing gears and methods selectively avoid catching the species being protected, bycatch and bycatch mortality of those species would be reduced by such MPAs. Reduced bycatch and bycatch mortality of other species in the area would also be expected. The Alternative 2 application of time/area management is ranked 3 on a scale of 1 - 3, the same as the no action alternative (Alternative 1).

Effects on Overfished Groundfish Same as Alternative 1. The MPA strategy under Alternative 2 would be to restrict or eliminate fishing activities (effort) where there are high encounter rates of overfished species, and to redirect effort outside of the closed areas where encounter rates are relatively lower. The specific application of MPAs are based on depth, time of year (seasonality), and gear restriction designed to minimize the likelihood of encountering canary and yelloweye rockfish in the Northern Shelf Environment, and cowcod and bocaccio in the Southern Shelf Environment. Because of the seasonal distributional behavior of rockfish, encounter rates and fishing patterns would be monitored and adjustments made to keep overall harvest within total catch OYs.

The CCAs off the coast of southern California, which are smaller than the southern shelf RCAs, would be continued. The conservation areas are designed to protect mature fish that have a high site affinity for habitats consisting of rocky reefs with overhangs and sheltering caves. That is, they never move far and are rarely found away from this habitat.

The GCAs under Alternative 2 would effectively eliminate fishing in areas where overfished rockfish are concentrated.

Effects on Emphasis Species Bycatch and bycatch mortality would remain similar to *status quo* levels. The RCAs may concentrate effort both shoreward and seaward of the boundaries. Seaward of the boundaries, catch, bycatch, and bycatch mortality of the DTS complex could increase due to effort shifting.

The RCAs may reduce the vulnerability of several species of groundfish that move onto the shelf during certain times of the year, thereby reducing bycatch and bycatch mortality. Effects would depend on the timing and application of the RCAs.

Fishing for English sole and other shelf and nearshore flatfish with small footrope trawls would be allowed in the North Shelf Environment shoreward of 50 or 100 fm (the inner RCA boundary), depending on time of year. The RCAs would continue to restrict access to these flatfish to some degree, although a substantial proportion of the biomass is shoreward of 50 fm. If effort concentrates shoreward of RCAs, catch, bycatch, and bycatch mortality of these and other shallow species may increase.

Effects of Capacity Reduction under Alternative 2: The trawl fleet would be reduced by 50% from 2002-2003 levels. The November 2003 trawl buyback program removed 91 permits from the fleet (about 35%); Alternative 2 would further reduce the fleet by about 15%. Effects of capacity reduction described above under "General Effects of Fishery Management Tools" are likely to be significant compared to *status quo* and other alternatives. The application of capacity reduction in Alternative 2 is ranked 2 or 3 on a scale of 1 - 4, depending on the species.

Effects on Overfished Groundfish Assuming an additional 15% reduction beyond the trawl buyback, a roughly proportionate increase in overfished species trip limit size would be anticipated. Thus, effort reduction would have an indirect impact on reducing bycatch and bycatch mortality.

Effects on Emphasis Species Trip limits for several species of groundfish at or near MSY would increase as a consequence of effort reduction under this alternative. Effort reduction would have an indirect effect on reducing bycatch and bycatch mortality of other groundfish.

The trawl fleet has relatively little impact on nearshore species such as cabezon and black rockfish. Such nearshore species are caught primarily by recreational and commercial hook-and-line fishers. Therefore, further trawl capacity reduction would have little or no effect on reducing bycatch and bycatch mortality for nearshore species such as black rockfish and cabezon

Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 2: Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans. Under Alternative 2, 100% of the at-sea whiting fleet would be monitored by onboard observers; shore-based whiting vessels wold continue to be required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings would be observed on shore; and approximately 10% of the non-whiting commercial groundfish fleet would be monitored with on-board observers. Commercial landings data and observer data would be used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish.

Under Alternative 2, catch reporting, record-keeping, and monitoring through the use of observers may improve over Alternative 1. Assuming the number of observer days remains the same, a higher proportion of total trips and catch would be observed due to the reduced fleet size and (perhaps) reduced total number of trips. If effort increases, trip limits may have to be reduced, and the level of observer coverage would be similar to Alternative 1. This tool is ranked 4 (low, relative to Alternatives 4-7) on a scale of 1 - 5.

Table 4.3.4. Effects of bycatch mitigation tools as applied in Alternative 2. Relative rank of the tools used to reduce bycatch and bycatch mortality. Overfished species in bold and emphasis species in italic. Species below MSY and subject to precautionary management are noted with (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			None	Larger trip limits	Soft sector scorecard	None	Yes	50% trawl fleet reduction from 2002-2003	RCAs	10% Observer coverage
Northern Shelf	**Canary rockfish**	1	3	2	4	2	2	2	3	4
	Lingcod	1	3	2	4	2	2	2	3	4
	Yelloweye rockfish	1	3	2	4	2	2	2	3	4
	Yellowtail rockfish	1	3	2	4	2	2	2	3	4
	Arrowtooth flounder	1	3	3	4	2	2	2	3	4
	English sole	1	3	3	4	2	2	2	3	4
	Petrale sole	1	3	3	4	2	2	2	3	4
Southern Shelf	**Boccacio**	1	3	2	4	2	2	2	3	4
	Cowcod	1	3	2	4	2	2	2	3	4
	Chilipepper	1	3	3	4	2	2	2	3	4
Slope	**Darkblotched rockfish**	1	3	2	4	2	2	2	3	4
	Pacific Ocean Perch	1	3	2	4	2	2	2	3	4
	Dover sole (p)	1	3	2	4	2	2	2	3	4
	Sablefish (p)	1	3	2	4	2	2	2	3	4
	Shortspine thornyhead (p)	1	3	2	4	2	2	2	3	4
	Longspine thornyhead	1	3	3	4	2	2	2	3	4
Pelagic	**Widow rockfish**	1	3	2	4	2	2	2	3	4
	Pacific whiting (incl.discard)	1	3	2	4	2	2	2	3	--
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3	4
	Cabezon	1	3	4	4	2	2	3	3	4
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

4.3.1.3 Impacts of Alternative 3 (Larger trip limits - shorter season)

Summary The policy goal of Alternative 3 is to minimize bycatch by increasing trip limits and shortening the fishing season by as much as 50%. In this alternative, bycatch and bycatch mortality are controlled in part by modifying effort and gear efficiency. Alternative 3 would reduce each vessels's fishing without reducing fleet size. This alternative supports Council objectives of preventing overfishing, rebuilding overfished stocks and keeping monitoring costs low. It would not maintain year-round groundfish fishing opportunities for individual vessels, but could be designed to maintain some level of groundfish product flow to markets over the entire year. If individual commercial vessel fishing periods were staggered, a year-round supply of fish would be available for some fish buyers and processors.

Tools Used The following mix of management measures are applied to create Alternative 3. Tool ranks are for Alternative 3 summarized in Table 4.3.5.

Table 4.3.5. Summary of bycatch mitigation tools as applied in Alternative 3.

Harvest Levels Same as Alternative 1
Vessel trip limits used, expected larger than Alt 1, similar to Alt 2
Vessel catch limits not used
Gear regulations same/ similar to Alternative 1
Time/area management may be same as Alternative 1 or different, depending on application
Capacity reduction same as Alt 1
Data reporting, record-keeping, and monitoring Similar to Alt 1; Could be higher or lower observation rate, depending on timing of fishing activities

- <u>Harvest Levels</u> (harvest policy, rebuilding) Harvest levels are assumed to be the same as under Alternatives 1 and 2.
- <u>Vessel trip limits</u> This alternative assumes the season would be shortened for fishing vessels and that some form of *PLATOONS* would be used to maintain fishing throughout the year. (Platoon systems divide vessels into two or more groups that operate on different schedules.) Vessel trip limits under this alternative are assumed to be the similar to those under Alternative1. However, seasonal patterns would likely be different, and bycatch of some species would likely be different.
- <u>Vessel catch limits</u> Vessel catch limits are not explicitly used as a tool in this alternative.
- <u>Gear Regulations</u> Alternative 3 would maintain the same gear regulations as Alternative 1 and be structured to keep catches within overfished species

OYs. This alternative would not permit the use of large footrope gear within current RCA boundaries, because that would increase the potential for catching overfished rockfish species. However, small footrope gear may be re-introduced into GCAs.

- Time/area management In addition to the GCAs used in Alternative 1, this alternative compresses the fishery through seasonal closures or other restrictions on fishing time for each commercial vessel. For instance, each platoon would be allowed only 6 months of fishing.
- Capacity reduction No further capacity reduction is considered under this alternative.
- Data reporting, record-keeping, and monitoring Catch reporting, record-keeping, and the monitoring program would be the same as Alternatives 1 and 2. The compressed season would mean that the percentage of total trips covered by observers would increase over Alternative 1.

Impacts on Groundfish Effects of tools used in Alternative 3 to reduce groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.6. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

Overfished groundfish Under Alternative 3, trip limit size would be increased to reduce bycatch and the season would be shortened so that larger trip limits could be maintained. By dividing the commercial fleet into two or more platoons, some level of landings and market flow would be maintained year-round. However, individual vessels would fish groundfish only during a designated portion of the year. Fleet response to this approach is hard to predict, especially if vessels were allowed to choose when they would fish without some pre-registration requirement. (The full year's trip limits must be determined before the beginning of the fishing year, January 1.) The shortened season could result in some fishers choosing alternative non-groundfish fisheries, or electing to fish at a particular time of the year. If increased fishing resulted at a time of year when encounter rates of overfished species is higher, more of those overfished species would be likely to be killed. Subsequent fishing later in the year would have to be curtailed to compensate for such unexpected occurrences. If fishers were allowed to freely choose in advance which period they would fish, it is likely product flow would be inconsistent or interrupted, because many would choose to fish groundfish when they could not fish for shrimp, crab, albacore or other species. Some level of groundfish bycatch would likely occur during those fisheries, and target trip limits would have to be reduced to compensate. Aside from these concerns, the impacts of a reduced season and larger trip limit size should be similar to Alternative 2, without the costs of further fleet reduction programs.

Emphasis species As was described above under Alternative 1, bycatch of DTS complex species may be the result of several factors, including size, attainment of regulatory limits, and high grading (for example, sablefish). A 50% reduction in fishing season and increased trip limits would tend to reduce regulatory bycatch/

discard. Larger trip limits for shortspine thornyhead would be expected to reduce bycatch/discard of this species. High grading of sablefish may still occur, however.

Larger trip limits for the "other flatfish" category would have relatively little effect on bycatch because market factors play an important role. Trip limits under the status quo are typically quite liberal and are larger than most vessels' landings. Bycatch and bycatch mortality are more related to market limitations such as size, price, and quantity. If a primary vessel response to reduced groundfish fishing time is to drop out of the fishery (or to spend more time in alternative fisheries rather than to fish harder during their groundfish openings), the overall catch of groundfish target species may be reduced. That would result in reduced bycatch and bycatch mortality of other groundfish as well.

As with Alternative 2, larger trip limits and shorter fishing time would have less effect on nearshore fisheries, unless open access commercial and recreational fishing seasons are also reduced. (See gray shaded box under trip limit column in Table 4.3.6).

Effects of Alternative 3 on Harvest Level Specifications: Objectives for setting optimum yield would remain the same as in Alternatives 1 and 2. Under Alternative 3, fishing periods would be compressed or the season shortened. Other than soft sector allocations similar to *status quo*, there would be no performance standards or OY reserves. Ranking of this tool as used in Alternative 3 would be the same as *status quo*, or 3 on a scale of 1 - 3.

Effects on Overfished Groundfish On a per vessel basis, a shorter season may allow larger shares of OY per trip due to potentially larger trip limits compared to *status quo*, and would have an impact similar to Alternative 2, reducing bycatch and bycatch mortality of overfished species.

Effects on Emphasis Species Objectives for optimum yield would remain the same as in *status quo.* On a per vessel basis, a shorter season may allow larger shares of OY per trip compared to *status quo*. Several species of groundfish at or above MSY are currently under-harvested due to constraints on overfished stocks or market limits. One possible consequence of this alternative is that more OY would go unharvested due to the reduced season.

Effects of Trip Limits under Alternative 3: Vessel trip limits would initially be the same as those in Alternative 2. The season would be shortened to match the new trip limit. The shortened season would allow access to more of the overall OY for groundfish species. Much would depend on fleet response to a shortened season and larger cumulative limits. Platooning of the fleet would be done to maintain a supply of groundfish year-round. If fishers increase effort to compensate for the reduced season, season length would be reduced to maintain trip limit size. The compressed season anticipated larger trip limits should have a significant impact on reducing bycatch and bycatch mortality compared to *status quo.* Although trip limits should be similar to Alternative 2, the capacity reduction alternative, this alternative ranks lower as it may be difficult to optimize trip limits and season length in such a fashion as to minimize bycatch and bycatch mortality compared to Alternative 2.

Effects on Overfished Groundfish Vessel trip limits would increase, especially outside of GCAs as a consequence of a 50% reduction in the fishing season. The fleet would be platooned into two or three groups with shortened fishing periods. This would create a more even flow of fish and supports the current Council goal of maintaining a year-round season. In either case, the larger trip limit sizes would tend to decrease bycatch and bycatch mortality associated with regulatory induced discards. If fishers compensate for the shortened season and larger trip limit by increasing effort, the benefits of a shortened season might not be realized. Too much effort could result in the season being reduced. A shorter season may reduce harvest if some fishers elect not fish during the openings. Bycatch and bycatch mortality would be reduced but product flow may be interrupted.

Effects on Emphasis Species Vessel trip limits would increase, especially outside of GCAs as a consequence of a 50% reduction in the fishing season.

As was described above under the *status quo,* bycatch of species within the DTS may be the result of several factors, including size, attainment of regulatory limit, and high grading related price structure of different sizes of sablefish. A 50% reduction in fishing season and increased trip limits for components of the complex would tend to reduce regulatory induced discard. Within the DTS complex, bycatch of shortspine thornyhead may be reduced if a larger trip limit for this species were allowed. High grading of sablefish may still occur, however.

The potential increase in trip limit size not likely a significant factor for some species of groundfish like those in the other flatfish category. Landing limits under *status quo* are quite liberal compared to current catches and attainment of the cumulative limit under Alternative 3 is not likely. Bycatch and bycatch mortality is related to market limitations for undersized fish, price, and constraints on quantity. If fleet response to the shortened season is to seek some alternative fishery rather than increase effort during season openings, bycatch and bycatch mortality may be reduced due to a reduction in overall harvest levels.

Effects of Catch Limits under Alternative 3: Vessel catch limits are not explicitly used as a tool in this alternative. Therefore this tool is ranked 4 (no effect) on a scale of 1 - 4.

Effects of Gear Regulations under Alternative 3: Gear regulations alternative would be similar to *status quo* and structured to keep catches within the OY limits for overfished species. Gear restrictions are likely to remain the same as under *status quo* in the near future due to rebuilding requirements of overfished species, however. Alternative 3 application of gear tools therefore ranks the same as *status quo*, or 2 on a scale of 1 - 3.

Effects on Overfished Groundfish It is not anticipated that a 50% reduction in fishing season would permit the use of large footrope gear within current RCA boundaries. However, small footrope trawls could be re-introduced into GCAs if overall OYs for overfished species could be maintained. Currently, lingcod and yelloweye catches remain below OY. Lingcod in particular may be harvested at a higher rate if small footrope trawls are reintroduced. Even with more liberal trip limits and new gear options, canary rockfish catch is very close to OY, thus would constrain access to fishing within the GCAs. Thus, bycatch and bycatch mortality within GCAs could increase over *status quo,* if management measures similar to those used in 2000-2002 were employed within the GCAs. Current canary rockfish, therefore may preclude use of small roller gear within the GCAs. A similar circumstance exists for the southern shelf area - bocaccio catch under *status quo* is very close to OY.

Effects on Emphasis Species Larger trip limits stemming from a shorter season may allow access to species of groundfish within the GCA that are precluded from harvest under *status quo.* Harvest levels for several species of shelf groundfish are below current OY levels. Use of small footrope gear could allow more access to Dover, English and petrale soles found on the shelf. Unfortunately, canary rockfish and bocaccio catches under *status quo* are very close to OY, so the use of such gear is unlikely.

Effects of Time/Area Management under Alternative 3: Fishing seasons would be significantly different than the other alternatives. The primary effect of seasonal closures is modeled under the trip limit tool for this alternative (see above).

GCAs similar to *status quo* would be used. GCAs are likely to remain the same as under *status quo* in the near future due to rebuilding requirements of overfished species, however. Alternative 3 application of time/area closures therefore rank the same as *status quo*, or 3 on a scale of 1 - 3.

Effects on Overfished Groundfish The principal tool for this alternative is to reduce time on the water using seasonal closures. Reducing time on the water would allow larger trip limits during open periods. As was pointed out above, this would have a positive benefit as larger trip limits tend to reduce bycatch in the form of regulatory induced discard of overfished species. Platooning of the fleet would be done to maintain a year-round flow of groundfish to markets, thus impacts would be comparable to Alternative 2. Compared to *status quo*, this alternative would still have a positive benefit in reducing bycatch and bycatch mortality of overfished species due to the general effect of increased trip limit size. The season may have to be shortened in order to maintain trip limit size. If the season is too short, some fishers may be elect not to fish. Overall catch of overfished species may decline or trip limits could be increased. The impact of effort reduction due to fishers opting out, would be a reduction in bycatch and bycatch mortality of overfished species.

Effects of on Emphasis Species In addition to the GCAs described under Alternative 1, the principal tool for this alternative is to reduce time on the water using seasonal closures. Depending on the timing of a seasonal closure, bycatch and bycatch mortality may be reduced. If platooning is considered as an option, fisheries outside of the GCAs might be feasible as increased trip limits would provide some flexibility in application of ratio management. For example, the DTS fishery could provide year round opportunities for a platooned fleet with larger trip limit sizes. In addition, a significant proportion of flatfish are distributed shoreward of RCAs; there may be an opportunity to have exceptions to closures for the shallow water flatfish fishery.

Effects of Capacity Reduction under Alternative 3: Capacity reduction is not used as a tool in this alternative. Therefore this tool is ranked 3 (no effect) on a scale of 1 - 3.

Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 3: Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans. Under Alternative 3, 100% of the at-sea whiting fleet would be monitored by onboard observers; shore-based whiting vessels wold continue to be required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings would be observed on shore; and approximately 10% of the non-whiting commercial groundfish fleet would be monitored with on-board observers. Commercial landings data and observer data would be used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish.

Under Alternative 3, catch reporting, record-keeping, and monitoring through the use of observers may improve over Alternative 1. Assuming the number of observer days remains the same, a higher proportion of total trips and catch would be observed due to the reduced fleet size and (perhaps) reduced total number of trips. If effort increases, trip limits may have to be reduced, and the level of observer coverage would be similar to Alternative 1. This tool is ranked 4 (low), the same as Alternative 2, on a scale of 1 - 5.

Table 4.3.6. Effects of bycatch mitigation tools as applied in Alternative 3. Relative rank of the tools used to reduce bycatch and bycatch mortality. Overfished species in bold and emphasis species in italic. Species below MSY and subject to precautionary management are noted with (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip Limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			None	Larger trip limits	Soft sector scorecard	None	Yes	None	RCAs and shortened season	10% Observer coverage, 100% logbook coverage, verification
Northern Shelf	**Canary rockfish**	1	3	3	4	2	2	3	3	4
	Lingcod	1	3	3	4	2	2	3	3	4
	Yelloweye rockfish	1	3	3	4	2	2	3	3	4
	Yellowtail rockfish	1	3	3	4	2	2	3	3	4
	Arrowtooth flounder	1	3	3	4	2	2	3	3	4
	English sole	1	3	3	4	2	2	3	3	4
	Petrale sole	1	3	3	4	2	2	3	3	4
Southern Shelf	**Boccacio**	1	3	3	4	2	2	3	3	4
	Cowcod	1	3	3	4	2	2	3	3	4
	Chilipepper	1	3	3	4	2	2	3	3	4
Slope	**Darkblotched rockfish**	1	3	3	4	2	2	3	3	4
	Pacific Ocean Perch	1	3	3	4	2	2	3	3	4
	Dover sole (p)	1	3	3	4	2	2	3	3	4
	Sablefish (p)	1	3	3	4	2	2	3	3	4
	Shortspine thornyhead (p)	1	3	3	4	2	2	3	3	4
	Longspine thornyhead	1	3	3	4	2	2	3	3	4
Pelagic	**Widow rockfish**	1	3	3	4	2	2	3	3	4
	Pacific whiting	1	3	3	4	2	2	3	3	4
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3	4
	Cabezon	1	3	4	4	2	2	3	3	4
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

4.3.1.4 Impacts of Alternative 4 (Sector and vessel catch limits)

Summary The policy goal of this alternative is to reduce bycatch by modifying the definition of "trip limit" to include *CATCH LIMITS* for overfished stocks, establishing vessel catch limits for each 2-month period, setting annual catch limits for the various fleet sectors, and establishing an in-season catch monitoring or verification program to ensure all catch is recorded. Trip (retention) limits for non-overfished groundfish would also be used in combination with vessel catch limits. Catch limits and retention limits would expire at the end of each period. Vessels carrying observers would have access to larger trip limits of non-overfished groundfish. In this alternative, control of bycatch and bycatch mortality is done by controlling overall catch and gear efficiency and requiring vessels to stop fishing for all groundfish when a catch limit is reached. Direct control of catch and individual vessel accountability set this alternative apart from the previous alternatives. Individual vessel performance would contribute to sector performance. A fishing sector could, therefore, be closed when the portion of OY allocated to that sector were reached. Other sectors would continue fishing unless an overall OY were reached.

This goal supports Council objectives of preventing overfishing, rebuilding overfished stocks, maintaining a year-round fishing season, and increasing individual and group accountability for their groundfish catches. Fishery monitoring would be increased over Alternative 1; monitoring costs would be higher.

Tools Used The following mix of management measures are applied to create Alternative 4. Tool ranks for Alternative 4 are summarized in Table 4.3.7.

Table 4.3.7. Summary of bycatch mitigation tools as used in Alternative 4.

Harvest Levels ABCs/OYs Same as Alternative 1; sector allocations established
Vessel trip limits   Used; perhaps more variations than Alt 1 - 3 due to more sectors. Larger trip limits for vessels with catch limits and observers.
Vessel catch limits   Used for vessels that pay for observers
Gear regulations   Same/ similar to Alternative 1
Time/area management Generally similar to Alternative 1; possible limited exemptions for vessels with catch limits and observers
Capacity reduction Same as Alt 1
Data reporting, record-keeping, and monitoring Similar to Alt 1, but more coverage expected due to incentives for vessels to pay for (additional) observers

- Harvest Levels (harvest policy, rebuilding) Objectives for optimum yield and rebuilding would remain the same as in Alternatives 1, 2, and 3. The harvest policy would be modified from the previous alternatives in that OYs would be subdivided into overfished species limits and non-overfished species guidelines for each fishing sector. Each sector would be monitored separately throughout the season for its progress towards those guidelines and caps. Broad fishery sectors would be specified: three limited entry whiting sectors, limited entry bottom trawl, limited entry fixed gear, open access, and recreational. Because several stocks show geographic variation north to south, the non-whiting sectors could be further subdivided, for example north and south of Cape Mendocino at 40°10' N. Lat. A portion of non-overfished groundfish OYs could be set aside in reserve for the fishery sector with the lowest bycatch to provide further incentive to reduce catch rates of overfished species. When a sector reached any cap, all vessels in the sector must stop fishing for groundfish. When a sector reached a guideline for a non-overfished species, the Council would evaluate whether sufficient OY remains to allow continued fishing without reducing opportunities for other sectors.
- Vessel trip limits Vessel trip limits for non-overfished groundfish species would be established sector-by-sector. They would reflect the number of vessels in the sector and the allocations for that sector. Some trip limits might initially be similar to those under Alternative 1, based on previously observed joint catch ratios of overfished and co-occurring groundfish species. Trip limits would likely be larger than under the previous three alternatives because they would be based more directly on OYs for those species and on the membership and participation of the various sectors.
- Catch Limits Restricted species catch limits for overfished groundfish (and perhaps other species needing reduced harvest) would be established for those limited entry vessels that pay the costs for their own observer coverage. These catch limits would exempt the vessel from sector allocations and would likely be combined with larger trip limits for non-overfished species. Catch limits may differ among vessels based on target species or strategy, gear, cooperative research fishing, participation in an EFP, etc. Vessels participating in the same EFP or a small cooperative would likely have similar catch limits. As with trip limits, these catch limits would not be transferable and would expire at the end of each period (that is, they could not be carried over to the next period). In contrast to trip limits, a vessel must stop fishing when it reaches any restricted species catch limit until the next period begins. When a vessel is observed to reach a restricted species catch limit, it must stop fishing for the remainder of the period. When an annual sector cap is reached or projected to be reached, vessels with unattained catch limits would continue fishing. The increased incentive to avoid catching overfished groundfish and the reduction of incentives to discard under this provision would be expected to reduce bycatch of overfished groundfish substantially. Facing the possibility of being shut down due to reaching a restricted species catch limit or sector cap, vessels would be more likely to retain all usable fish.

- Gear Regulations Gear regulations under this alternative would be the same or similar to Alternative 1, and would be structured to keep catches within the OY limits for overfished species. Incentives would be stronger to modify gear in order to reduce bycatch and bycatch mortality, due to strict caps and robust monitoring system of this alternative. Gear modifications that reduced the take of overfished rockfish outside of RCAs would have a direct beneficial impact on bycatch and bycatch mortality, compared to the first three alternatives. The fate of excluded fish is unknown. Fish interacting with and escaping fishing gear may succumb to delayed mortality even though bycatch in the form of discards is reduced.
- Time/Area Management Initially, time and area closures would be similar to those under Alternative 1, and would be based on the previously observed catch ratios of various groundfish species. Some additional flexibility might be possible due to increased monitoring and updating of catch ratios and performance of the fishing sectors. This alternative may allow changes in time or depth of RCAs based on more extensive monitoring data, since the observer program would likely be more finely stratified than under the *status quo* alternative. Reduction in the extent of the current GCAs would be intended not to allow increased catch/bycatch of overfished species, but could result in bycatch of other species.
- Capacity Reduction Further capacity reduction is not included in this alternative.
- Data Reporting, Record-keeping, and Monitoring This alternative would establish a more robust catch reporting, record keeping, and monitoring program than Alternative 1. Full (100%) logbook coverage would be required to improve the accuracy of estimated catch by commercial and charter boats. A subset of vessels within each sector would be chosen randomly and observed. (For vessel caps to be fully functional, every vessel would have to be observed.) Incidental catch rates of observed vessels would be quickly tabulated and applied to non-observed vessels of the sector. Vessels within a sector could also voluntarily pay for and carry an observer in order to have access to higher trip limits. Recreational sampling would be also be increased. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives.

Impacts on Groundfish The effects of the tools and tool applications used to reduce groundfish bycatch, bycatch mortality, and to increase individual and sector accountability in Alternative 4 are ranked and summarized in Table 4.3.8. Effects are ranked in comparison to the other alternatives. Lower numbers indicate a greater effect.

<u>Overfished species</u> Under this alternative, overfished species OYs would be subdivided into caps for each fishing sector; non-overfished species OYs would be subdivided into guidelines for each sector. A subset of vessels in each sector would be observed and catch/bycatch rates expanded to unobserved vessels inseason. Within each sector, overfished species catch limits (RSCs) would be assigned to each vessel. When a vessel reached a catch limit (RSC), it would be required to cease fishing. When a sector cap was reached or projected to be reached, all vessels in that sector would have to stop fishing. Intensive monitoring (observer coverage) would ensure success of this bycatch mitigation program. The primary direct effect of this alternative would be reductions in bycatch of overfished species due to strict caps, individual vessel catch limits, and monitoring of these species. It is highly likely that the shelf dwelling canary rockfish and bocaccio will present the biggest challenge to sectors because of their wide distributions and susceptibility to diverse gears. Current harvest levels for these two species are very close to the OYs. Catches of some other overfished species are below their OYs largely due to fishing constraints caused by canary rockfish and bocaccio. Thus, impacts of trip or catch limits on the various species would differ. Bycatch reduction impacts on overfished species with catch limits would rank higher than other emphasis groundfish species (see below).

There is some question as to whether incentives work on a fishery sector basis. Huppert *et al.* (1992) suggested that sector based incentive systems tend to penalize those participants who adopt methods of reducing bycatch of prohibited species, because fewer target species are likely to be caught. Sector based incentive programs work best for relatively small and discreet fishing units like fishing co-operatives. The Pacific whiting fishery sector uses a similar program to limit the incidental catch of salmon. Catch limits for overfished species applied to individual vessels and closely monitored should provide stronger incentives than sector limits alone. Impacts of catch limits on individual vessels under a comprehensive monitoring program would be similar to Alternative 5.

The limited entry fixed gear fleet might be successful in limiting the sector's bycatch of certain non-target species of concern (halibut, lingcod, and overfished rockfish), as the catch of those species is relatively small and fishing methods relatively selective. In contrast, the large recreational sector may have a difficult time controlling catch of overfished species through an incentive program because there are many and diverse participants. Thus, other means of controlling this sector's catch would likely be necessary.

Cumulative trip limits for non-overfished groundfish species would be increased for those vessels carrying observers. Cumulative trip limits for the entire sector could be relaxed in size to the extent fleet sectors were able to minimize bycatch of overfished species. Gear modifications would be encouraged to reduce the take of overfished species.

<u>Emphasis Species</u> Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring (non-overfished) groundfish, especially if unobserved participants in a sector did not apply bycatch reducing fishing tactics. A reduction in effort could result from early attainment of restricted species catch limits and overfished species sector caps. This may result in less harvest of other groundfish, thus reducing bycatch and bycatch mortality at the expense of lost economic opportunity. On the other hand, incentives, in the form of larger trip limits for observed vessels, and access to a reserve later in the year for the fishing sector, may change enough of each sector's fishing practices to reduce bycatch of overfished species and increase catch of other groundfish. Individual vessel restricted species catch limits would apply only to overfished species, with trip limits applied to other species. Sector harvest guidelines rank lower than restricted species catch limits for their effectiveness in reducing bycatch (See shaded boxes under "Trip Limits" and "Catch Limits" columns in Table 4.3.8).

Increased cumulative retention limits might result if bycatch of overfished species were well controlled using vessel restricted species catch limits, sector caps, incentives and gear modifications. This could result in increased access to those non-overfished groundfish with higher market value or demand. Bycatch may be reduced for some species such as Dover sole, shortspine thornyhead, sablefish, and yellowtail rockfish. Increased cumulative limits would have less impact on species that are constrained by market limits (some flatfishes and chilipepper rockfish, for example) rather than regulatory limits.

Effects of Harvest Levels under Alternative 4: Objectives for optimum yield and rebuilding would remain the same as in s*tatus quo.* Harvest policy would be modified from *status quo* in that OYs would be subdivided into caps allocated to each fishing sector with in-season monitoring of caps. Performance standards and sector allocations with OY reserves should have a significant effect, reducing potential bycatch and bycatch mortality compared to Alternatives 1-3. This tool, as used in Alternative 4, is ranked 2 (highly effective) on a scale of 1- 4.

Effects on Overfished Groundfish Under this alternative, overfished species OYs would be broken down into caps for each fishing sector with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A portion of other groundfish OY would be set aside in reserve for each fishery sector to provide an incentive to lower catch rates of overfished species. If successful, the primary direct effect of this alternative would be reductions in bycatch of overfished species due to strict caps and monitoring of these species. It is highly likely that the shelf dwelling canary rockfish and bocaccio will present the biggest challenge to sectors. Current harvest levels under *status quo* conditions are very close to OY. Catch of other overfished species are below OY largely due to fishing constraints caused by these two species.

There is some question as to whether incentives work on a fishery sector basis. Huppert *et al.* (1992) suggested that sector based incentive systems tend to penalize those participants who adopted methods of reducing bycatch of prohibited species, because fewer target species are likely to be caught. Sector based incentive programs work best for relatively small and discreet fishing units like fishing co-operatives. The Pacific whiting fishery sector utilizes a similar program to limit harvest of salmon incidental catch.

The limited entry fixed gear fleet would likely be successful limiting bycatch of non-target species of concern (halibut, lingcod, and overfished rockfish), as the catch of overfished species is small. In contrast, the recreational sector may have a difficult time controlling catch of overfished species through an incentive program, because there are many and diverse participants. Thus, other means of controlling this sectors' OY cap would likely be more effective.

Effects on Emphasis Species Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch reducing fishing tactics. A reduction in effort could result from early attainment of overfished species sector caps. The direct impact of OY caps may result in less harvest of other groundfish, thus reducing bycatch and bycatch mortality at the expense of lost economic opportunity. On the other hand, incentives, in the form of additional OY for the fishing sector may change enough of the sectors' fishing practices to reduce bycatch of overfished species and increase catch of other groundfish. If bycatch is proportional to catch, bycatch and bycatch mortality may increase for other groundfish.

Effects of Vessel Trip Limits under Alternative 4: Vessel trip limits would initially be the same as *status quo* and based on previously observed joint catch ratios of overfished species and various groundfish species. Trip limits might be relaxed (increased) depending on the performance of fleet sectors at maintaining catch caps. Trip limits under this alternative are given a rank of 2 (very effective) for some species and 3 (somewhat effective) for other species on a scale of 1 - 4.

Effects on Overfished Groundfish Vessel trip limits could be altered compared to the status quo due to more careful monitoring of catch, and vessel incentives to minimize catch and bycatch of overfished species, as the season progresses. To the degree that limits were liberalized, bycatch and bycatch mortality of overfished species may be reduced. Alternative 4 applies caps on a sector basis. Individual vessels may not have as strong of an incentive to avoid overfished species as in Alternatives 5 and 6. Therefore, it is likely that the greatest source of bycatch reduction is likely to be due to increased retention rates for bottom trawlers.

Studies of Alaska fisheries have shown that sector caps work with small identifiable fishing units, like cooperatives. The west coast whiting fleet is organized along similar lines and appear successful at implementing voluntary caps on bycatch of prohibited species. Under this alternative, a pelagic fishery catch cap for overfished shelf rockfish and widow rockfish may effectively managed by Pacific whiting cooperatives.

Effects on Emphasis Species Limit changes under this alternative are not likely to affect those species with catch levels below existing cumulative catch limits, especially if they are market limited. Effects of potential limit changes on these species were ranked lower than overfished species (see shaded scores under Trip limits in Table 4.3.4). Catches of more desirable species, like yellowtail rockfish, currently harvested below cumulative catch limits due to constraints associated with overfished species may be more accessible if the vessel sector incentive program is successful.

Effects of Catch Limits under Alternative 4: Sector caps may or may not be effective incentives for individual vessels to improve their bycatch performance. In the absence of individual vessel caps, unobserved vessels may have increased incentive to maximize revenues before a sector cap is reached. This could result in discarding all overfished species to avoid contributing to the landed catch accounting system, increased highgrading, and other changes in fishing behavior. If effectively monitored, Alternative 4 would be expected to reduce bycatch of overfished groundfish substantially. Facing the possibility of being shut down due to reaching a restricted species catch limit or sector cap, vessels would be more likely to retain all usable fish. [However, this could have unintended consequences. For example, catch projections could be compromised if only target species landings are monitored and static ratios applied . Managers may not be aware of increased retention rates and would continue to apply co-occurrence rates that would be higher than the actual bycatch rates (which could be declining).] Individual catch caps, increased monitoring, and larger trip limits would be expected to work towards reduced regulatory and economic bycatch. In addition, catch limits would enable relaxation of redundant restrictions (possibly including seasons and area restrictions), which could make it more profitable for vessels to truly minimize their bycatch to the extent practicable with less regulation. Only through individual performance will sector performance improve. Without incentives and opportunities for individual improvement, progress will be slow and bycatch rates could even deteriorate.

Vessel catch limits for overfished groundfish (and perhaps for other species needing bycatch reduction) would be established for limited entry vessels that carry an observer at their own expense. These caps may be different for different vessels depending on target strategy, gear, area, etc. This management tool may provide enough incentive to significantly reduce bycatch of overfished species through changes in fishing strategy and gear deployment. As with trip limits, these catch limits would not be transferable and would expire at the end of each period (that is, they could not be carried over to the next period). In contrast to IQs, they could not be bought and sold as needed for greater economic efficiency.

In contrast to trip limits, when a vessel reaches any catch limit, it must stop fishing until the next period begins.

One possible variation of sector caps and vessel catch limits could be for smaller groups of vessels to form cooperatives, pooling their individual catch limits so as to spread the risk of reaching any limit. This could be particularly effective for vessels that conscientiously strive to minimize their bycatch and are willing to experiment and cooperate to achieve optimum results.

This tool is ranked 2 (highly effective) for overfished species and some emphasis species and 3 (somewhat effective) for others on a scale of 1 to 4 (where 1 is the most effective and 4 is the least effective at reducing bycatch and bycatch mortality). However, due to the higher costs of full observer coverage (both to vessels and to the management agencies), this approach to minimizing bycatch may not be practicable, especially in the short term. If the observer program can be augmented over time, and vessel revenues improved enough to enable them to contribute to observer funding needs, this approach may become practicable.

Effects on Overfished Groundfish The increased incentive to avoid catching overfished groundfish and the increased incentives to retain more fish under this alternative would be expected to reduce bycatch of overfished groundfish substantially. Facing the possibility of being shut down due to reaching a vessel catch limit, vessels would be likely to fish more carefully and retain more usable fish. Full monitoring would be required.

Effects on Emphasis Species The creation of vessel catch limits for overfished species, combined with larger trip (retention) limits for other emphasis species, could increase the overall harvest of some other groundfish species up to OY. Some species will continue to be limited by markets; increased retention requirements would reduce the economic discard of these species and would encourage market development. Increased limits and retention of species such as Dover sole, shortpine thornyhead, sablefish, and yellowtail rockfish may reduce regulatory bycatch of these species under Alternative 4.

Effects of Gear Restrictions under Alternative 4: Management under Alternative 4 would include incentives to modify gear as an aid in reducing bycatch and bycatch mortality and keeping under strict vessel and sector caps. Gear restrictions as applied under Alternative 4 are assigned a rank of 2 on a scale of 1 - 3 among alternatives.

Effects on Overfished Groundfish Gear modifications that reduced the take of rockfish outside of RCAs may have a direct positive impact on bycatch and bycatch mortality of overfished species, compared to the first three alternatives. Depending on the type of gear modification, some un-observed impacts may occur, leading to bycatch mortality. Little is known about the survivability of fish escaping through meshes or escape panels. Fish excluder devices that eliminate overfished rockfish species provide a better opportunity for survival than sorting and discarding fish at the surface, which is generally lethal for rockfishes (see discussion under Alternative 1 *status quo* and Davis and Ryer (2003)). Cut-back trawls are being experimented with under EFPs. These nets are thought to be highly selective for flatfish and may allow rockfish to avoid capture without contact (Parker 2003).

With caps applied on a sector basis however, individual vessels may not have as strong of an incentive to modify gear to eliminate take of overfished species as in Alternatives 5 and 6 (see discussion above under **Harvest Levels**).

Effects on Emphasis Species It is hoped that incentives to modify gear to reduce bycatch and bycatch mortality of overfished species would be strong, due to strict caps and a robust monitoring system. If sector based caps are successful at minimizing bycatch of overfished species, more of the OY for other groundfish should be accessible. The midwater trawl fishery may be successful in taking yellowtail rockfish without excessive bycatch of widow rockfish for example. The DTS fishery might enjoy a large portion of overall OY if, through incentives, undersized sablefish and shortspine thornyhead bycatch could be reduced. Impacts to nearshore flatfish bycatch and bycatch mortality are unknown as changes in gear are likely to be done to reduce impacts to overfished species. As pointed out above, the strength of the incentives depends on changes in gear and behavior on the part of the entire sector in order. There may not be as strong as incentive as possible if caps were applied on an individual vessel basis (See Alternatives 5 and 6).

Effects of Time/Area Management under Alternative 4: Initially time and area closures (RCAs) would be similar to those under *status quo*, and would be based on the previously observed catch ratios of various groundfish species. Some limited additional flexibility in defining RCAs might be possible if fleet sector response to sector caps reduces bycatch. Time/area management as applied under Alternative 4 is given a rank of 3 (no additional effect over the *status quo*) on a scale of 1 - 3.

Effects on Overfished Groundfish This alternative may allow changes in time or depth of seasonal RCAs if fleet sectors are successful at maintaining harvest levels of overfished species at or below OY sector caps. Impacts to bycatch and bycatch mortality of overfished species would likely be the same as under *status quo*. Gains made due to successful fleet response to sector caps may be offset somewhat if managers change RCA boundaries to allow new opportunities to harvest other groundfish. Encounter rates with overfished shelf rockfish could increase as a result. If fishers retain overfished species, overall bycatch should be less than *status quo.*

Effects on Emphasis Species Initially time and area closures (RCAs) would be similar to those under *status quo*, and would be based on the previously observed catch ratios of various groundfish species. Impacts to bycatch and bycatch mortality would likely be the same as under *status quo.* If RCA boundaries are changed to allow more access to other groundfish, catch, bycatch and bycatch mortality of other shelf groundfish could increase somewhat.

Effects of Capacity Reduction under Alternative 4: Further capacity reduction is not included in this alternative. Therefore, it is ranked as 3 (no effect) on a scale of 1-3.

Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 4: Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans. Under Alternative 4, 100% of the at-sea whiting fleet would be monitored by onboard observers; and shore-based whiting vessels wold continue to be required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings would be observed on shore.

Under Alternative 4, observer coverage would be redesigned to ensure that each sector's bycatch of overfished groundfish species is accurately assessed and recorded, with results available for management purposes inseason. A minimum rate observation of each sector would be approximately 10% or as determined by statistical sample design methods. Full (100%) logbook coverage for each sector would be required to improve the accuracy of estimated catch by commercial and charter boats. Commercial landings data and observer data would be expanded sector-by-sector to all vessels in each sector. Vessels observed to achieve any catch limit of overfished species (or other restricted species catch limit) would be required to stop fishing for the remainder of the designated period. Vessels observed to stay below all restricted species limits would be authorized to continue fishing for additional target species; that is, larger trip limits would be available for vessels carrying observers. It may be possible to use video monitoring in conjunction with full retention and shoreside sampling to achieve the same level of catch verification.

The catch reporting, record keeping, and monitoring program established by Alternative 4 would be substantially more robust than Alternatives 1, 2 and 3. For vessel caps to be fully functional, every vessel would have to be observed. Vessels within a sector could also voluntarily pay for and carry an observer in order to have access to higher trip limits. Recreational sampling would be also be increased. In-season monitoring of commercial and recreational fisheries would ensure caps were not exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Discard may also be reduced in the commercial fishery compared to the first three alternatives as fishers are more likely to retain catches of all usable fish, including overfished species. Bycatch mortality of fish caught and released in the recreational fishery is unknown. The application of this tool is ranked 2 to 3 (highly effective) on a scale of 1 - 5 compared to the alternatives. The ranking depends on the level of observer coverage (whether 100% coverage is achieved or some lesser coverage rate of each sector).

Table 4.3.8. Effects of bycatch mitigation tools as applied in Alternative 4. Relative rank of the tools used to reduce bycatch and bycatch mortality. Overfished species in bold and emphasis species in italic. Species below MSY and subject to precautionary management are noted with (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			Catch ratios- allocate to sector with reserve	Yes	Vessel and Sector caps	None	Yes	None	RCAs	Increased Observer coverage commercial and CPFV, in-season est.
Northern Shelf	**Canary rockfish**	1	2	2	2	2	2	3	3	2
	Lingcod	1	2	2	2	2	2	3	3	2
	Yelloweye rockfish	1	2	2	2	2	2	3	3	2
	Yellowtail rockfish	1	2	2	3	2	2	3	3	2
	Arrowtooth flounder	1	2	3	3	2	2	3	3	2
	English sole	1	2	3	3	2	2	3	3	2
	Petrale sole	1	2	3	3	2	2	3	3	2
Southern Shelf	**Boccacio**	1	2	2	2	2	2	3	3	2
	Cowcod	1	2	2	2	2	2	3	3	2
	Chilipepper	1	2	3	3	2	2	3	3	2
Slope	**Darkblotched rockfish**	1	2	2	2	2	2	3	3	2
	Pacific Ocean Perch	1	2	2	2	2	2	3	3	2
	Dover sole (p)	1	2	2	3	2	2	3	3	2
	Sablefish (p)	1	2	2	3	2	2	3	3	2
	Shortspine thornyhead (p)	1	2	2	3	2	2	3	3	2
	Longspine thornyhead	1	2	3	3	2	2	3	3	2
Pelagic	**Widow rockfish**	1	2	2	2	2	2	3	3	2
	Pacific whiting (incl.discard)	1	2	2	2	2	2	3	3	2
Nearshore	*Black rockfish*	1	2	2	3	2	2	3	3	2
	Cabezon	1	2	2	3	2	2	3	3	2
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

Figure 4.7.

4.3.1.5 Impacts of Alternative 5 (Individual Fishing (Catch) Quotas and Increased Retention)

Summary The policy goal of this alternative is to significantly reduce bycatch by limiting every limited entry commercial vessel's groundfish catches through the use of annual, transferable, restricted species catch quotas (RSQs) for overfished species and transferable individual fishing quotas (IFQs) for other groundfish. These quotas would be mortality limits for each species. Direct control of catch and individual vessel accountability sets this alternative apart from Alternatives 1, 2 and 3; the use of annual catch limits that are transferable sets this apart from Alternative 4. A robust monitoring or catch verification program would be implemented to ensure reporting of all catch. Discarding of overfished species would be prohibited; discarding of other species would not be prohibited, but all catch would apply towards the IFQs. Gear regulations would be relaxed, allowing fishers the ability to modify gear and operations to avoid catch of overfished species and reduce unwanted bycatch of all species. Regulations could be amended to allow trawl vessels to use non-trawl gears where increased selectivity for certain species is possible. A portion of some OYs would be reserved for vessels with the lowest bycatch rates or amounts.

This goal supports Council objectives of preventing overfishing, rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is increased substantially over Alternatives 1, 2 and 3, and less substantially over Alternative 4. Increased monitoring also means increased costs.

Tools Used The following mix of management measures are applied to create Alternative 5. Tool ranks are summarized in Table 4.3.9

Table 4.3.9. Summary of bycatch mitigation tools as applied in Alternative 5.

Harvest Levels ABCs/OYs same as Alternative 1; allocations of catch shares to eligible vessels
Vessel trip limits not used for limited entry, with possible exceptions for small vessels. For open access, continued use.
Vessel catch limits vessel allocations are catch limits; transferable; some discard prohibitions
Gear regulations same/similar to Alternative 1; may be relaxed.
Time/area management generally similar to Alternative 1; may be relaxed for vessels with IFQs and observers
Capacity reduction none specified; fleet reduction expected to result from IQ program
Data reporting, record-keeping, and monitoring Full coverage of vessels in IFQ program

- Harvest Levels OYs would remain the same as in Alternative 1, however distributions of available OYs would be broken down into individual quotas (mortality limits) for each commercial limited entry vessel. A reserve of various species could be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OYs would be made available to those vessels that had not taken their overfished species limits.
- Vessel trip limits Vessel trip limits would be relaxed or absent, as each vessel would have individual caps on overfished and other groundfish species.
- Vessel Catch Limits Individual vessel caps in the form of dedicated access privileges (such as transferable restricted species catch limits (RSQs) for overfished stocks and individual transferable fishing quotas for other groundfish species) would be established with this alternative.   Vessels must stop fishing upon reaching any catch quota or obtain additional quota to continue fishing. Vessels with the lowest catch rates of overfished species would have the greatest access to additional fishing.
- Gear Regulations Gear regulation would be more flexible than under Alternative 1. Gear modification, and perhaps the use of alternative gears, would be allowed. Commercial limited entry trawl fishers would be encouraged to experiment with different methods to reduce bycatch of overfished species. The distinction between limited entry longline and pot permits could be eliminated, and/or those vessels allowed to use open access line gear to reduce their catch of overfished species. Strict caps and a robust catch monitoring system would reduce the need for gear regulations as the primary bycatch mitigation tool.
- Time/Area Closures In the short term, MPAs would be applied in a manner similar to the first four alternatives. However, under an RSQ/IFQ program, GCAs as they are currently used may become less important and less necessary as a tool to reduce groundfish bycatch. Once an individual vessel's RSQ/IFQ is attained, the vessel would be required to cease fishing for groundfish until additional quota is obtained. There may some limited circumstances where continued fishing might be allowed where the likelihood of encountering the particular species would be highly unlikely. Under an individual vessel catch limit/quota program, vessels would have a greater incentive to improve the selectivity of their fishing gear and techniques, fishing in areas where they can maximize their profits. MPAs for overfished species would tend to be redundant under this program. However, MPAs for other purposes, such as habitat areas of particular concern, or research reserves, might continue to be appropriate or necessary.
- Capacity Reduction No direct reduction in capacity is considered under this alternative. (See discussions under Alternatives 1 and 2). However, some degree of industry consolidation would be expected under an individual quota program. Capacity reduction accomplished through RSQ/ IFQ sales could have a positive direct effect on overfished species, if a species cap for a vessel is not used by the vessel. Excess quota could be re-distributed to active fishers or left in reserve.

- Data Reporting, Record-keeping, and Monitoring Increased observer coverage would be required. Although onboard observers would likely monitor fishing locations to a certain extent, VMS would be used to ensure more precise location and to verify vessels did not fish within an MPA or closed area (PFMC 2003e). Recreational sampling would also be increased under this alternative. Each IFQ vessel would be required to closely track its catches so it would know when it must stop fishing or purchase additional quota. In-season monitoring of the limited entry fishery would thus be vessel-by-vessel; monitoring of the recreational and commercial open access fisheries would be by sector, but increased monitoring may be necessary in order to ensure the quotas of the IFQ fishery are not eroded.

Impacts on Groundfish The effects of tools used in Alternative 5 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.10. Effects are ranked in comparison to the other alternatives, lower numbers meaning that the tool is expected to be more effective. Greater individual accountability is the hallmark of this alternative. Gear restrictions would be flexible (with the possible exception of gear requirements inside MPAs, where use of bottom fishing gears would likely remain limited). Performance standards (individual quotas and close monitoring) would provide strong incentives for individuals to modify their fishing gear and practices to reduce bycatch of overfished groundfish, minimizing the need for other regulatory intervention. RSQ and IFQ sales would lead to industry consolidation, including further fleet reduction .

Overfished groundfish OY for overfished species would be broken down into RSQs for each fishing vessel, with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A portion of the OYs of various species would be reserved for vessels with the lowest catches or catch ratios of overfished species. Any unused or reserved OY for other groundfish would be made available to those vessels that had not taken their RSQs.

Catches of canary and bocaccio rockfish are currently very close to their OYs, and the protective harvest levels for these species constrain catches of other co-occurring groundfish. The small individual catch quotas (RSQs) established by Alternative 5 would create strong incentives for vessels to develop gear modifications and fishing strategies to avoid taking the most constraining species. Quota transferability would be important to provide at least limited fishing opportunities even where encounter rates of these two species is low. RSQs for these two species would be very small, perhaps less than 100 pounds per vessel per year. Some fishers would reach their limits prematurely and be closed for much of the year. Some may choose to sell out rather than face the frustration of failure. Some will actively buy up quota share in order to maintain or expand their fishing activities. It is likely many vessels would self-separate into different fishing strategies where they believe they would have the greatest chance of success.

With respect to overfished species, the primary direct effect of this alternative would be reductions in both encounters and discard/bycatch. Individual catch quotas coupled with complete observer coverage would greatly improve catch and bycatch reporting. Vessels would be required to stop fishing or obtain additional quota whenever they reached an RSQ limit. They would actively try to avoid encounters of the most restrictive species. They would be required to retain all overfished species. Thus, overfished species bycatch (discarded catch) should be reduced or eliminated with this alternative. If an overfished species OY were reached, further fishing would be prohibited or severely curtailed.

Trip limits would no longer be used for the commercial limited entry fishery but would likely be used for the open access sector. Gear restrictions would be relaxed to facilitate experimentation in bycatch avoidance methods. In the short term, GCAs would be maintained (although perhaps their boundaries revised) to limit potential encounters with overfished species. In the longer term, such regulatory constraints would be less necessary for overfished species, but may be continued to mitigate bycatch of other species.

<u>Emphasis Species</u> OYs for non-overfished groundfish species would be allocated as IFQs for each limited entry vessel. A portion of some OYs may be reserved for vessels with the lowest catches or catch ratios of overfished species. Any unused OYs would be made available to those vessels that had not taken their overfished species allotments (RSQs).

As was pointed out above, there may be strong incentives to buy and sell RSQ and IFQ shares in order to continue fishing and to develop new strategies. Fishers are currently constrained from fully using several groundfish that are near MSY levels. Under an IFQ program, many may still not be able to fully harvest their IFQs because they used their RSQs in other strategies or to cover unexpected catches. By purchasing additional RSQs of some species (such as canary rockfish), some vessels would be able to make fuller use of their yellowtail rockfish IFQ.

If previous bycatch rate assumptions were lower than actual encounter rates of overfished species, it is likely short term landings of non-overfished species would be reduced. This is because the expanded observer/reporting program would more accurately record bycatch rates. Over time, fishers would improve their ability to avoid overfished species or will be unable to succeed financially. If previous bycatch estimates overestimated the true encounter/bycatch rates, landings would increase because vessels would be able to fish longer than expected. Those fishing strategies that most successfully avoid constraining species while maintaining harvest of healthy stocks will prevail; those with the worst bycatch rates will be phased down. Bycatch of Dover sole, shortspine thornyhead, and sablefish would be expected to be reduced significantly as a consequence, as this complex can often be harvested with low encounter rates of canary rockfish and bocaccio. Under Alternative 5, other groundfish that are not overfished are not required to be retained. The result may be an increase in bycatch and bycatch mortality of other groundfish due to higher catch attainment. Thus, impacts of catch limits on emphasis species have slightly lower ranking compared to overfished species (See gray shaded boxes under catch limit and retention requirement columns in Table 4.3.10).

Some bycatch and discard mortality could still occur if a vessel approaches attainment of its IFQ. There may be some incentive to finish out the season by spreading out the remaining IFQ in order to maintain the supply of groundfish to the market. In addition, some bycatch and bycatch mortality beyond the IFQ could occur on the last trip when the IFQ is reached. Provisions to carry-over unused quota, or borrow from the next year's, would mitigate this.

Market limits may still have an impact on bycatch and bycatch mortality, as they would continue to exist in the absence of regulatory limits. Low bycatch rates of some species would remain low due to restrictions in MPAs.

If midwater trawl vessels targeting whiting (or widow rockfish) were allowed to operate in areas closed to bottom trawling, incidental catch of emphasis species would occur, but at a lower rate.

Effects of Harvest Level Specifications under Alternative 5: Harvest Levels would differ from *status quo* in that OYs would be allocated to individual vessels in the form of RSQ and IFQ shares with a portion held in reserve. Performance standards and OY reserves are required by this alternative. Harvest caps could not be exceeded by individual vessels and overfished species would have to be retained. Shares may be purchased in order to continue fishing. This alternative ranks 1out of a range of 1 - 3 in terms of performance standards and OY reserves.

Effects on Overfished Groundfish OY for overfished species would be broken down into RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused or reserve OY for other groundfish would be made available to those vessels that had not taken their overfished species OY share.

Canary rockfish and bocaccio catches are currently very close to OY, and constrain catches of other co-occurring groundfish. Under this alternative, incentives would be strong to develop specific gear modifications and adopt new fishing strategies to avoid taking these species. Without transferability, it might be impossible to conduct a fishery where encounter rates of these two species is high. OY shares under this alternative will be very small on a per vessel basis.

One indirect effect will be a partitioning of the fleet into different fishing strategies, as vessel owners buy and sell RSQ and IFQ shares to make fishing practical and profitable for a particular strategy.

The primary direct effect of this alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. Thus, overfished species bycatch (discarded catch) should be reduced or eliminated with this alternative as there would be less incentive to do so. Discarded fish counts against the IFQ and observer coverage under this alternative is 100% of the commercial fleet. Some discarding could continue in minor nearshore and recreational fisheries.

Effects on Emphasis Species OY for other groundfish would be broken down into IFQs for each fishing vessel with in-season monitoring of caps. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. When OY is reached, further fishing would be prohibited or severely curtailed, unless additional IFQ share were purchased.

As was pointed out above, there may be strong incentives to buy and sell RSQ and IFQ shares in order to more selectively fish using different strategies. Fishers are not currently able to access other groundfish at or near MSY levels. As an example, some fishers may successfully modify gear and/or purchase enough canary rockfish RSQ to take advantage of yellowtail rockfish IFQ.

If enough fishers are successful at acquiring RSQ shares and/or are able to make appropriate gear modifications to catch more OY of other groundfish then catches of more species may move toward OY levels. The result may be an increase in bycatch and bycatch mortality of other groundfish due to higher catch attainment.

Some bycatch and discard mortality could still occur if a vessel approaches attainment of the IFQ. There may be some incentive to finish out the season by spreading out the remaining IFQ in order to maintain the supply of groundfish to the market. In addition, some bycatch and bycatch mortality could occur on the last trip when the IFQ is reached.

Effects of Trip Limits under Alternative 5: Vessel trip limits would be relaxed or absent. Essentially, the trip limit would amount to the RSQ or IFQ that could be taken on an annual basis. Markets may influence trip size, however, and some bycatch and bycatch mortality may occur as a consequence. See discussion above under **Harvest Levels**. Trip limits under this alternative rank 1 on a scale of 1 - 4.

Effects on Overfished Groundfish There would be no need for a trip limit as each vessel would have an individual cap on overfished species and an ITQ for other groundfish species. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species due to relaxed trip limits.

Effects on Emphasis Species Vessel trip limits would be relaxed or absent, as each vessel would have an individual RSQ cap on overfished species and an IFQ for other groundfish species. Under this alternative, regulatory induced discards of other groundfish are not anticipated. Market induced discard resulting from size, price, and quantity requirements would be expected.

Effects of Catch Limits under Alternative 5: Transferable individual vessel RSQs for overfished species would be established with this alternative. Transferable IFQs would be established for other groundfish species (See discussion under **Harvest Levels**). Overfished species would have to be retained and discarded catch of other species would count against a vessels quota. Bycatch and bycatch mortality would therefore be significantly reduced. compared to other alternatives not using individual quotas. Vessel catch limits in the form of RSQs and IFQs are ranked 1 for those species currently constrained by trip limits, and 2 for species that are currently constrained by market, on a scale of 1 - 4.

Effects on Overfished Groundfish Individual catch limits should work positively to reduce discard of overfished species to near zero, due to a 100% retention requirement and relaxed trip limits. Regulatory induced discard associated with trip limits should be also be eliminated. OY reserves would provide incentives to minimize catch of overfished species.

RSQ shares would need to be purchased if a fisher needed more share of groundfish to continue fishing. Shares of canary rockfish and bocaccio in particular would be very small on a per vessel basis. Fishers are likely to purchase RSQ shares to participate in a fishing strategy that increases the likelihood of encountering canary rockfish and bocaccio. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species.

Effects on Emphasis Species Individual transferable quotas (IFQs) would be established for other groundfish species. Regulatory induced bycatch for some species of other groundfish like yellowtail rockfish and shortspine thornyhead could be avoided due to relaxed trip limits. IFQ shares will need to be purchased if a fisher needed more share of groundfish to continue fishing. Vessel catch limits are not expected to change bycatch and bycatch mortality of some groundfish species currently limited by market factors. Sablefish is not currently overfished and 100% retention would not be required. Some high-grading and discard is likely to occur with this species. English sole is another example of a species limited primarily by market factors. Bycatch of some species could increase if a vessel owner sold IFQ shares for some species and continued to fish in an area for other species.

Effects of Gear Restrictions under Alternative 5: Gear restrictions would be more flexible than *status quo.* Individual fishers would have the choice to modify gear to reduce efficiency, but would not be required to do so. Since regulatory gear requirements would be relaxed, fishers could also develop gear to more efficiently take a particular species. As a bycatch and bycatch mortality reduction tool, a rank of 1 (highest) on a scale of 1 - 3 was assigned to the approach used in this alternative, because gear innovation would be facilitated and encouraged by the economic incentives for vessels to achieve optimal bycatch rates.

Effects on Overfished Groundfish Gear modification would be facilitated, allowing fishers to experiment with different methods to reduce bycatch of overfished shelf rockfish species. Strict caps and a robust catch monitoring system would allow relaxation of the EFP process normally required for modified gear. To the degree gear modifications were successful, this alternative may have a positive direct effect of reducing bycatch and bycatch mortality of overfished species. A more likely scenario is a reduction in bycatch due to higher retention rates, as fishers by and sell RSQ shares to develop selective fishing strategies that allow more access to other groundfish..

Effects on Emphasis Species Gear regulation would be more flexible, allowing experimentation and modification to reduce bycatch and bycatch mortality of overfished species. The impact of such modifications on other groundfish is unknown.

Effects of Time/Area Management under Alternative 5: Time/Area management would be based more on need to protect sensitive species, to protect essential fish habitat, and protect other benthic animals such as corals and other invertebrates. In order to accomplish this, the alternative proposes closures of areas to groundfish gears that make bottom contact. The method this tool is used in Alternative 5 is ranked 2 on a scale of 1-3 for its effectiveness in reducing bycatch and bycatch mortality of demersal bottom dwelling species, as compared to the alternatives.

Effects on Overfished Groundfish The cowcod conservation areas would remain in effect to accomplish rebuilding. The GCAs established to conserve other overfished shelf species would also remain in effect, minimizing bycatch and bycatch mortality within those areas. Fishing with midwater trawl gear for Pacific whiting and widow rockfish would be allowed within the GCAs, the same as under Alternatives 1-4. Some reduction in the catch, bycatch and bycatch mortality of Pacific whiting and widow rockfish would continue to result from restrictions on bottom trawls and other gears in the GCAs.

Effects on Emphasis Species The anticipated effects would be similar to those for overfished species; some reduction in the catch, bycatch and bycatch mortality of non-overfished groundfish would continue to result from restrictions on bottom trawls and other gears in the GCAs.

Effects of Capacity Reduction under Alternative 5: No direct reduction in capacity is applied under this alternative. Some level of fleet consolidation would occur as market forces would favor more efficient vessels. Thus, capacity reduction would be an indirect effect of this approach rather than an intentional or specified result. However, capacity reduction would occur in all sectors, not just the trawl fleet as in Alternative 2. Therefore, this tool is ranked 1 on a scale of 1-3.

Effects on Overfished Groundfish Some capacity reduction may occur if vessel owners sell RSQ and IFQ shares and elect to fish in a non-groundfish fishery. Capacity reduction accomplished through RSQ and IFQ sales could have a positive direct reducing bycatch of overfished species. Some vessel owners may also choose to fish in other fisheries and hold onto RSQ and IFQ shares. To the degree shares were unused, catch, bycatch, and bycatch mortality would be reduced.

Effects on Emphasis Species See discussion above.

Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 5: Alternative 5 would require 100% observer coverage of all limited entry commercial vessels and increased monitoring of other groundfish fisheries.

Under Alternative 5, observer coverage would be redesigned to ensure that each commercial limited entry vessel's bycatch of overfished groundfish species is accurately assessed and recorded, with results available for management purposes inseason. Logbooks would not be required or used. Vessels reaching any catch limit of overfished species (or other restricted species catch limit) would be required to stop fishing until they obtain additional quota. This would be until the beginning of the next year unless they purchased quota from a shareholder. A program to monitor quota transfers would be required.

The catch reporting, record keeping, and monitoring program established by Alternative 5 would be substantially more robust than Alternatives 1, 2, 3 and 4, as every limited entry vessel would be observed and monitoring of other sectors would be increased substantially. This would have a direct effect of reducing encounter/bycatch of overfished species compared to the first four alternatives. Discard/bycatch would also be reduced in the commercial fishery compared to the first four alternatives as fishers would be required to retain all overfished groundfish and more likely to retain catches of all usable fish, since all fish would count towards their individual quotas. This tool is ranked 1 (most effective) on a scale of 1 - 5 for its incentive to avoid catching unwanted fish and 2 for reducing discard/bycatch.

Table 4.3.10. Effects of bycatch mitigation tools as applied in Alternative 5. Relative rank of the tools used to reduce bycatch and bycatch mortality. Overfished species in bold and emphasis species in italic. Species below MSY and subject to precautionary management are noted with (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip Limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			Yes with OY reserve	None	Individual vessel RSQ and IFQs	Retain overfished	Flexible	RSQ & IFQ sales	Areas closed to bottom fishing	100% Observer coverage commercial and CPFV, Inseason est.
Northern Shelf	**Canary rockfish**	1	1	1	1	1	1	1	2	1
	Lingcod	1	1	1	1	1	1	1	2	1
	Yelloweye rockfish	1	1	1	1	1	1	1	2	1
	Yellowtail rockfish	1	1	1	2	2	1	1	2	1
	Arrowtooth flounder	1	1	1	2	2	1	1	2	1
	English sole	1	1	1	2	2	1	1	2	1
	Petrale sole	1	1	1	2	2	1	1	2	1
Southern Shelf	**Boccacio**	1	1	1	1	1	1	1	2	1
	Cowcod	1	1	1	1	1	1	1	2	1
	Chilipepper	1	1	1	2	2	1	1	2	1
Slope	**Darkblotched rockfish**	1	1	1	1	1	1	1	2	1
	Pacific Ocean Perch	1	1	1	1	1	1	1	2	1
	Dover sole (p)	1	1	1	2	2	1	1	2	1
	Sablefish (p)	1	1	1	2	2	1	1	2	1
	Shortspine thornyhead (p)	1	1	1	2	2	1	1	2	1
	Longspine thornyhead	1	1	1	2	2	1	1	2	1
Pelagic	**Widow rockfish**	1	1	1	1	1	1	1	2	1
	Pacific whiting (incl.discard)	1	1	1	1	1	1	1	2	1
Nearshore	*Black rockfish*	1	1	1	2	2	1	1	2	2
	Cabezon	1	1	1	2	2	1	1	2	2
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

4.3.1.6 Impacts of Alternative 6 (No-take Reserves, Individual Catch Quotas, and Full Retention)

Summary The policy goal of this alternative is to reduce bycatch to near zero by establishing large no-take reserves in areas where overfished groundfish are most likely to be encountered, prohibiting discard of most groundfish, and accurately accounting for all catch. This alternative reduces bycatch and bycatch mortality by direct controls on catch, effort, and gear efficiency.

This alternative supports Council objectives for protecting and rebuilding depleted groundfish stocks, but at higher cost for monitoring than *status quo*.

Tools Used The following mix of management measures are applied to create Alternative 6. Tool ranks are summarized in Table 4.3.11.

Table 4.3.11. Summary of bycatch mitigation tools as applied in Alternative 6.

Harvest Levels ABCs/OYs same as Alternative 1; allocations of catch shares to eligible vessels
Vessel trip limits Not used for limited entry, with possible exceptions for small vessels. For open access, possible continued use.
Vessel catch limits   Vessel allocations are catch limits; transferable; extensive discard prohibitions
Gear regulations   Tighter regulations, gear certifications required.
Time/area management   Greater use of area closures (MPAs and reserves)
Capacity reduction None specified; fleet reduction expected to result from IQ program
Data reporting, record-keeping, and monitoring Full coverage of all commercial groundfish vessels; increased monitoring of open access and recreational sectors

- <u>Harvest Levels</u> OYs would remain the same as in Alternatives 1-5, however the limited entry portion of OYs would be allocated among limited entry vessels as overfished species catch limits (RSQs) and IFQs for non-overfished species. Monitoring of the limited entry fleet would be vessel-by-vessel; monitoring would be substantially increased for the open access and recreational fisheries. If a sector (recreational, open access or limited entry) reached its allocation, that fishery would be closed or severely curtailed to protect the other fisheries. If a species overall OY were reached, further fishing would be prohibited or severely curtailed to prevent overfishing. A portion of the OYs of various species would be reserved for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment.

- Vessel trip limits Vessel trip limits would be relaxed or absent, as each vessel would have individual caps for overfished and other groundfish species.
- Vessel Catch Limits Individual vessel caps in the form of RSQs for overfished stocks and IFQs for other groundfish would be established. All groundfish would be retained. Thus, groundfish bycatch (discard) would be near zero.
- Gear Regulations Gear regulation would be actively used to reduce bycatch and bycatch mortality. The use of gears that produce higher bycatch rates or overfished groundfish or other marine species would be phased out. Fishers would be required to adopt gear modifications, use only certified gear types, and/or adopt approved fishing strategies that have been certified to minimize the impacts on marine species and the physical environment. Increased groundfish retention requirements would stimulate vessels to develop gear modifications and fishing strategies that avoid capture of undersized and overfished groundfish.
- Time/Area Closures would take the form of large permanent or semi-permanent no-take marine reserves. The placement and size may differ significantly from the other alternatives. For purposes of this analysis, we assume reserves would be patterned after Option 3a of the Council's Phase I Technical Analysis of marine reserves (PFMC 2001). This type of reserve would be tailored to protect overfished species and would set aside 20% of the habitat or biomass with a similar reduction in harvest of the species. Marine reserves would directly reduce bycatch and bycatch mortality of all fish within the closed area. The amount of reduction in bycatch and bycatch mortality resulting from a reserve would be in proportion to the proportion of a species' habitat set aside compared to the total amount of habitat vulnerable to fishing. This would vary depending on the species protected and design of the reserve. The 100% retention requirement would still be the primary means of reducing bycatch outside of reserves.
- Capacity Reduction No direct reduction in capacity is considered under this alternative.
- Data Reporting, Record-keeping, and Monitoring Full (100%) observer coverage and near 100% retention of all groundfish would be required for all limited entry vessels. Sampling/monitoring of the recreational and open access fisheries would be substantially increased under this alternative. Real-time catch reporting would be developed to ensure each fishery stays within its designated catch limits.

Summary of Impacts on Groundfish Effects of tools used in Alternative 6 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.12. Effects are ranked in comparison to the other alternatives. Lower numbers indicate a greater effect.

Overfished groundfish OYs for overfished species would be allocated between limited entry, open access, and recreational fisheries as under the other six alternatives. The limited entry allocation would be further subdivided and allocated among all vessels as individual restricted species catch limits (RSQs). Each sector would be closed upon reaching its allocation; all sectors would be closed or severely curtailed if the OY for an overfished species were reached. This would effectively keep catches from exceeding the most constraining specified OYs. Catches of other overfished stocks would likely be below their OYs, being constrained by the most constraining stock. Individual shares of canary rockfish and bocaccio would be very small, perhaps substantially less than 100 pounds per year, resulting in severely limited fishing opportunity for many vessels. Many vessels would attempt to purchase additional quota to pursue whatever they perceive to be their best fishing strategies. Large no-take reserves would reduce the likelihood of encountering overfished species, but unless the closed areas covered a species' entire range, encounter/bycatch would occur in open areas, although at a lower rate.

Non-certified gears would be phased out; only those gears certified as low-bycatch or low-impact would be allowed. Such restrictions would likely reduce catch and bycatch of overfished species. No-take reserves would eliminate all fishing for groundfish inside the reserves, reducing bycatch of overfished species and minimizing impact to overfished species habitats.

Unobserved recreational trips would be the primary source of overfished species bycatch.

Emphasis Species The overall harvest policies of Alternative 6 would be the same as the other six alternatives. Limited entry allocations would be subdivided into individual annual vessel catch quotas, which may be larger than the trip limits in Alternatives 1-4 but the same as the IFQs in Alternative 5. Any sector reaching its allocation of a non-overfished species would be curtailed or closed, depending on the species and whether other sectors' allocations were threatened. Any unused allocations would be made available to those vessels that had not taken their overfished species allotments. IFQ shares would have effects similar to Alternative 5. However, the establishment of large no-take reserves more restrictive gear requirements could make it more difficult for vessels to take their IFQs. Also, the most constraining RSQ limits (for canary and bocaccio rockfish) would increase the likelihood that substantial amounts of target species quotas would not be taken. This alternative differs from Alternative 5 in that all groundfish must be retained (only overfished groundfish must be retained in Alternative 5). The primary direct effects of this alternative would be reduced groundfish discard/bycatch and likely reduced catches and catch rates of many target groundfish species as well. The no-take reserves and gear restrictions could result in intensified fishing with certified gears and methods in open areas. Catches of all groundfish species would be eliminated within the reserve boundaries; over time, abundance of target groundfish species could increase around the edges of reserves as fish migrate outward.

Effects of Harvest Level Specifications under Alternative 6: OYs would remain the same as in *status quo;* however, distributions of available OY would be broken down into caps for each fishing vessel with in-season monitoring of caps. Performance standards and OY reserves are required by this alternative. Harvest caps cannot be exceeded by individual vessels and overfished species must be retained. Shares may be purchased in order to continue fishing. This alternative ranks 1 on a scale of 1 to 3 in terms of performance standards and OY reserves.

Overfished Groundfish OY for overfished species would then be broken down into caps or RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment.

The impacts of application of this tool within Alternative 6 is similar to the impacts described under Alternative 5. Small individual shares of RSQ for some species like canary rockfish and bocaccio would have to be purchased and sold to consolidate enough share to fish under certain strategies. The primary direct effect of this alternative would be reductions in bycatch due to strict caps and 100% retention of all groundfish. Thus, overfished species bycatch (discarded catch) should be near zero with this alternative due to the 100% retention requirement. Unobserved recreational trips would be the primary source of overfished species bycatch.

Emphasis Species Objectives for optimum yield would remain the same as under *status quo*. OY for overfished species only would then be broken down into caps for each fishing vessel with inseason monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. Tradable IFQ shares would have impacts similar to Alternative 5 in that shares are likely to be bought and sold to consolidate fishing strategies. This alternative differs from Alternative 5 in that all groundfish must be retained. The primary direct effect of this Alternative would be reductions in bycatch due to strict caps and 100% retention of all groundfish

Effects of Trip Limits under Alternative 6: Vessel trip limits would be relaxed or absent, as each vessel would have individual RSQ and IFQ caps on groundfish. Essentially the trip limit would take the form of an individual vessel annual quota.

Because trip limits would not be used, the application of this tool is given a rank of 1 (most effective).

Overfished Groundfish Vessel trip limits would be relaxed or absent, because each vessel would have an RSQ on overfished species. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species due to relaxed trip limits and a 100% retention requirement.

Emphasis Species Vessel trip limits would be relaxed or absent, because each vessel would have an individual cap on other groundfish. Direct effects expected under this alternative compared to status quo would be a reduction in size related and market-induced discard of other groundfish due to the 100% retention requirement.

Effects of Catch Limits under Alternative 6: Individual vessel caps for overfished stocks would be established with this alternative. 100% of all groundfish would be retained. Bycatch and bycatch mortality would therefore be significantly reduced. compared to other alternatives not using individual quotas and to Alternative 5. Vessel catch limits in the form of RSQs and IFQs rank 1 (most effective) on a scale of 1 - 4.

Overfished Groundfish The impacts to overfished groundfish would be similar to those under Alternative 5. The 100% retention requirement and 100% observer coverage would reduce bycatch of overfished species to near zero. Regulatory induced bycatch would be eliminated. See discussion above under Alternative 5.

Emphasis Species Individual transferable quotas would be established for other groundfish with this alternative. This application of catch limits in this alternative be similar to Alternative 5. Impacts would be different due to the 100% retention requirement and 100% observer coverage. Bycatch of other groundfish would be near zero and regulatory and market related bycatch would be eliminated.

Effects of Gear Restrictions under Alternative 6: Gear restrictions would be applied more fully than under *status quo.* This application of gear restrictions is given a rank of 1 or 2 on a scale of 1 - 3. All gears would have to be certified as low bycatch or low impact under this alternative. This would effectively reduce all bycatch below Alternatives 1-4. In the short term, it would likely be more effective than Alternative 5 also, as all vessels would be required to use certified gears. In the long term, however, the incentives and flexibility to experiment with various gear modifications under Alternative 5 would likely lead to continual improvement in bycatch avoidance and minimization.

Overfished Groundfish Fishers would be required to fish only with gears that have been certified to reduce bycatch, and vessels must stay within RSQs. Unless opportunities for gear experimentation were provided, the best gears at reducing bycatch might not be identified. Some unseen mortality could take the form of overfished species caught but excluded by fishing gears. The bycatch mortality of escaping fish is unknown.

Emphasis Species Fishers would be required to fish only with gears that have been certified to reduce bycatch, and vessels must stay within IFQs. The 100% retention requirement may be very challenging for some fishers seeking ways of selecting against unmarketable fish. For example, fishers may use a larger mesh-size to in an attempt to eliminate most of the undersized fish. Reduction of catch of unwanted fish would contribute to the reduction in bycatch. However, unseen mortality could take the form of undersized fish caught but excluded by the gear. Impacts of direct and delayed mortality of escaping fish is poorly understood.

Effects of Time/Area Management under Alternative 6: Time/area management would take the form of permanent or semi-permanent marine reserves. The placement and size may differ significantly from all of the other alternatives. These areas would set aside at least 20% of the habitat or biomass of the overfished species would be set aside, and that biomass available for harvest would be similarly reduced. MPAs would be more permanent than GCAs described in previous alternatives. Areas established under this alternative would be closed to all fishing. This tool ranks 1 on a scale of 1-3.

Overfished Groundfish Extensive habitat and species distribution mapping would be needed in order to define new boundaries for overfished species. Because there are several overfished species, the proportion of area set aside to total fishable area may be larger or smaller than 20%. Impacts will be difficult to determine until the location and composite size of these areas are determined.

No-take marine reserves directly reduce bycatch and bycatch mortality of overfished species within the closed area. The amount of reduction in bycatch and bycatch mortality of an overfished species due to a reserve would be in proportion to the amount of habitat set aside compared to the total amount of its habitat vulnerable to fishing. Movement of fish into and out of reserves may confound efforts to protect mobile/migratory species. If catch levels were not reduced, effort would likely shift to adjacent areas, increasing impacts of fishing outside the boundaries. Bycatch and bycatch mortality could increase unless catch were reduced in proportion the area set aside.

Studies of groundfish trawl fishery of the coast of British Columbia suggest fishing changes species composition and spatial structure of the fishery. Movement of trawlers through redistribution of effort and fish movement appears to reduce vulnerability (Walters and Bonfil 1999). The authors suggested use of individual effort quotas (rather than catch) and use of carefully placed protected areas to protect sensitive stocks.

Impacts of various MPA and no-take reserve options for bocaccio, Pacific ocean perch, and lingcod are described in the Phase I Council report on marine reserves (PFMC 2001). Reserves appear to reduce rebuilding time, similar to that which could be achieved by reducing the exploitation rate. An additional benefit would be reduced habitat impacts. Some loss of fishing opportunity would occur with reserves that included a reduced harvest rate (option 3a in the Phase I document).

The 100% retention requirement would still be the primary means of reducing overfished species bycatch. Some indirect benefits to the overfished species would likely occur due to reduced disturbance of habitat afforded by a no-take reserve.

Emphasis Species Time/area management would include establishment of permanent or semi-permanent no-take marine reserves. The placement and size may differ significantly from all of the other alternatives. Such reserves would directly reduce bycatch and bycatch mortality of other groundfish species within the closed area. The amount of reduction in bycatch of any particular groundfish species due to a no-take reserve would be in proportion to the vulnerable population inside and outside the boundaries.

The 100% retention requirement would be the primary means of reducing discard/bycatch outside of marine reserves.

Effects of Capacity Reduction under Alternative 6: No direct reduction in capacity is applied under Alternative 6. Some level of fleet consolidation would occur as market forces would favor more efficient vessels. Thus, capacity reduction would be an indirect effect of this approach rather than an intentional or specified result. However, capacity reduction would occur in all sectors, not just the trawl fleet as in Alternative 2. Therefore, this tool is ranked 1 on a scale of 1 to 3.

Effects on Overfished Groundfish Some capacity reduction may occur if vessel owners sell RSQ and IFQ shares and elect to fish in a non-groundfish fishery. Capacity reduction accomplished through RSQ and IFQ sales could have a positive direct reducing bycatch of overfished species. Some vessel owners may also chose to fish in other fisheries and hold onto RSQ and IFQ shares. To the degree shares were unused, catch, bycatch, and bycatch mortality would be reduced.

Effects on Emphasis Species See discussion above.

Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 6: Alternative 6 would require 100% observer coverage of all commercial groundfish vessels and increased monitoring of recreational groundfish fisheries. Under Alternative 6, observer coverage would be redesigned to ensure that each commercial vessel's bycatch of overfished groundfish species is accurately assessed and recorded, with records available almost immediately for management purposes. Logbooks would not be required or used. Vessels reaching any catch limit of overfished species (or other restricted species catch limit) would be required to stop fishing until they obtain additional quota. This would be until the beginning of the next year unless they purchased quota from another shareholder. A program to monitor quota transfers would be required.

The catch reporting, record keeping, and monitoring program established by Alternative 6 would be similar to Alternative 5 with increased monitoring of open access and recreational sectors. This would have a direct effect of reducing encounter/ bycatch of overfished species compared to the Alternatives 1-4. Discard/bycatch would also be reduced in the commercial fisheries as fishers would be required to retain nearly all groundfish and all fish would count towards their individual catch limits. This tool is ranked 1 (most effective) on a scale of 1 - 5 for its effectiveness in reducing groundfish bycatch.

Table 4.3.12. Effects of bycatch mitigation tools as applied in Alternative 6. Relative rank of the tools used to reduce bycatch and bycatch mortality. Overfished species in bold and emphasis species in italic. Species below MSY and subject to precautionary management are noted with (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			Yes, with OY reserve	Relaxed	Individual vessel RSQ and IFQs	Retain all groundfish	Yes	RSQ & IFQ sales	Areas closed to all groundfish fishing	100% Observer coverage commercial and CPFV, in-season est.
Northern Shelf	**Canary rockfish**	1	1	1	1	1	1-2	1	1	1
	Lingcod	1	1	1	1	1	1-2	1	1	1
	Yelloweye rockfish	1	1	1	1	1	1-2	1	1	1
	Yellowtail rockfish	1	1	1	1	1	1-2	1	1	1
	Arrowtooth flounder	1	1	1	1	1	1-2	1	1	1
	English sole	1	1	1	1	1	1-2	1	1	1
	Petrale sole	1	1	1	1	1	1-2	1	1	1
Southern Shelf	**Boccacio**	1	1	1	1	1	1-2	1	1	1
	Cowcod	1	1	1	1	1	1-2	1	1	1
	Chilipepper	1	1	1	1	1	1-2	1	1	1
Slope	**Darkblotched rockfish**	1	1	1	1	1	1-2	1	1	1
	Pacific Ocean Perch	1	1	1	1	1	1-2	1	1	1
	Dover sole (p)	1	1	1	1	1	1-2	1	1	1
	Sablefish (p)	1	1	1	1	1	1-2	1	1	1
	Shortspine thornyhead (p)	1	1	1	1	1	1-2	1	1	1
	Longspine thornyhead	1	1	1	1	1	1-2	1	1	1
Pelagic	**Widow rockfish**	1	1	1	1	1	1-2	1	1	1
	Pacific whiting (incl.discard)	1	1	1	1	1	1-2	1	1	1
Nearshore	*Black rockfish*	1	1	1	1	1	1-2	1	1	1
	Cabezon	1	1	1	1	1	1-2	1	1	1
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

4.3.1.7 Impacts of Alternative 7 (*Preferred -* Sector and vessel catch limits, future IFQ)

Summary The policy goal of this alternative is to reduce bycatch by setting annual catch limits for the various fishery sectors and then rewarding those sectors with the least bycatch. Fishery sectors would become the primary management unit, with overfished species mortality limits set for each sector. Landings of target species by each sector would be monitored through the season; bycatch species catch amounts would be estimated based on the bycatch model co-occurrence rates. Over the next several years, the Council will move to creating the necessary inseason catch/bycatch monitoring infrastructure. Initially, this would include revising the PacFIN inseason tracking system (called quota species monitoring or QSM). The observer program would also be expanded so that each sector's progress towards its limits could be directly determined quickly during the season (rather than estimated based on target species). The definition of "trip limit" would be revised to include catch limits, which would refer to a species mortality limit as opposed to a retention limit. Initially, catch limits would likely be established for overfished groundfish stocks; over time, as the monitoring infrastructure comes online, additional species would likely be added. Ultimately, individual fishing quotas or *DEDICATED ACCESS PRIVILEGES* would be established for those sectors and vessels as the Council deems appropriate. Vessel catch limits would be established for vessels that carry an observer at the vessel's expense, would be set for each two-month period (or other amount of time), and would expire at the end of each period (just as trip limits expire). Trip (retention) limits for non-overfished groundfish may be used in combination with vessel catch limits. Vessels with catch limits may have larger trip limits for non-overfished species than vessels without observers. A fishing sector would be closed when any catch limit for that sector is reached or projected to be reached. Other sectors would continue fishing unless an overall OY were reached.

Vessel catch limits are expected to be an incentive to carry observers, because eligible vessels would get a guaranteed portion of the sector allocations and be eligible for larger trip limits. These catch limits would enable the vessel to alter its strategy and gear to stay within the cap without the risk of being closed by other vessels' high bycatch rates. This could be especially important if sectors are large and include diverse fishing strategies. For example, vessels predominantly fishing deepwater species (e.g., DTS complex) may want not to be lumped with vessels fishing nearshore flatfish. It is important to recognize that sectors may not be limited entry units; that is, once a sector is closed a vessel having permits to fish within another open sector may be free to do so.

This alternative supports Council objectives of preventing overfishing, rebuilding overfished stocks, maintaining a year-round fishing season, and increasing individual and group accountability for their groundfish catches. Fishery monitoring would be increased over Alternatives 1through 4; monitoring costs would be higher.

Tools Used The bycatch mitigation tools summarized in Table 4.3.13. are combined to create Alternative 7.

Table 4.3.13. Summary of bycatch mitigation tools as applied in Alternative 7.

Harvest Levels ABCs/OYs same as Alternative 1; sector allocations established
Vessel trip limits Used; similar to Alternative 4 and applied by sector. Larger trip limits for vessels with catch limits and observers.
Vessel catch limits Used for vessels that pay for observers; support for future development of IFQ programs, as appropriate.
Gear regulations   Similar to Alternative 1, but may be relaxed for vessels with catch limits and observers.
Time/area management Generally similar to Alternative 1, with limited exemptions for vessels with catch limits and observers
Capacity reduction Same as Alt 1; moving towards Strategic Plan capacity goals and supporting future development of dedicated access privileges/IFQs.
Data reporting, record-keeping, and monitoring Similar to Alt 1, but more coverage expected due to incentives for vessels to pay for (additional) observers

- <u>Harvest Levels, Including Sector Caps</u> (harvest policy, rebuilding) Overall objectives for optimum yield and rebuilding would remain the same as in Alternatives 1-6. The harvest policy would be modified from the Alternatives 1-3, 5 and 6 in that OYs for overfished species (and/or other designated species) would be subdivided and allocated to each fishery sector (the same as in Alternative 4). These allocations would be total mortality limits for the designated species. Each sector would be monitored separately throughout the season for its progress towards those allocations. When a sector reaches (or is projected to reach) any catch mortality allocation, all fishing by that sector will be closed. Harvest guidelines for other species also may be established if the Council believes they will help minimize bycatch to the extent practicable.

  Broad fishery sectors would be specified initially: limited entry bottom trawl, limited entry fixed gear, three limited entry whiting sectors, open access, and Tribal fisheries. Sectors could be defined by target fishery, by gear, or other criteria. Depending on how they are defined, sectors could be open to any eligible vessels, with free movement in and out, or they could be closed. They could be voluntary sectors or they could be defined by a permit or endorsement. Because several overfished stocks show geographic variation north to south, the non-whiting sectors could be further subdivided, for example north and south of Cape Mendocino at 40°10' N. latitude. A portion of any OY could be set aside in reserve for the fishery sector or sectors with the lowest bycatch to provide further incentive to reduce bycatch or bycatch rates. When a sector reaches any species mortality cap, all vessels in the sector must stop fishing. (Depending on how sectors are defined, regulations could define whether this would mean stop all fishing for groundfish, stop fishing with a particular gear or for a particular target species, stop fishing in an area, continue fishing only with a bycatch reduction device, etc.) If a sector reached a guideline for a non-overfished species, the Council would evaluate whether vessels may continue fishing along with other sectors. Reaching an OY for any species would result in closing all sectors that take that species.

- <u>Vessel trip limits</u> Vessel trip limits would be established and adjusted sector-by-sector to reflect the number of vessels participating in the sector and its allocations. Some trip limits might initially be similar to those under Alternative 1, based on previously observed joint catch ratios of overfished and co-occurring groundfish species. In the long term, catch/bycatch data on a sector-by-sector basis would be available inseason; in the short term, there will probably be little or no change.
- <u>Catch Limits</u> Catch limits may be included in the definition of "trip limit," referring to a one- or two-month period, or defined separately as a period or annual vessel limit. Catch limits could be applied sector by sector for any species, but initially would likely refer to overfished groundfish or other species needing bycatch reduction. Catch limits would require some method of verification, such as on-board observers, which may limit their application to very small limited entry vessels and open access vessels. Vessels may choose to carry an observer at the vessel's expense in order to receive vessel catch limits, which would exempt the vessel from a sector allocation. Vessek catch limits may be the same for all vessels or may vary depending on fishing strategy; they may be increased in conjunction with an EFP, for research activities, or other specified purpose. As with trip limits, these catch limits would not be transferable and would expire at the end of each period. That is, they could not be carried over to the next period, unless specified. In contrast to trip limits, a vessel must stop fishing when it reaches any restricted species catch limit for the remainder of the period. In contrast, when an annual sector cap is reached or projected to be reached, all vessels in that sector must stop fishing for the remainder of the year or until allowed to start again.

  Individual vessel catch limits would be expected to greatly increase the incentive to avoid catching overfished groundfish and to retain all usable fish. They could also provide exemption from other restrictions and/or be used in conjunction with larger trip limits for healthy stocks. In the future, they could provide a basis for IFQs.
- <u>Gear Regulations</u> Gear regulations under this alternative would be the same or similar to Alternative 1, and would be structured to keep catches within the

OY limits for overfished species. If gear improvements and bycatch reduction methods are identified, they could be required for all vessels in a sector. Vessels that carry an observer at their own expense and operate under catch limits may be granted exemption from certain gear regulations.

- Time/Area Management Initially, time and area closures would be similar to those under Alternatives 1 - 4, with boundaries based on the previously observed catch ratios of various groundfish species. However, vessels with bycatch caps (catch limits) and on-board catch/bycatch monitors may be able to achieve the groundfish bycatch minimization goals without such closed areas. Therefore, exemption from certain GCA restrictions may be authorized for observed vessels.[8/] This alternative may allow changes in RCA boundaries based on more extensive monitoring data, because the observer program would likely be more finely stratified than under the *status quo*. Reduction in the extent of the current GCAs would be intended not to allow increased catch/bycatch of overfished species, but could result in bycatch of other species.
- Capacity Reduction Further capacity reduction is not included in this alternative until and unless dedicated access privileges are developed. The Council has indicated its intention to consider IFQs.
- Data Reporting, Record-keeping, and Monitoring This alternative would establish a more robust catch reporting, record keeping, and monitoring program than Alternative 1-3. Logbook coverage would be the same as under the no action alternative. To make Alternative 7 distinguishable from the no action alternative, the observer program would be augmented and the sampling plan revised to monitor each sector. The necessary differences include monitoring a subset of vessels within each sector and providing observer data inseason for management purposes. For vessel catch limits (caps) to be fully functional, each vessel would have to be observed. In the short term, incidental catch rates of observed vessels would be tabulated annually and expanded to non-observed vessels of the sector. Each sector's bycatch rates used in the bycatch model would be updated annually, and management measures for each sector revised according to the FMP procedures. Unanticipated changes in catch and/or bycatch rates could result in any sector exceeding an allocation in a year (just as under the status quo and Alternatives 2, 3 and 4; this would be discovered in a retrospective analysis). Corrective action would be taken when updated data and analysis become available. In the longer term, sectors would be managed based on current year observations and the risk of sector overage would be reduced.

  Vessels could voluntarily pay for and carry an observer in order to have access to higher trip limits. This would exempt the vessel from sector

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[8/]However, future time/area restrictions could be established for non-groundfish species or essential fish habitat (EFH) reasons as the observation database improves over the years.

allocations and other specified restrictions. The vessel would agree to stop fishing when data indicate it has reached its vessel catch limit.

In order to protect each sector's allocations, each sector's catch and bycatch would need to be monitored adequately. Therefore, recreational sampling also would be increased.

Impacts on Groundfish The effects of the tools and tool applications used to reduce groundfish bycatch, bycatch mortality, and to increase individual and sector accountability in Alternative 7 are ranked and summarized in Table 4.3.14. Effects are ranked in comparison to the other alternatives. Lower numbers indicate a greater effect.

<u>Effects on Overfished Groundfish</u> Under Alternative 7, overfished species would be allocated as species mortality caps for each fishing sector. A subset of vessels in each sector would be observed and catch/bycatch rates expanded to unobserved vessels. In the long term, this data would be available inseason. Within each sector, overfished species catch limits would be assigned to each vessel that carries an observer at its own expense. When a vessel reaches an RSC, it would be required to cease fishing. When a sector cap is reached or projected to be reached, all vessels in that sector must stop fishing. Vessels that provide observer coverage at their own expense would have access to larger limits of target species and be guaranteed a portion of a restricted species sector cap. A vessel catch limit would be the equivalent of a non-transferable IQ. Full observer coverage would ensure success of this part of the bycatch mitigation program. The primary direct effect of this alternative would be reductions in bycatch of overfished species due to strict caps, individual vessel catch limits, and monitoring of these species. It is likely that bocaccio and canary rockfish will present the biggest challenge to sectors because of their wide distributions and susceptibility to diverse gears. Much of the current focus of the groundfish management program is to reduce and maintain harvest levels for these two species below their OYs. Catches of many species (both overfished and healthy stocks) are likely to remain below their OYs largely due to fishing constraints for canary rockfish and bocaccio. Thus, impacts of trip limits and catch limits on the various species would differ. Bycatch reduction benefits to overfished species with catch limits would be greater than to other emphasis groundfish species (see below).

Some researchers and analysts have questioned whether incentives work on a fishery sector basis. For example, Huppert *et al.* (1992) suggested that sector-based incentive systems tend to penalize those participants who adopt methods of reducing bycatch of prohibited species because those efforts may also reduce their catch of target species. However, sector-based incentive programs may work well for relatively small and homogeneous sectors, such as co-operatives. For example, the at-sea whiting sectors actively share each vessel's daily catch and bycatch information in order to minimize their bycatch of salmon and rockfish species. In larger or more diverse sectors, individual vessel catch limits would be expected to more effectively minimize bycatch. However, due to the need for full observer coverage, this approach may not be practicable, at least until a sufficient monitoring infrastructure has been established. On the other hand, individual vessel catch limits (for overfished groundfish species), coupled with larger cumulative trip limits of non-overfished species, could provide a mechanism for some vessels to generate enough revenues to pay the increased costs of full observer coverage.

The limited entry fixed gear fleet might be successful in limiting bycatch of certain non-target species of concern (halibut, lingcod, and overfished rockfish), because the catch of those species is relatively small, fishing methods relatively selective, and the allocation program provides a long fishing season. In contrast, the recreational sector is large and diverse, and identification of effective bycatch reduction incentives will be problematic. Thus, other means of controlling this sector's bycatch would likely be necessary.

The intent of sector allocations would be to minimize, to the extent practicable, bycatch rates of the entire sector. The best result would be for all vessels in each sector to minimize their individual bycatch rates. To the extent bycatch rates of overfished stocks are minimized, cumulative trip limits for other species taken by the sector could be increased; larger trip limits tend to result in lower regulatory bycatch. To achieve this desired result, individual vessels must have both incentive and opportunity to improve their bycatch avoidance methods and to share this information with other vessels in the sector.

Impacts of well-monitored vessel catch limit and sector cap program would be similar to Alternative 5.

<u>Effects on Emphasis Species</u> Effects on emphasized groundfish species and other emphasis species are difficult to predict. However, negative effects of bycatch should decline over time. In the short term, impacts could increase if vessels move into areas of higher abundance of emphasis species, or use methods that increase bycatch rates of those species. Close monitoring of sector caps could further constrain harvest of co-occurring (non-overfished) groundfish, especially if unobserved participants in a sector did not apply bycatch reducing fishing tactics. Early closure (and thus reduced fishing effort) could result from early attainment of sector caps or vessel catch limits. If the result is less harvest of other (healthy) groundfish, this catch/bycatch mortality reduction would be at the expense of lost economic opportunity. On the other hand, incentives, in the form of larger trip limits for observed vessels, and possible access to a reserve later in the year, may change enough of each sector's fishing practices to reduce bycatch of overfished species and increase catch of other groundfish.

Sector harvest guidelines rank lower than catch limits for their effectiveness in reducing bycatch (See shaded boxes under "Trip Limits" and "Catch Limits" columns in Table 4.3.14).

Trip (retention) limits would likely be increased if vessel catch limits, sector caps, incentives and gear modifications effectively minimize bycatch of overfished species. This could include increased access to those non-overfished groundfish with higher market value or demand. Regulatory bycatch may be reduced for some species such as Dover sole, shortspine thornyhead, sablefish, and yellowtail rockfish. However, larger trip limits are less likely to reduce economic bycatch of species that are constrained by market limits (some flatfishes and chilipepper rockfish, for example) rather than regulatory limits.

Effects of Harvest Levels under Alternative 7: Objectives for optimum yield and rebuilding would remain the same as in s*tatus quo.* Harvest policy would be modified from *status quo* in that OYs would be subdivided into caps allocated to each fishing sector with in-season monitoring of caps. Performance standards and sector allocations with OY reserves should have a significant effect, reducing potential bycatch and bycatch mortality compared to Alternatives 1-3. This tool, as used in Alternative 7, is ranked 2 (highly effective) on a scale of 1- 3 (where 1 is the most effective and 3 is the least effective at reducing bycatch and bycatch mortality).

Effects on Overfished Groundfish Under this alternative, overfished species OYs would be subdivided and allocated as species mortality limits for each fishing sector. By more finely subdividing OYs and managing each sector separately, there is greater potential to prevent overfishing of any overfished species, or at least mitigating the extent of overfishing. Improved monitoring over the long term will provide information for improved bycatch mitigation. Augmentation of inseason observer data would be necessary to achieve this result.

When a sector allocation (cap) is reached, further fishing by that sector would be prohibited or severely curtailed. (Reaching an OY would result in closure of all fishing that takes that species.) A portion of an OY or OYs could be set aside in reserve for each fishery sector or individual vessels that achieve bycatch minimization standards. Implementation details would be developed along with more detailed analysis at some time in the future.

Successful implementation of a sector cap program could result in reduced bycatch of overfished species. It is likely that canary rockfish and bocaccio will present the biggest challenge to most sectors because current harvest levels are very near the OYs. Catch of other many other groundfish species are below OY largely due to fishing constraints caused by these two species.

Effects on Emphasis Species Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch reducing fishing tactics. A reduction in effort could result from early attainment of overfished species sector caps. The direct impact of sector caps may include reduced harvest of other groundfish, thus reducing bycatch and bycatch mortality at the expense of lost economic opportunity. On the other hand, incentives, in the form of additional OY for the fishing sector may change enough of the sectors' fishing practices to reduce bycatch of overfished species and increase catch of other groundfish. If bycatch is proportional to catch, bycatch and bycatch mortality may increase for other groundfish.

Effects of Vessel Trip Limits under Alternative 7: To the degree that trip limits may be increased for some species, regulatory bycatch and bycatch mortality of those species may be reduced. This tool ranks 2 (highly effective) for species that currently are restricted by small trip limits. For less-constrained species with larger trip limits, this tool ranks 3 (somewhat effective). The effectiveness scale for this tool is 1 - 4 (where 1 is the most effective and 4 is the least effective at reducing bycatch and bycatch mortality).

Vessel trip limits would initially be the same as *status quo,* and based on previously observed joint catch ratios of overfished species and various groundfish species. Trip limits for a sector might be relaxed (increased) if the sector stays within its catch caps.

Effects on Overfished Groundfish Vessel trip limits could be different than those under the status quo due to more careful monitoring of catch, and vessel incentives to minimize catch and bycatch of overfished species could result in inseason increases as the season progresses. To the degree that trip limits are increased, regulatory bycatch and bycatch mortality would be expected to decline. Because the basic management unit in Alternative 7 is a sector, individual vessels within a sector would likely have less incentive to avoid overfished species compared to Alternatives 5 and 6. If this holds true, the greater source of bycatch reduction for bottom trawlers would be due to increased retention rather than avoidance.

Studies of Alaska fisheries have shown that sector caps work with small identifiable fishing units, like cooperatives. The West Coast whiting fleet is organized along similar lines and appears successful at implementing voluntary caps on bycatch of prohibited species. Under Alternative 7, a widow rockfish cap for the whiting sector may be an effective approach. However, this example points out the two-edged-sword of the approach; in 2004, a single tow by one whiting vessel captured over three times the total annual catch of canary rockfish anticipated for the entire sector. That single tow would have ended the season for the entire sector. However, closing a sector of the fishery would reduce the likelihood of a greater overage during the year.

Effects on Emphasis Species Limit changes under this alternative are not likely to affect those species with high levels of economic bycatch. Catches of such species are typically below current trip limits, usually due to market limits. Thus, trip limit increases are less effective for these species and the tool is ranked lower than for overfished species (see shaded scores under Trip limits in Table

4.3.14). More desirable species, such as yellowtail rockfish, currently harvested below cumulative catch limits due to constraints associated with overfished species, may be more accessible if the vessel sector incentive program is successful.

Effects of Catch Limits under Alternative 7: Sector caps may or may not be an effective incentives for individual vessels to improve their bycatch performance. In the absence of individual vessel caps, unobserved vessels may have increased incentive to maximize revenues before a sector cap is reached. This could result in discarding all overfished species to avoid contributing to the landed catch accounting system, increased highgrading, and other changes in fishing behavior. If effectively monitored, Alternative 7 would be expected to reduce bycatch of overfished groundfish substantially. Facing the possibility of being shut down due to reaching a restricted species catch limit or sector cap, vessels would be more likely to retain all usable fish. However, this could have unintended consequences. For example, catch projections could be compromised if only target species landings are monitored and static ratios applied. Managers may not be aware of increased retention rates and would continue to apply co-occurrence rates that would be higher than the actual bycatch rates (which could be declining). Such occurrences would be discovered in retrospective analyses. Individual catch caps, increased monitoring, and larger trip limits would be expected to work towards reduced regulatory and economic bycatch. In addition, catch limits would enable relaxation of redundant restrictions (possibly including seasons and area restrictions), which could make it more profitable for vessels to truly minimize their bycatch to the extent practicable with less regulation. Only through individual performance will sector performance improve. Without incentives and opportunities for individual improvement, progress will be slow and bycatch rates could even deteriorate.

Vessel catch limits for overfished groundfish (and perhaps for other species needing bycatch reduction) would be established for limited entry vessels that carry an observer at their own expense. These caps may be different for different vessels depending on target strategy, gear, area, etc. This management tool may provide enough incentive to significantly reduce bycatch of overfished species through changes in fishing strategy and gear deployment. As with trip limits, these catch limits would not be transferable and would expire at the end of each period. That is, they could not be carried over to the next period. In contrast to IQs, they could not be bought and sold as needed, resulting in greater economic efficiency. In contrast to trip limits, when a vessel reaches any catch limit, it must stop fishing until the next period begins.

One possible variation of sector caps and vessel catch limits could be for smaller groups of vessels to form cooperatives, pooling their individual catch limits so as to spread the risk of reaching any limit. This could be particularly effective for vessels that conscientiously strive to minimize their bycatch and are willing to experiment and cooperate to achieve optimum results.

This tool is ranked 2 (highly effective) for overfished species and some emphasis species and 3 (somewhat effective) for others on a scale of 1 to 4 (where 1 is the most effective and 4 is the least effective at reducing bycatch and bycatch mortality). However, due to the higher costs of full observer coverage (both to vessels and to the management agencies), this approach to minimizing bycatch may not be practicable, especially in the short term. If the observer program can be augmented over time, and vessel revenues improved to enable them to pay for all or part of observer costs, this approach may become practicable.

Effects on Overfished Groundfish The increased incentive to avoid catching overfished groundfish and the increased incentives to retain more fish under this alternative would be expected to reduce bycatch of overfished groundfish substantially. Facing the possibility of being shut down due to reaching a vessel catch limit, vessels would be likely to fish more carefully and retain more usable fish. Full monitoring would be required.

Should catch limits be transformed into IQs or dedicated access limits for individual vessels or small groups of vessels within a sector, this tool's rank would be upgraded to 1, especially if accompanied by a full retention requirement.

Effects on Emphasis Species The creation of vessel catch limits for overfished species, combined with larger landings limits for other emphasis species, could increase the overall harvest of some other groundfish species up to OY. Some species will continue to be limited by markets; increased retention requirements would reduce the economic discard of these species and would encourage market development. Increased limits and retention of species such as Dover sole, shortspine thornyhead, sablefish, and yellowtail rockfish may reduce regulatory bycatch of these species under Alternative 7.

Effects of Gear Restrictions under Alternative 7 : Under this alternative, vessels would have greater incentives to modify gear in order to reduce bycatch and bycatch mortality, due to strict caps and robust monitoring system of this alternative. Gear modifications that reduced the take of overfished rockfish outside of GCAs would have a direct beneficial impact on bycatch and bycatch mortality, compared to the first three alternatives. The fate of excluded fish is unknown. Fish interacting with and escaping fishing gear may suffer delayed mortality even though bycatch in the form of discards is reduced. This tool is ranked 2 (moderate effect) on a scale of 1 - 3 (where 1 is the most effective and 3 the least effective at reducing bycatch and bycatch mortality).

Management under Alternative 7 would include incentives to modify gear as an aid in reducing bycatch and bycatch mortality and in keeping under strict vessel catch limits and sector caps. Gear restrictions as applied under Alternative 7 are assigned a rank 2 (moderately effective) on a scale of 1 - 3 among alternatives (where 1 is the most effective and 3 is the least effective at reducing bycatch and bycatch mortality).

Effects on Overfished Groundfish Gear modifications, such as the small trawl footrope requirement, have reduced the take of rockfish throughout the management area. Gear regulations that further reduce the catch of rockfish outside of GCAs would be expected to have additional direct positive impact on bycatch and bycatch mortality of overfished species, compared to the first three alternatives. Depending on the type of gear modification, some un-observed impacts may occur, leading to bycatch mortality. Little is known about the survival rates of fish escaping through meshes or escape panels. However, fish excluder devices that avoid or eliminate rockfish species provide a better opportunity for survival than sorting and discarding fish at the surface, which is generally lethal for rockfishes (see discussion under Alternative 1 *status quo* and Davis and Ryer (2003)). Also, cut-back (selective flatfish) trawls recently tested in Oregon have been shown to be highly selective for flatfish and appear to avoid capturing some rockfish species without contacting them (Parker 2003).

It is clear that gear regulations can, in some cases, significantly reduce bycatch and/or bycatch mortality of some species. Gear restrictions are most effective when vessel operators support the bycatch objectives and develop their own modifications to optimize the effectiveness of these regulations. Under Alternative 7 sector allocations, there would be some incentive for such innovation. When combined with individual catch limits and larger trip limits there would be greater incentive and opportunity to innovate. However, this opportunity would be less than Alternative 5, where vessels would have the opportunity to acquire additional quota if an attempt failed or if and overfished species were inadvertently encountered. (Also see discussion above under **Harvest Levels**).

Effects on Emphasis Species Gear regulations can, in some cases, significantly reduce the catch of non-overfished species. Such gear restrictions are typically subverted, often at the expense of those species in need of bycatch reduction. Gear regulations are most effective when vessel operators understand and support the bycatch objectives and develop their own modifications to optimize the effectiveness of these regulations. The incentives provided by sector caps are limited; they may or may not prove stronger than under the no action alternative. Individual vessel catch limits, combined with larger trip limits for non-overfished species (including those emphasized here) provide greater incentive and opportunity for innovation than Alternatives 1-3 but less than Alternative 5.

This applies to economic bycatch as well as regulatory bycatch. For example, sablefish and shortspine thornyhead have often been constraining species in the DTS fishery. Bottom trawl gear and methods that selectively reduce the capture of shortspine thornyheads and small sablefish would result in increased revenues for those vessels. However, gear regulations intended to accomplish that result can easily be subverted by unwilling fishers. Impacts to nearshore flatfish bycatch and bycatch mortality are unknown because gear changes are likely to reduce impacts to overfished species. As pointed out above, the strength of the incentives depends on changes in gear and behavior on the part of the entire sector. (See also Alternatives 5 and 6).

Effects of Time/Area Management under Alternative 7: Time and area closures are designed to reduce encounter rates with overfished stocks and other rockfish species. Any fishing that results in capture of rockfish will result in near 100% mortality of those fish; thus, avoidance is the most effective way to reduce bycatch mortality. Sectors that use gear and/or methods that avoid these species will have greater access to these restricted areas, other would be similar to those under *status quo*, at least in the short term, and would be based on the previously observed catch ratios of various groundfish species. Alternative 7 anticipates changes to the observer program that would improve the quality and quantity of catch and bycatch data over time. That information could provide the basis for changes to the GCA boundaries. In addition, vessels paying for their own observer coverage may be granted limited exemption from closed areas, generating additional data that would not otherwise be available. However, any differences in effects from the no action alternative are expected to be negligible, at least in the short term. Thus, time/area management as applied under Alternative 7 is given a rank of 3 (no additional effect over the *status quo*) on a scale of 1 - 3 (where 1 is the most effective and 3 is the least effective at reducing bycatch and bycatch mortality).

Effects on Overfished Groundfish Impacts to bycatch and bycatch mortality of overfished species would likely be the same as under *status quo*. Encounter rates with overfished shelf rockfish are greatly reduced under the no action alternative. Thus, time/area management as applied under Alternative 7 is given a rank of 3 (no additional effect over the *status quo*). However, in this the negative effects are greatly reduced from previous (pre-2002) years.

Effects on Emphasis Species Impacts on emphasis species would likely be the same as under *status quo.* If RCA boundaries are changed to allow more access to other groundfish, catch, bycatch, and bycatch mortality of other shelf groundfish could increase somewhat.

Effects of Capacity Reduction under Alternative 7: No direct reduction in capacity is applied under this alternative. Some level of fleet consolidation would occur as market forces would favor more efficient vessels. Thus, capacity reduction would be an indirect effect of this approach rather than an intentional or specified result.   Therefore, this tool is ranked 2 on a scale of 1-3.

Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 7: Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans.

Logbook coverage would continue to be the same as under the status quo alternative. Under Alternative 7, observer coverage would be redesigned to ensure that each sector's bycatch is accurately assessed and recorded; in the long term, results would be available for management purposes inseason. A minimum observation rate in each sector would be approximately 10%, or as determined by statistical sample design methods. Additional observer coverage is anticipated because commercial limited entry vessels will be offered incentives to pay for observer coverage. Commercial landings data and observer data would be expanded sector-by-sector to all vessels in each sector. Vessels observed to achieve any catch limit would be required to stop fishing for the remainder of the designated period. Vessels observed to stay below all catch limits would be authorized to continue fishing for additional target species; that is, larger trip limits would be available for vessels carrying observers. It may be possible to use video monitoring in conjunction with full retention and shoreside sampling to achieve the same level of catch verification.

The catch reporting, record keeping, and monitoring program established by Alternative 7 would be substantially more robust than Alternatives 1, 2 and 3. Vessel catch limits can be effective only when the vessels are fully observed. Incidental catch rates of observed vessels would be quickly tabulated and applied to non-observed vessels of the sector; data from vessels paying their own observer costs may not be applicable to vessels that remain in similar sectors. Recreational sampling would also be increased. If the observer program is upgraded to the point where catch and bycatch data are available inseason, annual/biannual OYs may be more closely achieved. If data are available only between seasons, management precision will be similar to the no action alternative, but data quality will be better. The application of this tool is ranked 2 to 3 (highly effective to moderately effective) on a scale of 1 - 5 compared to the alternatives (where 1 is the most effective and 5 is the least effective at reducing bycatch, bycatch mortality, and improving accountability).

Table 4.3.14. Effects of bycatch mitigation tools as applied in Alternative 7. Overfished species in **bold** and emphasis species in *italic* . Precautionary species management (p). Shaded areas reflect change in rank due to fisheries or species characteris

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area closures	Monitoring program
			Catch ratios- allocate fisning mortality limits to sector	Yes; larger for vessels that pay for observers	Individual vessel catch llimits for vessels that pay for observers	None	Yes	None	RCAs	>10% Observer coverage commercial and CPFV, increasing with data vailable inseason
Northern Shelf	**Canary rockfish**	1	2	2	2	2	2	2	3	2
	Lingcod	1	2	2	2	2	2	2	3	2
	Yelloweye rockfish	1	2	2	2	2	2	2	3	2
	Yellowtail rockfish	1	2	2	2	2	2	2	3	2
	Arrowtooth flounder	1	2	3	3	2	2	2	3	2
	English sole	1	2	3	3	2	2	2	3	2
	Petrale sole	1	2	3	3	2	2	2	3	2
								2		
Southern Shelf	**Boccacio**	1	2	2	2	2	2	2	3	2
	Cowcod	1	2	2	2	2	2	2	3	2
	Chilipepper	1	2	3	3	2	2	2	3	2
								2		
Slope	**Darkblotched rockfish**	1	2	2	2	2	2	2	3	2
	Pacific Ocean Perch	1	2	2	2	2	2	2	3	2
	Dover sole (p)	1	2	2	2	2	2	2	3	2
	Sablefish (p)	1	2	2	2	2	2	2	3	2
	Shortspine thornyhead (p)	1	2	2	2	2	2	2	3	2
	Longspine thornyhead	1	2	3	3	2	2	2	3	2
								2		
Pelagic	**Widow rockfish**	1	2	2	2	2	2	2	3	2
	Pacific whiting (incl.discard)	1	2	2	2	2	2	2	3	2
								2		
Nearshore	*Black rockfish*	1	2	2	3	2	2	2	3	2
	Cabezon	1	2	2	3	2	2	2	3	2
	Range of Alternative Scores	1	1-3	1-4	1-4	1-2	1-3	1-3	1-3	1-5

4.3.2 Impacts on Pacific Halibut

Pacific halibut is a highly prized fish targeted by commercial, recreational and tribal fisheries along the West Coast. Directed halibut fishing is managed through a combination of gear, season, area and size restrictions. Only specified hook-and-line gear (see below) may be used to fish for halibut, and only halibut taken with hook-and-line gear may be retained. (The only exception is for tagged halibut, which may be retained regardless of gear, size or area. However, if a tagged halibut is retained, the tag must be returned to the *INTERNATIONAL PACIFIC HALIBUT COMMISSION* (*IPHC*).) The retained fish may only be sold if taken in authorized halibut fisheries, otherwise it may be only be kept for personal consumption. A minimum size limit also applies throughout the range of the species; only halibut over 82 cm (32 in) may be retained in any fishery. Again, the exception is that tagged halibut of any size may be retained.

During specific annual seasons/areas, legal-sized halibut may be retained and landed in recreational, commercial setline, and tribal setline fisheries. An allowance is also made for commercial salmon trollers, who are authorized to retain limited amounts of halibut caught while fishing for salmon. Any halibut taken with other gear, outside those seasons/areas, or under legal size, is considered bycatch and must be returned to the sea. Pacific halibut (unless tagged) may not be legally retained by trawl gear at any time and all that are caught are bycatch. Many halibut may survive if handled gently and returned to the sea quickly. Harvest regulations are established to attain but not exceed the estimated total allowable harvest for the year.

The bycatch of Pacific halibut off the West Coast has relatively little impact on the overall status of the population, but it does affect the total allowable harvest for directed West Coast halibut fisheries, including groundfish fisheries authorized to retain halibut. Halibut are migrants from northern waters off Canada and Alaska, where the bulk of the population resides. Little, if any, spawning occurs off the West Coast. Each year, the estimated bycatch of legal-sized fish off the West Coast is subtracted from the estimated yield to determine the allowable harvest for target fisheries. Consequently, the amount of bycatch has a direct impact on the recreational and setline fisheries for halibut. Pacific halibut are most frequently caught by bottom trawls operating in the 100-300 fathom depth range off Washington and Oregon, but also are taken at shallower depths on the shelf and off northern California. Few halibut are taken by midwater trawl gear.

Bycatch is estimated as a function of the halibut catch rate and effort fished for a particular time, area, depth, and target species category. Some of these categories have much higher catch rates than others and could be termed “halibut hot spots.” Much of the distribution of Pacific halibut falls within the GCAs. Therefore, bycatch has been reduced from previous years because bottom trawl effort is curtailed in these areas.

Impacts of the Alternatives Compared to Alternative 1 (status quo/no action), bycatch of Pacific halibut would not likely change much under Alternatives 2 and 3. The recent reductions in halibut bycatch would be maintained, to the extent that depth restrictions for on-bottom groundfish fishing are not expanded under these alternatives. However, this reduction could be partially offset if effort were concentrated in an area or time when halibut were also concentrated. For example, observed halibut bycatch rates by bottom trawl fisheries during the late 1990s were higher during the January through August period than during September through December. Therefore, if the fishing season (and effort) under Alternative 3 were concentrated during January through August, halibut bycatch and bycatch mortality could increase.

By further reducing the race for fish, Alternatives 4-7 increase vessels' flexibility to practice bycatch avoidance techniques. These alternatives may provide greater awareness and opportunity to conduct fishing operations in a manner that could lead to reduced bycatch and bycatch mortality of halibut. The desire to avoid halibut bycatch is likely comparable to the desire to avoid bycatch of overfished species, so halibut bycatch would tend to be reduced, at least in the same direction if not magnitude, as bycatch for overfished species. In addition, halibut bycatch under Alternative 6 would likely be reduced to the extent that closed areas are located in areas where halibut are concentrated. However, bycatch would be increased to the extent that greater fishing effort on bottom occurred in halibut hot spots because of closed areas elsewhere. Incentives for gear modifications and changes to fishing practices to remain within groundfish bycatch caps under these alternatives could increase or decrease halibut bycatch, depending on the modifications implemented.

Although not expressly included in the alternatives, Pacific halibut could be treated like a groundfish for purposes of applying restricted or prohibited species caps (Alternatives 5-7) or allowing vessels with low halibut bycatch to access a groundfish OY reserve (Alternatives 4, 5, and 7). If a cap were applied, then halibut bycatch would be reduced accordingly. If Alternative 6 were modified to require full retention of halibut (as for groundfish), then discard/bycatch would be eliminated.

Currently, trawl bycatch and bycatch mortality of Pacific halibut off the West Coast are primarily a function of the amount of bottom fishing effort in times and areas where halibut occur. Reducing trawl effort in these areas reduces bycatch, and increasing effort increases bycatch. To the extent that fishing effort patterns change with respect to halibut distribution and abundance, the impact of the alternatives will increase or decrease halibut bycatch. In addition, Alternatives 4, 5 and 6 would increase monitoring and reporting; improved halibut bycatch information would ultimately contribute to bycatch reduction.

Halibut bycatch in the groundfish fisheries may be more effectively reduced through the application of certain fisheries management tools than through the measures described in alternatives. For example, allowing retention of Pacific halibut by the trawl fishery and by other fisheries outside of currently allowed seasons or areas could substantially reduce discard/bycatch. Similarly, gear modification through the use of halibut bycatch reduction devices, which have been used in trawl fisheries off Alaska, may be beneficial, although potentially costly, for reducing bycatch off the West Coast. Such regulatory changes would primarily be based on social and economic considerations that are not explicitly addressed in the alternatives. They could be included in any of the alternatives.

4.3.3 Impacts on Protected Species

This section examines interactions between protected species and groundfish fisheries under the programmatic alternatives being considered consideration in this EIS. As a point of clarification, interactions and incidental catches are different than bycatch. Interactions and incidental catches involve fishing gears and marine mammals, turtles and birds, while bycatch consists of discards of fish. Turtles, although defined as fish in the Magnuson-Stevens Act and thus technically bycatch, are included in this section because of their protected status (NMFS 1998).

4.3.3.1 Impacts on Pacific Salmon

Pacific salmon are among the most highly prized species targeted by commercial, recreational and tribal fisheries on the West Coast. Directed salmon fishing is managed through a combination of catch limit, gear, season, area, size and fin-clip restrictions. Pacific coast fisheries in Council-managed waters (3-200 nm offshore) are directed toward and harvest primarily chinook (king) salmon and coho (silver) salmon. Small numbers of pink salmon are also harvested, especially in odd-numbered years. There are no directed fisheries for other Pacific salmon species, and they occur rarely (sockeye) or in very limited numbers (steelhead and chum) in Council-managed harvests.

Several salmon stocks on the West Coast are listed as threatened or endangered

Table 4.3.15. Salmon bycatch in the Pacific whiting fisheries, 1995-2002. At-sea data from NMFS Observer Data; shorebased data from ODFW.

At-sea Whiting Sector	1995	1996	1997	1998	1999	2000	2001	2002
Chinook Salmon	11578	1446	1,398	1477	4391	6260	2,568	1679
Other Salmon 4/	4,414	279	924	27	802	115	770	173
Total Salmon	15992	1725	2,322	1,504	5,193	6,375	3,338	1,852
Percent Chinook	72.4	83.8	60.2	98.2	84.6	98.2	76.9	90.7
No. Chinook/ mt	0.1133	0.013	0.012	0.012	0.038	0.0546	0.0272	0.0267
Shorebased Sector								
Chinook Salmon	2954	674	1,558	1,699	1,696	3,306	2,627	1,062

under the ESA. Salmon caught in trawl nets are classified as prohibited species; therefore, salmon captured by groundfish trawl fisheries and brought aboard must be returned to the sea as soon as possible and with minimal injury (after allowing for sampling by an observer).

Relatively few salmon are incidentally taken during commercial fishing operations for groundfish. As a result of the spatial/ temporal overlap between chinook salmon distribution and the midwater trawl fishery for whiting, most salmon bycatch is taken when fishing for Pacific whiting (Table 4.3.8). Salmon are most often present in the water column, rather than near the sea floor, and midwater trawl gear is primarily used to capture whiting. In the at-sea fishery, the trawl nets are emptied on the deck, and salmon can be removed from the catch and returned to the sea quickly. Nearly all vessels in the shore-based fishery empty their trawls directly into the hold, typically filled with refrigerated seawater, where the entire catch remains for several hours until offloaded at shore-based processing plants. Through Exempted Fishing permits (EFPs), these vessels have been exempted from requirements to sort all of the catch; all must be retained and delivered so all salmon and other species can be observed and tallied at the plant. All retained salmon must be relinquished to the appropriate State.

The 1992 *BIOLOGICAL OPINION* (BO) analyzing the effects of the Pacific Coast groundfish fishery on salmon stocks listed under the ESA established limits to bycatch of chinook salmon. Currently the limit is set at 0.05 chinook salmon per metric ton of Pacific whiting, with an associated total catch of 11,000 chinook for the coastwide Pacific whiting fishery. This BO was subsequently reviewed and the allowable chinook catch level reaffirmed in 1993, 1996 and 1999.

The 1992 BO also requires the Council to provide for monitoring of salmon bycatch in the midwater trawl fishery for whiting, but not in the bottom trawl fishery for groundfish. Currently, this monitoring requirement is based on not jeopardizing the existence of listed salmon species, including the Snake River fall chinook, lower Columbia River chinook, upper Willamette River chinook, and Puget Sound chinook. At present, the at-sea whiting fishery has 100% observer coverage. In recent years, a cooperative voluntary effort between the fishing industry and management agencies has been implemented to facilitate observer coverage and collect information on directed whiting landings at shoreside processing plants. Participating vessels are issued *EXEMPTED FISHING PERMITS* (EFPs), which allow vessels to land unsorted catch at designated processing plants. Permitted vessels are not penalized for landing prohibited species, including Pacific salmon, nor are they held liable for overages of groundfish trip limits. In 2003, 99% of the whiting catch by the shoreside fishery was landed under an EFP.

Impacts of the Alternatives In general, the impacts of the alternatives on salmon bycatch is relatively minor. Compared to Alternative 1, bycatch of Pacific salmon in the whiting fisheries would not likely change much under

Alternatives 2, 3, and 4. Alternatives 5 and 6 would substantially increase observer coverage and thus provide a more comprehensive understanding of salmon bycatch. Alternative 7 would provide an intermediate level of observer coverage between Alternative 4 and Alternatives 5 and 6. Improved bycatch information could lead to some improvements. However, given the voluntary efforts by whiting fishers to avoid salmon bycatch in these fisheries, little bycatch reduction would likely occur in these fisheries.

4.3.3.2 Impacts on Seabirds

Interactions between seabirds and fishing operations are wide-spread and have led to conservation concerns in many fisheries throughout the world. Abundant food in the form of offal (discarded fish and fish processing waste) and bait attract birds to fishing vessels. Of the gear used in the groundfish fisheries in the North Pacific, seabirds are occasionally taken incidentally by trawl and pot gear, but they are most often taken by longline gear. Around longline vessels, seabirds forage for offal and bait that has fallen off hooks at or near the water's surface, and are attracted to baited hooks near the water's surface, during the setting of gear. If a bird becomes hooked while feeding on bait or offal, it can be dragged underwater and drowned.

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

In the Pacific Coast groundfish fisheries, groundfish observers collect information on interactions between seabirds and groundfish fisheries. Catcher-processors and motherships participating in the Pacific whiting fishery have had full observer coverage since the mid-1970s. The non-whiting portion of the groundfish fishery has had observer coverage only since the fall of 2001. Between September 2001 and October 2002, approximately 10% of the coastwide limited entry trawl landed weight and 30% of the limited entry fixed gear landed weight was observed.

The incidental take of seabirds by the at-sea whiting fleet is rare and infrequent. The species that have been taken by the at-sea whiting fleet include black-footed albatross, northern fulmar, and unidentified puffin. In the limited entry groundfish fisheries, few interactions with seabirds have been observed (Table 4.3.16).

Table 4.3.16. Interactions between seabirds and the Pacific Coast groundfish fisheries documented by West Coast Groundfish Observers between September 2001 and October 2002.

Species	Gear Type	Type of Interaction
Unidentified Gull (*Larus species)*	Trawl	1 Individual Taken
Unidentified Seabird	Trawl	4 Individuals Taken
Short-tailed Albatross (*Phoebastria albatrus*)	Longline and Trawl	Feeding on Discard
California Brown Pelican (*Pelecanus occidentalis californicus*)	Rod and Reel	Feeding on Discard
Marbled Murrelet (*Brachyramphus marmoratus*)	Trawl	Landed on Deck
Black-footed Albatross (*Phoebastria nigripes*)	Trawl, Longline, and Pot	Feeding on Discard
Leach's storm-petrel *(Oceanodroma leucorhoa***)**	Trawl	Landed on Deck
Cassin's auklet *(Ptychoramphus aleuticus)*	Trawl	Landed on Deck
Pigeon guillemots *(Cepphus columba***)**	Pot	Feeding on Discard
Laysan albatross *(Phoebastria immutabilis)*	Pot	Feeding on Discard
Unidentified Cormorant (*Phalacrocorax species)*	Rod and Reel	Feeding on Discard
Unidentified Storm Petrel (*Oceanodroma species*)	Longline	Landed on Deck
Unidentified Shearwater (*Puffinus species*)	Pot	Feeding on Deck

In response to increased national concern about the incidental take of seabirds, NMFS, USFWS, and the Department of State collaborated in 2001 to develop the U.S. *National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries*. The purpose of this plan is to provide national-level policy guidance on reducing the incidental take of seabirds in U.S. longline fisheries and to require NMFS, in cooperation with USFWS, to conduct an assessment of all U.S. longline fisheries to determine whether an incidental take problem exists. Using the West Coast Groundfish Observer Program's first year of data, NMFS drafted a preliminary assessment of seabird interactions with the groundfish longline fleet in 2003. There were no incidental takes of seabirds by longline vessels documented by NMFS groundfish observers during September 2001 to October 2002; however, a number of interactions between seabirds and longline vessels were observed (see Table 4.3.8). Additionally, this National Plan of Action further requires NMFS, in cooperation with USFWS, to work through the regional fishery management council process in partnership with longline fishery representatives to develop and implement mitigation measures in those fisheries where the incidental take of seabirds is a problem. Therefore, NMFS will continue to work with the USFWS to better understand the interactions between seabirds and the groundfish fisheries and evaluate the need for seabird incidental take mitigation and management measures.

In order to predict the effects of the bycatch reduction alternatives on Pacific Coast seabird populations, it is important to have knowledge of the distribution, intensity, and duration of fishing effort associated with the groundfish fisheries. This information is currently unavailable for the groundfish fleet, but additional sources information should soon become available.

As of January 1, 2004, all vessels are required to carry Vessel Monitoring System (VMS) equipment while fishing for groundfish. VMS equipment identifies precise vessel location information. Additionally, information on the distribution of fishing effort is being developed as part of an Essential Fish Habitat Risk Assessment scheduled to be available in the spring of 2004. Because of the temporal and spatial overlap between seabird populations and groundfish fishing effort, projected harvest levels and proposed area closures will be used as a proxy for predicting the bycatch reduction alternatives on seabird populations.

Incomplete or Unavailable Information As required by CEQ's NEPA implementing regulations, any time there is incomplete or unavailable information, the federal agency must not only identify that such information is unavailable, but also make an assessment of the importance of that information and what would be the agency's evaluation of the predicted environmental impacts (i.e., best professional judgement) (40 CFR Part 1502.22). Accordingly, NMFS acknowledges that information on the distribution, intensity, and duration of fishing effort is incomplete with no current means of accurately tracking this information. This information is important in order to quantify fishing effort and predict the potential risks of interactions with seabirds. Thus, the following paragraphs shall present a best professional judgement (i.e., qualitative assessment) of the predicted environmental impacts of the alternatives on seabirds.

Under Alternative 1, interactions between the Pacific Coast groundfish fishery and seabirds are expected to be similar to the seabird/fishery interactions during the 2002/2003 groundfish fishery. Based on West Coast Groundfish Observer data, the combined use of trip limits, gear restrictions, and area closures has resulted in few interactions between the groundfish fleet and seabirds (Table 4.3.8). Seabirds may benefit from the temporal and/or spatial distribution of fishing effort associated with trip limit management and area closures, provided that these management measures do not concentrate fishing effort in areas important to seabird foraging and/or breeding. As more information is gathered on seabird interactions with the groundfish fleet, gear restrictions and area closures may be modified to reduce interactions with seabirds.

Under Alternative 2, the number of commercial groundfish trawl vessels would be a reduced to 50% or 2000 levels. This reduction in fleet size, paired with gear restrictions and area closures, would likely reduce the trawl fleet's interactions with seabirds. Additionally, by increasing the trip limits for various groundfish species, any race for fish should be further reduced, potentially allowing fishing behavior to be modified to avoid interactions with seabirds.

Alternative 3 would implement a shorter fishing season, as opposed to the current year-round groundfish fishery, as well as gear restrictions and trip limits designed to discourage fishing in certain areas. Under this alternative, the number of vessels would not be reduced, but fishing would be concentrated in shorter seasons. If fishing activities were concentrated into seasons where there was limited seabird activity along the Pacific Coast, the number of interactions may be reduced under Alternative 3. However, if fishing were to be concentrated into seasons important for seabird foraging and/or breeding, interactions with seabirds may increase under Alternative 3. During closed periods, all interactions with seabirds would be greatly reduced. The overall effect of Alternative 3 is difficult to predict but it likely depends on the seasonality of the concentrated groundfish fishery.

Alternative 4 would continue the use of trip limits but with additional restrictions on the amount of groundfish catch that can occur. The objective of Alternative 4 is to provide extended groundfish fishing opportunities for vessels with low rates or low amounts of groundfish bycatch. The effects on seabird/ fishery interactions due to additional catch restrictions are difficult to predict; however, it is likely that they would be similar to those under Alternative 3.

Alternative 5 would establish individual vessel groundfish catch quotas (IFQs and RSQs) as a means to mitigate groundfish bycatch and would relax some gear restrictions to encourage fishers to develop individual groundfish bycatch avoidance techniques. While establishment of groundfish quotas may be an effective way to limit bycatch of groundfish species, IQs alone would not directly reduce interactions between seabirds and the Pacific Coast groundfish fleet. However, it is likely that the establishment of individual groundfish catch quotas would result in further reducing the number of trawl vessels. IQs should also provide a much greater opportunity for vessels to choose when and where they will fish. Additionally, an IQ program may require 100% observer coverage to ensure effectiveness; therefore, the level of information on seabird interactions (as well as seabird distribution) would likely increase substantially. As more is understood about the interactions between groundfish vessels and seabirds along the Pacific Coast and as this information is passed along to fishers, Alternative 5 has the potential to reduce interactions with seabirds.

Under Alternative 6, no-take marine reserves and vessel caps would be used to mitigate bycatch by groundfish vessels. Marine reserves would likely be designed to reduce or prevent incidental take of overfished groundfish species, although they could also be designed to reduce bycatch of other species. Should these areas of reduced fishing coincide with areas important for foraging and breeding seabirds, then Alternative 6 may be useful in reducing the potential for seabird/fishery interactions. Conversely, if these restricted areas cause fishing effort to be concentrated in areas used by seabirds, then Alternative 6 may increase the potential for seabird/fishery interactions. However, the added implementation of groundfish quotas would likely result in a smaller fleet and more cautious fishing strategies. Therefore, Alternative 6 is predicted to result in reduced seabird/fishery interactions compared to Alternatives 1, 2, and 3 and similar to Alternative 5. As more information is gathered on seabird interactions with the groundfish fleet, marine protected areas may be modified to reduce interactions with seabirds.

Alternative 7 would establish sector allocations and continue the use of trip limits, but with additional restrictions on the amount of groundfish catch that can occur. The objectives of Alternative 7 are to reward those sectors achieving low groundfish bycatch rates or amounts, and to provide incentives for individual vessels to reduce their bycatch. Vessels that opt to voluntarily pay the costs of observer coverage would receive vessel catch limits of overfished species, larger trip limits of other species, and be exempted from certain sector restrictions. The effects on seabird/ fishery interactions due to these restrictions are difficult to predict; however, it is likely that they would be similar to those under Alternatives 4 and 5.

As more information about the spatial and temporal overlap of groundfish fisheries and seabird populations along the Pacific Coast is gathered, a more comprehensive understanding of seabird/fishery interactions is possible. If it is found that mitigating the effects of the Pacific Coast groundfish fishery on seabirds is necessary, additional management measures, such as seabird deterrents (i.e., streamer lines), discharging offal opposite the hauling station, and reducing fishing activity in areas and/or during seasons important for seabird breeding and/or foraging, may be required under any of the alternatives.

4.3.3.3 Impacts on Marine Mammals

The marine mammal species accounts presented here are taken primarily from the most recent Stock Assessment Reports (Carretta *et al.* 2001) prepared by NMFS as required by the Marine Mammal Protection Act (MMPA).

Table 4.3.17. Marine mammal species that occur off the West Coast that are, or could be, of concern with respect to potential interactions with groundfish fisheries.

	Scientific Name	ESA Status
Pinnipeds		
California sea lion	*Zalophus californianus*	
Pacific harbor seal	*Phoca vitulina richardsi*	
Northern elephant seal	*Mirounga angustirostris*	
Guadalupe fur seal	*Arctocephalus townsendi*	T
Northern fur seal	*Callorhinus ursinus*	
Northern or Steller sea lion	*Eumetopias jubatus*	T
Sea otters		
Southern	*Enhydra lutris nereis*	T
Washington	*Enhydra lutris kenyoni*	
Cetaceans		
Minke whale	*Balaenoptera acutorostrata*	
Short-finned pilot whale	*Globicephala macrorhyncus*	
Gray Whale	*Eschrichtius robustus*	
Harbor porpoise	*Phocoena phocoena*	
Dall's porpoise	*Phocoenoides dalli*	
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	
Short-beaked common dolphin	*Delphinus delphis*	
Long-beaked common dolphin	*Delphinus capensis*	

The groundfish fisheries have been determined not to jeopardize any marine mammal species. None of the alternatives under consideration is expected to significantly impact any marine mammal.

Table 4.3.18. Cetaceans that are present but not likely to interact with groundfish fisheries or that have not been documented having had interactions in observed groundfish fisheries.

	Scientific name	ESA Status
Bottlenose dolphin	*Tursiops truncatus*	
Striped Dolphin	*Stenella coeruleoalba*	
Sei whale	*Balaenoptera borealis*	E
Blue whale	*Balaenoptera musculus*	E
Fin whale	*Balaenoptera physalus*	E
Sperm whale	*Physeter macrocephalus*	E
Humpback whale	*Megaptera novaeangliae*	E
Bryde's whale	*Balaenoptera edeni*	
Sei whale	*Balaenoptera*	E
Killer whale	*Orcinus orca*	
Baird's beaked whale	*Berardius bairdii*	
Cuvier's beaked whale	*Ziphius cavirostris*	
Pygmy sperm whale	*Kogia breviceps*	
Risso's dolphin	*Grampus griseus*	
Striped dolphin	*Stenella coeruleoalba*	
Northern right-whale dolphin	*Lissodelphis borealis*	

California Sea Lion - Incidental mortalities of California sea lions have been documented in set and drift gillnet fisheries (Carretta *et al.* 2001; Hanan *et al.* 1993). Skippers logs and at-sea observations have shown that California sea lions have been incidentally killed in Washington, Oregon, and California groundfish trawls and during Washington, Oregon, and California commercial passenger fishing vessel fishing activities (Carretta *et al.* 2001).   Total human-caused mortality (1,352 sea lions) is less than the 6,591 sea lions allowed under the Potential Biological Removal formula (Carretta et al. 2001).

Harbor Seal - Combining mortality estimates from California set net, northern Washington marine set gillnet, and groundfish trawl results in an estimated mean mortality rate in observed groundfish fisheries of 667 harbor seals per year along Washington, Oregon, and California (Carretta et al. 2001).

Northern Elephant Seal - There are no recent estimated incidental kills of Northern elephant seals in groundfish fisheries along Washington, Oregon, and California, however they have been caught in setnet fisheries (Carretta et al. 2001).

Guadalupe Fur Seal - There have been no U.S. reports of mortalities or injuries for Guadalupe fur seals (Cameron and Forney 1999; Julian 1997; Julian and

Beeson 1998), although there have been reports of stranded animals with net abrasions and imbedded fish hooks (Hanni et al. 1997).

Northern Fur Seal - There were no reported mortalities of northern fur seals in any observed fishery along the West Coast of the continental U.S. during the period 1994-1998 (Carretta *et al.* 2001), although there were incidental mortalities in trawl and gillnet fisheries off Alaska (Angliss and Lodge 2002).

Eastern Stock Steller Sea Lion - These have been observed taken incidentally in WA/OR/CA groundfish trawls and marine set gillnet fisheries (Angliss and Lodge 2002). Total estimated mortalities of this stock (44) is less than the 1,396 Steller sea lions allowed under the Potential Biological Removal formula (Angliss and Lodge 2002).

Southern Sea Otter - During the 1970s and 1980s considerable numbers of sea otters were observed caught in gill and trammel entangling nets in central California. During 1982 to 1984, an average of 80 sea otters were estimated to have drowned in gill and trammel nets (Wendell *et al.* 1986). This was projected as a significant source of mortality for the stock until gill nets were prohibited within their feeding range. More recent mortality data (Pattison *et al.* 1997) suggest similar patterns during a period of increasing trap and pot fishing for groundfish and crabs (Estes *et al.* In Press). This elevated mortality appears to be the main reason for both sluggish population growth and periods of decline in the California sea otter population (Estes *et al.* In Press).

Sea Otter (Washington Stock) - Gillnet and trammel net entanglements were a significant source of mortality for southern sea otters (Wendell *et al.* 1986) and some sea otters were taken incidentally in setnets off Washington (Kajimura 1990). Evidence from California and Alaska suggests that incidental take of sea otter in crab pots and tribal set-net fisheries may also occur. Sea otters are also quite vulnerable to oil spills due to oiled fur interfering with thermoregulation, ingested oil disintegrating the intestinal track, and inhaled fumes eroding the lungs (Richardson and Allen 2000).

Harbor porpoise - Harbor porpoise are very susceptible to incidental capture and mortalities in setnet fisheries (Julian and Beeson 1998). Off Oregon and Washington, fishery mortalities of harbor porpoise have been recorded in the northern Washington marine set and drift gillnet fisheries (Carretta *et al.* 2001). However, these fisheries have largely been eliminated.

Dall's porpoise - Observers document that Dall's porpoise have been caught in the California, Oregon and Washington domestic groundfish trawl fisheries (Perez and Loughlin 1991) but the estimated annual take is less than two porpoise per year.

White-sided Dolphin - Observers have documented mortalities in the California, Oregon, and Washington groundfish trawl fisheries for whiting (Perez and Loughlin 1991). The total estimated kill of white-sided dolphins in these fisheries averages less than one dolphin per year (Carretta *et al.* 2001).

Risso's Dolphin - There have been no recent Risso's dolphin moralities in West Coast groundfish fisheries (Carretta *et al.* 2001), although Reeves *et al*.(2002) report that Risso's are a bycatch in some longline and trawl fisheries.

Common Dolphin - Common dolphin mortality has been estimated for set gillnets in California (Julian and Beeson 1998); however, the two species (short-beaked and long-beaked) were not reported separately. Reeves *et al*.(2002) relate that short-beaked common dolphins are also a bycatch in some trawl fisheries.

Short-finned Pilot Whale - Total human-caused mortality (3) of this species is less than the 6 short-finned pilot whales allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Eastern Pacific Gray Whale - These have been an incidental catch in set net fisheries, but there have been no recent takes in groundfish fisheries (Angliss and Lodge 2002).

Minke Whale Minke whales have occasionally been caught in coastal gillnets off California (Hanan *et al.* 1993), in salmon drift gillnet in Puget Sound, Washington, and in drift gillnets off California and Oregon (Carretta *et al.* 2001). There have been no recent takes in groundfish fisheries off California , Oregon, or Washington (Carretta *et al.* 2001).

Sperm Whale - There are no recent observations of sperm whale incidental catches in West Coast groundfish fisheries.

Humpback, Blue, Fin, and Sei Whales - There are no recent observations of incidental catches of these species in West Coast groundfish fisheries.

Killer Whale - The only incidental take recorded by groundfish fishery observers was in the Bering Sea/Aleutian Islands (BSAI) groundfish trawl (Carretta *et al.* 2001). There are also reports of interactions between killer whales and longline vessels (Perez and Loughlin 1991). (Longline fishers in the Aleutian Islands reported several cases where orcas removed sablefish from longlines as the gear was retrieved.) There are no other reports of killer whale takes in West Coast groundfish fisheries (Carretta *et al.* 2001).

California Coastal Bottlenose Dolphin - Due to its exclusive use of coastal habitats, this bottlenose dolphin population is susceptible to fishery-related mortality in coastal set net fisheries. However, from 1991-94 observers saw no bottlenose dolphins taken in this fishery, and in 1994 the state of California banned coastal set gillnet fishing within 3 nm of the southern California coast. In central California, set gillnets have been restricted to waters deeper than 30 fathoms (56 m) since 1991 in all areas except between Point Sal and Point Arguello. These closures greatly reduced the potential for mortality of coastal bottlenose dolphins in the California set gillnet fishery.

4.3.3.4 Impacts on Sea Turtles

The sea turtle species accounts are taken from the species accounts of the Environmental Assessment for the issuance of a marine mammal permit to the California/Oregon drift gillnet fishery (NMFS 2001a).

Table 4.3.19. Sea turtle species occurring off the West Coast that are or could be of concern with respect to potential interactions with groundfish fisheries.

	Scientific Name	ESA Status
Loggerhead	*Caretta caretta*	T
Green	*Chelonia mydas*	T
Leatherback	*Dermochelys coriacea*	E
Olive (Pacific) ridley	*Lepidochelys olivacea*	T

Numerous human-induced factors have adversely affected sea turtle populations in the North Pacific and resulted in their threatened or endangered status (Eckert 1993; Wetherall *et al.* 1993). Documented incidental capture and mortality by purse seines, gillnets, trawls, longline fisheries, and other types of fishing gear adversely affect sea turtles, however the relative effect of each of these sources of impact on sea turtles is difficult to assess (NMFS and USFWS 1998a; 1998b; 1998c; 1998d). Each of the sea turtle species that might interact with groundfish fisheries are listed. Little data are available estimating total annual mortalities except in the drift gillnet fishery, which is not part of the groundfish FMP. None of the alternatives is expected to result in any impacts on these species.

Loggerhead - The primary fishery threats to the loggerheads in the Pacific are pelagic longline and gillnet fisheries (NMFS and USFWS 1998c). These gears are not used for taking groundfish.

Leatherback - Primary threats to leatherbacks in the Pacific are the killing of nesting females and eggs at nesting beaches and incidental take in coastal and high seas fisheries (NMFS and USFWS 1998b). Groundfish fishing operations are not known to affect this species.

Olive Ridley - Occasionally these turtles are found entangled in scraps of net or other floating debris. Although they are generally thought to be surface feeders, olive ridleys have been caught in trawls at depths of 80-110 meters (NMFS and USFWS 1998d).

4.3.4 Miscellaneous Species

Miscellaneous species include sea urchins, starfish, corals, octopuses, various crustaceans and finfish. Little information is available about these species and the amount of interaction with groundfish fishing and fishing gears. Alternatives 4-7 would be expected to result in reduced groundfish fishing, especially on-bottom fishing, and thus would reduce bycatch of benthic species. The establishment of long-term no-take reserves by Alternative 6 would likely provide the greatest protection to benthic animals within the reserve boundaries. Outside marine reserve boundaries, fishing could intensify. Requirements to use only certified gears may reduce the potential for increased impacts in such areas. Although there is no way to anticipate the effects of the various alternatives, no significant effects are expected. Further detailed environmental analysis would be necessary before any regulations were promulgated.

4.4 Impacts on the Social and Economic Environment

To help track potential impacts, this socioeconomic analysis is organized according to various socioeconomic components of the human environment that could be affected by the alternatives. The following (Table 4.4.1) is a list of the components and examples of the specific impact assessment variables that are considered.

Table 4.4.1. Socioeconomic Components of the Human Environment and Impact Assessment Variables.

Component of the Human Environment	Impact Assessment Variables
Incentives and disincentives regarding bycatch	The benefits and costs to fishers of avoiding and/or discarding fish
Commercial harvesters	Production levels of different sectors; ex-vessel revenues and operation expenses (average costs); distributional effects among commercial harvesters such as changes in level of dependence and involvement; effects on other fisheries.
Recreational fisheries	Value of the recreational experience; benefits and costs to charter/commercial operations.
Tribal fisheries	Fulfillment of subsistence needs; revenues and costs
Buyers and processors	Gross product revenues and operation expenses (average costs)
Communities	Employment and income
Consumers of groundfish products and other members of the general public	Product prices, quality and availability; non-consumptive and non-use values
Fishing vessel safety	At-sea fatalities and injuries
Management and enforcement costs	At-sea and dockside monitoring and enforcement costs; practicability and administration costs

Precise predictions of the associated effects of the bycatch reduction alternatives are not possible due to data limitations. Therefore, this socioeconomic impact assessment focuses on providing a qualitative description of the economic issues, the cause and effect relationships, and the direction and general magnitude of the anticipated economic impacts of each alternative.

To identify plausible and potentially significant impacts resulting from the alternative programs, this analysis relies heavily on best professional judgement of various economic analysts and fishery management professionals. The analysis draws on records of previous experience with similar NMFS and Council management actions as represented in other NEPA environmental reviews (EISs/EAs), peer-reviewed scientific journal articles, and other previously reviewed and screened documents. This reference literature summarizes existing knowledge of impacts based on accepted scientific standards. When it is possible to draw potentially competing interpretations from the existing literature, the variations in the patterns of impacts and responses are described.

The analysis also relies on a limited number of informant interviews. These interviews were conducted with government agency personnel and other individuals familiar with the groundfish fisheries. This expert knowledge was used to supplement the available documentary record of the range of likely socioeconomic impacts of the management measures in each alternative and to determine how the effects of the alternatives considered are likely to deviate from those described in existing case studies and reports.

4.4.1 Social and Economic Impacts of Alternative 1 (No Action/Status Quo)

4.4.1.1 Effects on Fishers' Incentives to Reduce Bycatch

Under the current management regime, quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely.

However, in comparison to a race for fish allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards. The cumulative bimonthly trip limits effectively guarantee each limited entry permit holder access to his or her trip limit in each two-month period, and there is little that one fisher can do to directly affect the catch of others within that period.

In a typical race for fish situation, vessels compete with each other for shares of the overall quota of fish. Because cumulative trip limits have reduced the race for fish in the West Coast groundfish fisheries, fishers do not necessarily place themselves at a competitive disadvantage by adopting fishing practices that reduce the catch of unwanted fish (e.g., fish with low value or overfished species). For example, a vessel can take the time to move out of an area when it experiences high catches of unwanted species without the threat that other harvesters will cut into its share of the total quota. Similarly, taking shorter tows and sets to check for incidence of unwanted species does not penalize a vessel in terms of the amount of fish it may eventually catch. Finally, under the cumulative trip limit system a vessel can modify it gear and fishing strategies to reduce unwanted catches — for example, using smaller trawls or trawls with large mesh escape panels — without fearing that the possible reduced catch per effort will reduce its overall catch and revenue.

4.4.1.2 Effects on Commercial Harvesters

This section provides a brief overview of economic conditions of fish harvesters under the *status quo*. The overview describes the groundfish harvests in terms of landed pounds from major species groups and provides a brief summary of participation by limited entry and open access vessels in the groundfish fisheries through 2002.

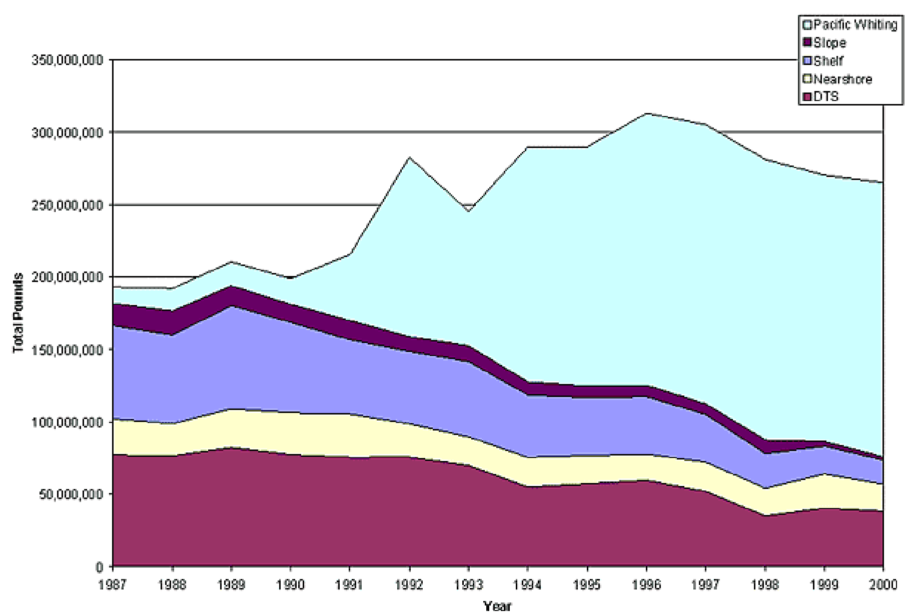
Table 4.4.2. Exvessel revenues in the groundfish fisheries (excluding the Pacific whiting fishery) by sector, 1999-2002.

Sector	1999	2000	2001	2002
	Exvessel Revenues ($1,000)			
Limited Entry Non-Trawl	9814	10946	8693	6852
Limited Entry Trawl	32,634	34,032	28,257	24010
Open Access (All)	7,762	8,732	8,254	7161
Total	**50,210**	**53,710**	**45,205**	**38023**

Source: Data provided by the Pacific Coast Fisheries Information Network (PacFIN, 11/2003).

Figure 4.2 illustrates the increase in total West Coast commercial groundfish

Figure 4.2. Landings in the groundfish fisheries by species group, 1987-2000. Source: PacFIN data 2003.



landings from 1987 to 1996 when landings peaked at over 300 million pounds. An important feature of this graphic is the increase in landings of Pacific whiting while landings of other West Coast groundfish (primarily rockfish and deepwater flatfish species) declined by nearly 50%. This steep decline in non-whiting groundfish landings has affected a much larger segment of the commercial groundfish fleet; only a few dozen vessels actively harvest whiting, while hundreds target other groundfish species. The decline in non-whiting landings has been driven by declining stocks of major target species, primarily several rockfish species that have been declared overfished.

The decline in landings of non-whiting groundfish has had a significant adverse economic impact on a number of harvesting sectors in the past. Table 4.4.2, which focuses only on the most recent years of 1999-2002, shows exvessel revenues in the West Coast groundfish fisheries increased in 2000 by 7% from 1999 levels, then dropped by 16% in 2001 and another 16% in 2002. The declines were greater in the limited entry sector than in the open access sector, with non-trawl revenues falling by a greater percentage than trawl revenues. The non-trawl sector targets higher-value species than the trawl sector (on average), and restrictions on shelf rockfish and sablefish hit that sector harder.

Decreased earnings in the groundfish fisheries have led to an overall decline in the number of vessels participating in the groundfish fisheries, but there are significant differences in participation trends across sectors. Figure 4.3 shows limited entry fixed-gear vessel participation from 1999 through 2002. During the four year period, the number of unique limited entry vessels participating in the groundfish fishery declined from 302 in 1999 to 204 in 2002 in response to various regulatory and resource changes. Reduced shelf rockfish trip limits and sablefish allocations were one cause. Declines in participation have been most noticeable during the summer months—in the July-August period the number of participating vessels declined from 242 to 142. The fact that participation in the shoulder seasons has not declined over the four year period suggests that the decline primarily involves part-time vessels, and that full-time vessels are continuing to participate. The establishment of a sablefish endorsement, the tier system, and ability of limited entry fixed gear vessels to stack permits have facilitated a reduction in fleet capacity.

Figure 4.3. Limit entry fixed-gear vessel participation by period and year, 1999-2002. Source: PacFIN data 11/2003.

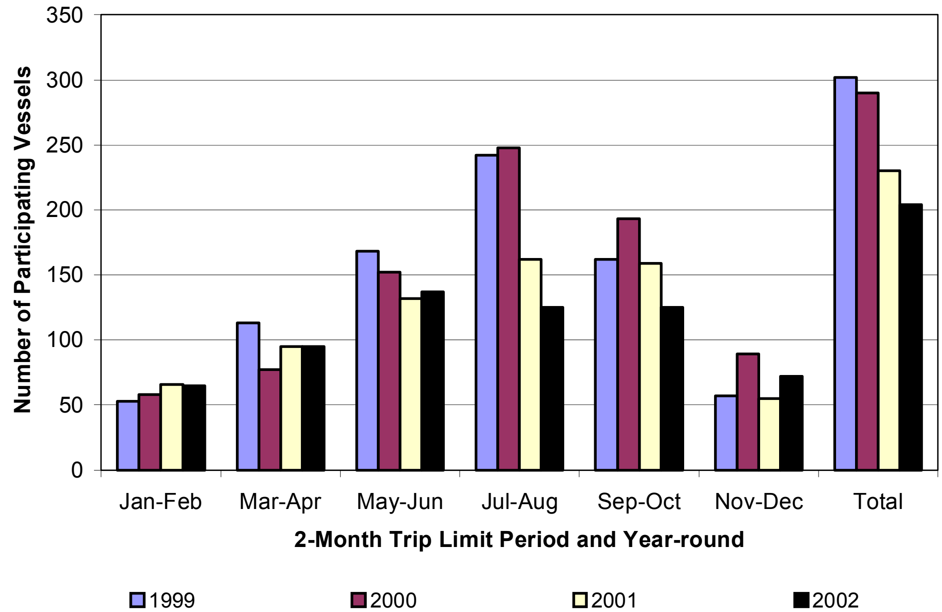
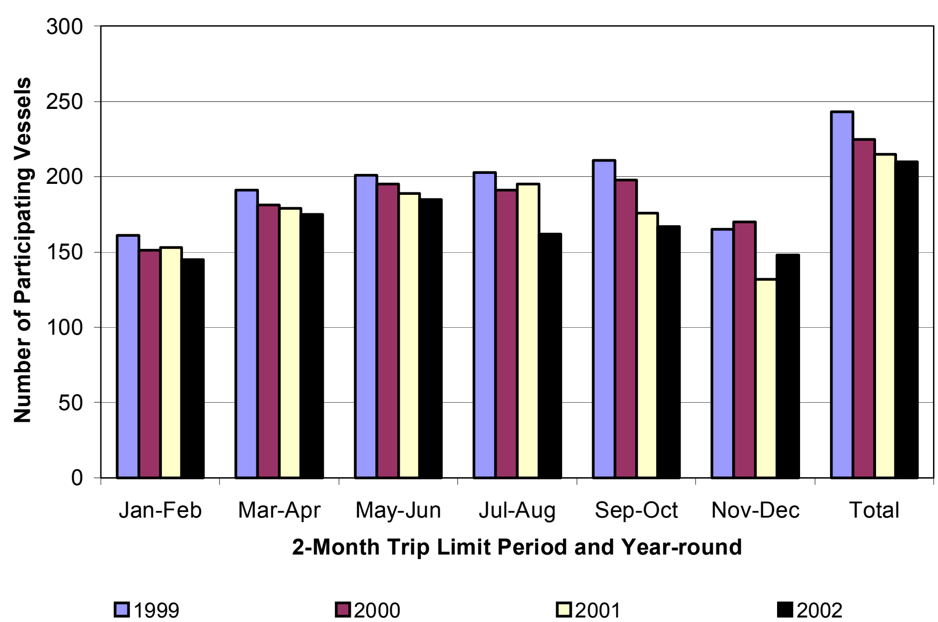


Figure 4.4 shows the participation pattern of limited entry trawl vessels, except those vessels participating exclusively in the Pacific whiting fishery.

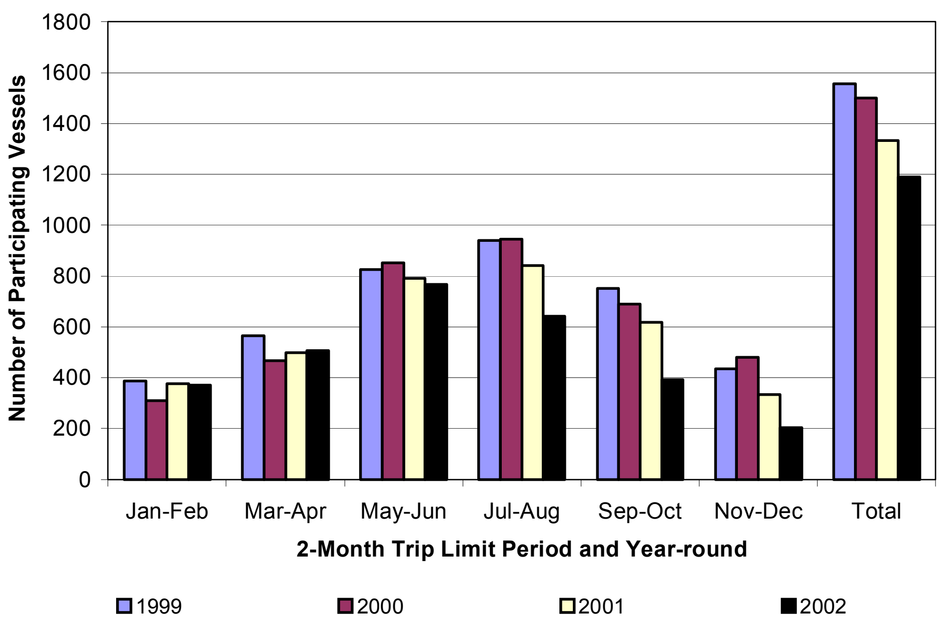
Figure 4.4. Limited entry trawl vessel participation by period and year, 1999-2002, excluding whiting-only vessels. Source: PacFIN data, 11/2003.



Participation by the non-whiting trawl sector is spread out more evenly over the six two-month periods in comparison to the participation seen in the fixed gear sector. While there has been a decline in participation by the non-whiting trawl sector during the four year period, the decline is relatively small. However, the trawl buyback program approved in late 2003 eliminated 92 trawl permits. This means a larger decrease is expected in 2004 and future years.

Figure 4.5 shows participation in the open access sector of the West Coast groundfish fisheries. The pattern here is similar to that seen in the limited entry fixed gear sector, with higher levels of participation during the summer months, but some level of participation throughout the year. Overall, the decline in participation is less pronounced than the decline seen in the limited entry fixed gear sector. Nevertheless, there has been a substantial movement of vessels in the directed open access sector into other fisheries or out of fishing altogether.

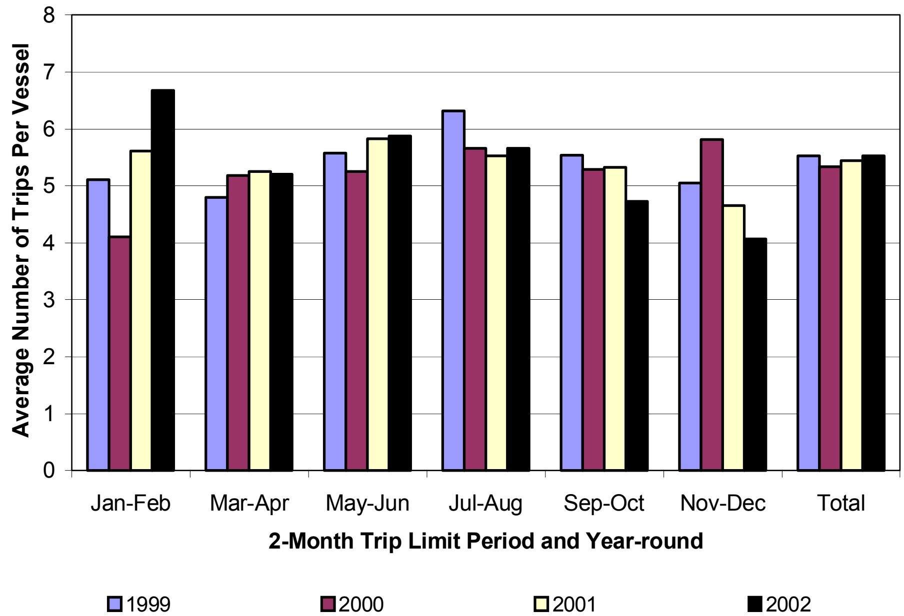
Figure 4.5. Open access vessel participation by period and year, 1999-2002. Source: PacFIN data 11/2003.



Despite the decline in the number of vessels participating in the groundfish fisheries, capital utilization rates continue to be low for all sectors of the commercial groundfish fishery. In 2000, analysts estimated that 9% of the limited entry fixed gear vessels could harvest all of their sablefish allocation and 12% of the vessels could harvest the non-sablefish components of the fishery (PFMC, 2000). For the limited entry trawl fishery, it was estimated that only about 27% to 41% of the existing fishing capacity was needed to catch and deliver the shoreside harvest, and 6% to 13% of the open access vessels could take that groundfish allocation.

Figures 4.4.6 - 4.4.8 show the average number of distinct fishing trips of vessels participating in the same three general sectors (limited entry fixed gear, limited entry trawl and open access) within each two-month trip limit period. The number of trips within each period may be an indicator of the effects of declining trip limits on participating vessels. It is presumed that, if the number of trips that vessels take within a trip limit period is low, there is a greater likelihood that discards will occur and that higher trip limits will lead to reductions in discards. For example, if vessels are able to take only one trip during the two-month period, it is likely that discards due to trip limit overages will occur for many of the

Figure 4.6. Average number of trips/landings per limited entry trawl vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.

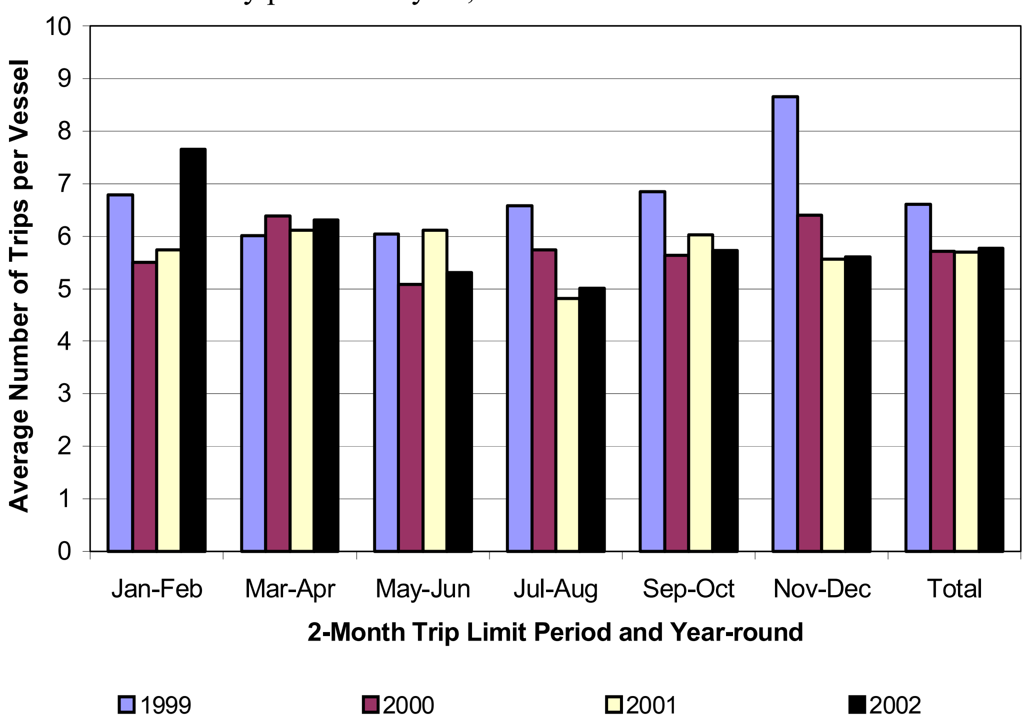


species. If vessels are making 3 or more trips during a period, discards due to overages may be a smaller percentage of total landings. In fact, the data show that in the limited entry sectors trips per vessels have remained relatively constant throughout the four year period — ranging in most cases between five and six for both sectors. While these data suggest that the amount of trip limits, particularly for target species, may not be a major factor leading to higher bycatch levels, additional analysis of trip level data of individual vessels is necessary before definitive conclusions can be reached.

In terms of projecting future socioeconomic effects of continuing the *status quo*, the general downward trend in landings, exvessel revenues, and vessel participation in the groundfish fisheries is expected to persist. Some displaced fishers may switch to non-groundfish fisheries. A substantial number of groundfish vessel owners already derive a substantial portion of their income from other fisheries. Many vessel owners and captains 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 (OCZMA, 2002). These fishers are likely to recover some portion of the revenue previously generated from groundfish fishing. However, many of these alternative fisheries are already fully exploited. Furthermore, it is probable that some displaced vessel owners will have difficulty relocating their operations given the limited access programs that have been implemented in West Coast fisheries and other U.S. fisheries. In addition, some boat owners may not be capable of shifting into other fisheries without significant additional capital outlays, while others may face increased costs and uncertain markets if they are forced to shift their operations away from the communities in which they live.

Given that opportunities for displaced fishers to recover their lost harvest and income may be limited, and that the groundfish fisheries are already characterized by limited profitability, it is likely that some displaced fishers will be forced to sell out or retire. It is uncertain how active the West Coast or nationwide market is for the types of vessels, gear, and other investment capital used in the groundfish fisheries. However, it is possible that the West Coast market for these assets could quickly be flooded, thereby depressing the immediate resale value of fishing equipment and vessels. Furthermore, the increasingly restrictive regulatory environment for groundfish fisheries may diminish the long-term investment value of the vessels and permits owned by displaced fishers who opt to continue fishing. This could create an economic hardship for those fishers who

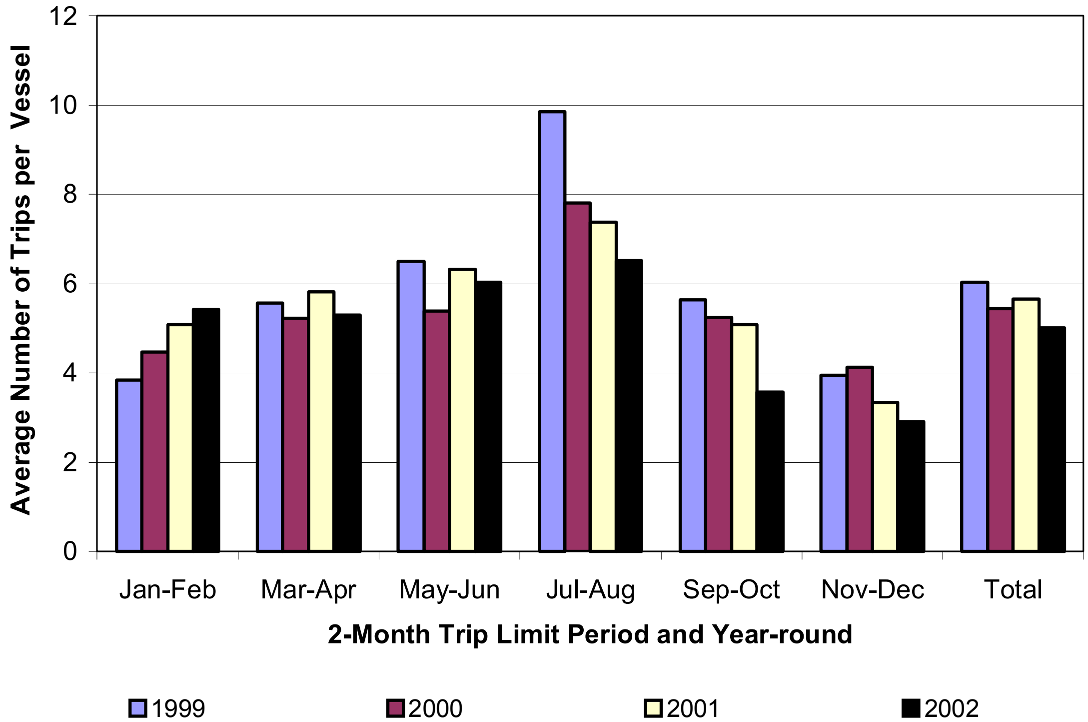
Figure 4.7. Average number of trips/landings per limited entry fixed gear vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.



are relying on money earned from selling their fishing assets to supplement their retirement funds.

Transfer of effort from groundfish to non-groundfish fisheries could also indirectly create economic hardship in the form of reduced profitability for fishers already engaged in non-groundfish fisheries. The majority of fisheries along the West Coast and other areas of the U.S. are fully utilized. If fishers in the groundfish fisheries were to shift their effort to other fisheries, catch per unit of effort and individual harvest for non-groundfish fishers would likely decline due to the intensified fishing pressure on fish stocks.

Figure 4.8. Average number of trips/landings per open access vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.



4.4.1.3 Effects on Recreational Fisheries

Recreational fishing has been part of the culture and economy of West Coast fishing communities for more than 50 years (PFMC, 2003d). Along the northern coast, recreational fishing traditionally targeted salmon, but rockfish and lingcod often provided a bonus to anglers. The estimated number of recreational marine anglers in Southern California was two and a half times the number in the next most numerous region, Washington state. While the bulk of recreational fishers in all areas were residents of those areas, a significant share were non-residents. Oregon had the greatest share of non-resident fishers at more than one-fifth of total ocean anglers (PFMC, 2003d).

Recreational fishing in the open ocean has generally been on an increasing trend since 1996; however, charter effort has decreased while private effort increased during that period (PFMC, 2003d). 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 around 1996, when salmon seasons were shortened in response to reduced salmon abundance. Groundfish are both targeted and caught incidentally when other species, such as salmon, are targeted. While the contribution of groundfish catches to the overall incentive to engage in a recreational fishing trip is uncertain, it seems likely that the possibility or frequency of groundfish catch on a trip adds to overall enjoyment and perceived value of the trip.

In terms of projecting future socioeconomic effects of Alternative 1, the general downward trend in recreational landings is expected to persist due primarily to the long-term nature of efforts to rebuild overfished rockfish stocks. This decline is expected to have a negative effect on the value of the groundfish fishing experience and may induce some anglers to either choose not to fish or to target other species. Opportunities for recreational fisheries to shift some of their effort away from groundfish resources towards other resources may be limited.

In recent years, recreational fishery catches and catch rates of some overfished groundfish (such as bocaccio) have greatly exceeded expectations, resulting in fishery closures for the first time. The validity of recreational catch estimates has been questioned, and the West Coast recreational fishery monitoring program has recently been modified to improve the precision and timeliness of recreational catch data. Data that become available over upcoming years could indicate that recent catch estimates have overestimated or underestimated recreational harvests, especially in California's large recreational fisheries. If recent recreational catches are determined to have been lower than previously believed, greater fishing opportunities would be likely in the future. If recent catches are found to be higher than previous estimates, recreational fishing opportunities could be further restricted. At this time, either scenario is plausible.

Another confounding factor is what has become known as the rebuilding paradox. As an overfished stock increases in abundance, it becomes more likely some of those fish will be caught, unless fishing effort is reduced. Depending on the particular rebuilding strategies, this could lead to even greater restrictions in the future. Given the data limitations and speculative nature of future management actions, it is impossible to quantify impacts.

4.4.1.4 Effects on Tribal Fisheries

Four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish (PFMC, 2003d). The primary groundfish species targeted by Tribal fisheries are sablefish and Pacific whiting. Tribal fishers also take small amounts of black rockfish in their *USUAL AND ACCUSTOMED FISHING*

AREAS. The Tribes, NMFS, and the States have negotiated formal allocations for sablefish and Pacific whiting. In addition, the Tribes' anticipated black rockfish catches are acknowledged when the Council makes its annual harvest recommendations. There are also several groundfish species taken in Tribal fisheries for which the Tribes have no formal allocation.

In most recent years, Pacific whiting accounted for the bulk of tribal groundfish harvest tonnage (PFMC, 2003d). In 1999 and 2000, 32,500 mt of whiting was set aside for treaty Indian tribes of the U.S. OY of 232,000 mt for 2000. In 2001 and 2002, the whiting OY was reduced 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. To date, only the Makah tribe has fished for Pacific whiting.

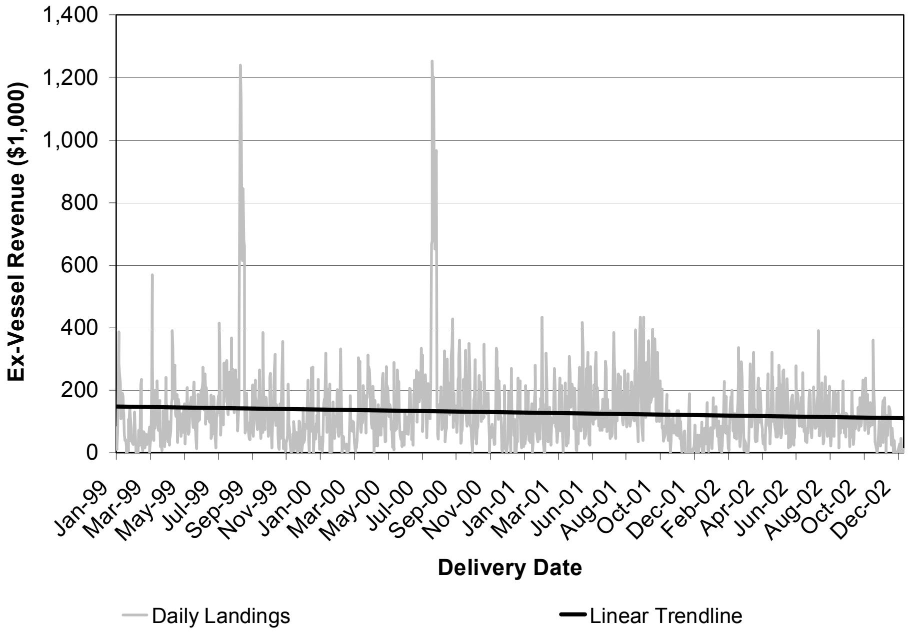
In terms of exvessel revenue, sablefish landings provided well over half of total tribal groundfish revenue each year, except 1998, 1999 and 2002 (PFMC, 2003d). Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery. This portion of the allocation tends 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 among the tribes according to a mutually agreed-upon allocation scheme.

The future socioeconomic effects of continuing the *status quo* on tribal fisheries are difficult to predict. The expected continuing downward trend in the OY specifications, especially for overfished rockfish, may result in smaller tribal groundfish opportunities. On the other hand, the sliding scale methodology used to determine the treaty Indian share of Pacific whiting is the subject of ongoing litigation (PFMC, 2003d). The outcome of this litigation and its subsequent effects on tribal participation in groundfish fisheries are uncertain.

4.4.1.5 Effects on Buyers and Producers

One of the primary goals of the West Coast Groundfish FMP is to ensure a steady flow of fish to buyers and processors throughout the year. This section examines flows of non-whiting groundfish to buyers and processors and attempts to determine the impact of two-month cumulative trip limits.
Figure 4.4.9. shows ex-vessel value of West Coast groundfish landings (excluding Pacific whiting) from 1999-2002. While the data reflect a general downward trend in revenues, they also show that there is a relatively steady overall flow of groundfish landings. In other words, the management regime appears to be relatively successful in maintaining a steady flow of product to seafood processors. It should be noted that fishery-wide data may mask variation in product flow to individual processors.

Figure 4.9. Value of Daily Landings of Groundfish (Excluding Pacific Whiting), 1999-2002. Source: PacFIN.



However, data also suggest that large buyers of groundfish have been hit hard by decreases in groundfish harvest. There was a 36% decline in buyer counts between 1995 and 2000 for those entities where groundfish was greater than 33% of their purchases and total purchases were greater than $10,000 (OCZMA, 2002). The number of buyers with total purchases greater than $1.5 million decreased by 56%.

The precipitous decline in the number of business entities is due both to reduced deliveries of groundfish and the overall consolidation within the processing industry (OCZMA, 2002). The buyer/processor sector has become quite concentrated, with approximately 5% of the buyers responsible for 80% of purchases (PFMC, 2003b). 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% bought from trawl vessels.

This trend of consolidation in the processing sector is expected to continue. As the amount of target species delivered to buyers and processors continues to decline, we would expect higher average costs in this sector because of the reduction in the overall level of production. Fixed costs (i.e., costs that do not change with the level of production, such as loan repayments, general office and accounting expenses, and insurance costs) will be allocated to a smaller amount of product, thereby raising the average cost per unit of product. The variable costs of processors and buyers may also increase under a continuation of the *status quo*, as the reduction in supply of fish is likely to put upward pressure on exvessel prices. These cost increases will be larger for those processors and buyers that are most dependent on groundfish. Smaller operations will probably be more affected by changes in landings than larger buyers because smaller buyers are relatively less diversified in the range of species handled. As average costs per unit of production rise, it is possible that they will exceed the value of production and lead to a temporary shutdown or permanent closing of some firms.

An additional problem that processors may face if landings decline is the maintenance of a skilled workforce (Parrish et al., 2001). Diminished work opportunities could diminish processors' ability to attract and maintain a skilled workforce. This could lead to either increased costs related to less efficient workers or additional expenditures to recruit or retain skilled workers.

4.4.1.6 Effects on Communities

The groundfish fisheries have historically provided West Coast commercial harvesters and processors with a relatively steady source of income over the year, supplementing the revenues earned from more seasonal fisheries. By maintaining year-round fishing and processing opportunities, the two-month cumulative trip limits have promoted year round employment in coastal communities. However, the downward trend in revenues caused by lower catch limits and area closures has had a significant negative economic impact on local businesses that are directly or indirectly involved in and are supported by the groundfish fisheries. In particular, the decrease in groundfish catches has had a direct and significant negative impact on individual fishing enterprises. Fishery participants have suffered from a loss of earning potential, investment value and lifestyle. Some fishing operations have been forced to change fisheries or leave the industry. The groundfish crisis has also had a significant effect on the shoreside part of the industry (Chambers, 2002). Included are individuals or firms that process, distribute, and sell fishery products, and enterprises that provide goods and services to the fish-harvesting sector, such as chandlers, gear manufacturers, boatyards, tackle shops, bait shops, and insurance brokers. While the percentage of business derived from the groundfish fisheries may be relatively small for some of these firms, any permanent loss of income during this extended period of stagnation in the U.S. economy could affect their economic viability.

On the other hand, when examined from a community frame of reference, the economic contribution of the harvesting and processing of groundfish fishery resources to the total economy of even small coastal communities is diluted by the relative scale of other economic activities, such as tourism and the wood products industry. Nevertheless, the finding that relatively few persons would be negatively affected economically, and the overall economy of a community would not be significantly affected, does not lessen the economic hardship that reduced earnings or loss of a job would create for some fishers and their families.

Those who have become unemployed face the social and psychological costs of job loss. Individuals who lose their jobs typically experience heightened feelings of anxiety, depression, emotional distress, and hopelessness about the future, increases in somatic symptoms and physical illness, lowered self-esteem and self-confidence, and increased hostility and dissatisfaction with interpersonal relationships. In addition, both spouses and children of such individuals are at risk of similar negative effects. Families may find it difficult to pay bills and afford transportation, health care, and even food and clothing. The results of this financial strain may be high levels of psychological distress among some family members as well as an increase in physical health problems.

In addition to economic losses associated with declines in landings and revenues, there has been the loss of lifestyle to contend with. It is likely that enjoyment of the lifestyle or work itself is an important motivation for fishing among fishery participants. Moreover, some individuals may be motivated to fish for a living by a long-term family tradition. The loss of fishing-related jobs has caused some individuals to abandon the fishing lifestyle. A decrease in the economic viability of the commercial fishing lifestyle has, in turn, diminished the influence of local maritime culture in some communities. Groundfish fisheries are a historically important component of an industry that is deeply intertwined with the social and cultural resources of some coastal communities. For example, the Newport Beach dory fishing fleet, founded in 1891, is a historical landmark designated by the Newport Beach Historical Society.

It is also important to recognize that fishing communities are typically dynamic and continually adapting to change (Gilden, 1999). Despite reductions in groundfish fisheries, other substantial and well managed fisheries remain available to West Coast fishers: Dungeness crab, sardines, Pacific shrimp and albacore tuna (OCZMA, 2002). Many commercial groundfish fishers have already diversified their fishing operations to include these non-groundfish fisheries. Processors, wholesalers, distributors, and brokers are obtaining their groundfish from other sources or have looked for substitute products. This period of transition for the communities involved in groundfish fisheries has been eased by Congressional appropriations for economic adjustment and recovery programs. In 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon, and Washington to mitigate the effects of the groundfish crisis. While this level of government assistance is unlikely to continue, coastal communities are expected to continue to find ways to successfully adapt to contracting groundfish fisheries, although many more individual businesses involved in these fisheries will likely face economic hardship and possible bankruptcy.

4.4.1.7 Effects on Consumers of Groundfish Products

By spreading out fishing more evenly over the year, cumulative trip limits allow buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers and keeping consumer demand high. The decline in rockfish landings in the groundfish fisheries has probably had a minimal effect on consumers of groundfish products because of the availability of substitutes for West Coast groundfish products in the regional food distribution (PFMC, 2003d). Most supermarkets and restaurants do not rely on local supplies to stock their shelves or prepare menus (although some retail or restaurant patrons may place a premium on knowing the product they are purchasing is locally caught (Parrish et al., 2001)). Locally caught products that are no longer available are replaced with close substitutes obtained from elsewhere in the global supply chain. Although rockfish caught in West Coast fisheries are considered to be of high quality and are valued in West Coast fresh markets, similar products from South America, Mexico, Canada, or Alaska can substitute for West Coast production.

4.4.1.8 Effects on Fishing Vessel Safety

Some gains in fishing vessel safety are at least partially realized under the *status quo*. Cumulative landings limits provide fishers with the opportunity to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. Low earnings on the part of individual harvesters limit funds for maintenance and safety equipment. Poor maintenance, bad weather, and a desperate need to fish may to lead to significant incidence of injury and losses in life and capital (Young, 2001). In addition, 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 discouraged 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). To the extent that the groundfish crisis will deepen in the future, these negative effects on fishing vessel safety are likely to continue.

4.4.1.9 Effects on Management and Enforcement Costs

The current management regime results in a management process that is contentious, difficult and expensive. With an excessively large fleet and relatively restrictive management measures, violations are likely. Consequently, enforcement costs will be high. In addition, as fishers attempt to maintain a livelihood, they exert pressure to set harvest levels as high as possible and to allow fishing to continue as long as possible. The same pressures that induce managers to maintain high quotas create incentives for fishery scientists and concerned environmental advocates to urge for more precise stock assessments and catch monitoring. NMFS maintains a risk-averse management policy, which means that greater uncertainty regarding the status or productive capacity of a stock or stock complex corresponds to greater caution in setting target catch levels. Reducing uncertainty requires more expensive data collection and analysis systems. NMFS and PSMFC spent nearly $6 million on these activities in 1999 (the states and PFMC spent additional money). NMFS estimates that it will need nearly an additional $13 million to satisfy its highest priority needs in responding to the current groundfish crisis. If granted, research and monitoring costs would increase to about $20 million, nearly half the value of the non-whiting groundfish fishery.

Several factors influence the cost of managing the West Coast groundfish fishery. NMFS conducts scientific surveys to track abundance trends for major groundfish stocks. The trawl logbook program is administered by the States of Washington, Oregon, and California, in conjunction with PSMFC. The States maintain the reporting system for commercial fishery landings and contribute to monitoring recreational groundfish catches. Commercial landings data are compiled in the Pacific Fishery Information Program, or PacFIN, and recreational statistics in the RecFIN program. The NMFS West Coast groundfish observer program contributes data on catch and discards, and state employees sample commercial landing to estimate species composition. This and other information is analyzed in comprehensive stock assessments prepared by federal, state, and academic scientists. An extensive stock assessment review process provides public and scientific peer review of these assessments. Much of the Council's meeting schedule is devoted to reviewing groundfish stock assessment information, developing harvest level recommendations, developing management measures consistent with harvest levels and goals and objectives of the groundfish FMP, and monitoring the pace of groundfish fisheries over the course of the year. Typically, information is scarce, which increases the amount of discussion, debate, and analysis relating to multiple management issues. The budgets of many state resource management agencies have been shrinking for several years, and federal funding for NMFS and the Council have not kept pace with the increasing complexity of the management program. Much of the complexity is the direct result of two fundamental policies: maintaining year-round fishing and marketing opportunities, and holding monitoring and other information costs as low as possible. For example, the recent trawl buyback program has eliminated 91 vessels from the fleet. The NMFS bycatch model tracks landings by every trawl vessel and projects how each vessel is expected to respond to changes in trip limits and other measures. Participation by vessels that remain in the fishery will undoubtedly change, in part due to increases in trip limits and in part due to changing ownership as some owners of eliminated vessels reenter the fishery by purchasing vessels that were not bought out. This will add an increased level of uncertainty and complexity in both the trip limit projections and bycatch projections until a level of stability is reestablished.

Technological developments are expected to mitigate the rate at which the management costs for the groundfish fisheries will escalate. For example, on

January 1, 2004, a Vessel Monitoring System (VMS) was implemented for the limited entry sector of the groundfish fishery. In other regions of the U.S., VMS has proven to be an effective, cost-saving technology for the monitoring and enforcement of large restricted areas over great distances. A VMS is an automated, real-time, satellite-based tracking system, operated by NMFS and the U.S. Coast Guard, which obtains accurate geographic position reports from vessels at sea. The cost of VMS transmitting units has decreased as new technologies have emerged. At this time, VMS transceiver units range in price from approximately $800 to $5,295 per unit, installed (PFMC, 2003e). The more expensive units allow two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel.

VMS does not replace or eliminate traditional enforcement measures, such as aerial surveillance, at sea patrol boats, landing inspections, and documentary investigation (PFMC, 2003e). Traditional enforcement measures may need to be activated in response to information received via the VMS. However, VMS positions can be efficient in identifying possible illegal fishing activity and can provide a basis for further investigation by one or more of the traditional enforcement measures. In doing so, it makes certain activities of investigating officers more cost effective because less time will be spent pursuing false trails and fishing operators who are following the rules. Furthermore, VMS positions in themselves can also be used as the basis for an enforcement action.

Another major benefit of VMS is its deterrent effect (PFMC, 2003e). It has been demonstrated that if fishing vessel operators know that they are being monitored and that a credible enforcement action will result from illegal activity, then the likelihood of that illegal activity occurring is significantly diminished. VMS transmitters are required for all limited entry groundfish vessels as of January 1, 2004.

4.4.2 Social and Economic Impacts of Alternative 2 (Larger trip limits - fleet reduction)

This alternative examines the economic effects of increased trip limits achieved by reducing the number of trawl permits by 50% from the 2002-2003 level.

This alternative was developed based on the central theme of capacity reduction in the Council's *Strategic Plan for Groundfish*. In the time since this alternative was put forward, a major capacity reduction program has been implemented, reducing the number of active limited entry trawl permits by roughly 35%. This fleet reduction was in the form of a vessel buy-back program that eliminated the purchased permits and permanently prohibits those vessels from fishing anywhere in the U.S. Congress authorized a loan that the commercial groundfish industry must repay. The goal of reducing the fleet by 50% has not been fully achieved;

however, it is doubtful that another trawl fleet reduction program will be undertaken in the near future unless Congress authorizes additional funding.

This fleet reduction will have major effects on the economic and social conditions of the fishing industry throughout the West Coast, and most of those effects have not yet been observed. In many ways, this alternative is now much more similar to Alternative 1. It is not certain that cumulative trip limits will increase by the same percentage; new trip limits will be calculated based on the NMFS *BYCATCH MODEL* and will likely change over time as remaining vessels establish new fishing patterns. Thus, this buyback program does not fully equate to the fleet reduction measures proposed under Alternative 2.

4.4.2.1 Effects on Fishers' Incentives to Reduce Bycatch

Capacity reduction is usually pursued for reasons other than reducing bycatch, such as increasing the level of fishery profits (Pascoe, 1997). As such, effort reduction is generally not considered a bycatch management policy per se. However, reducing the level of effort in the groundfish fishery and increasing trip limits are likely to have substantial beneficial effects on the level of bycatch. In a study of West Coast groundfish, discard rates were found to vary inversely with the harvest amount of the trawl trip limits imposed (Pikitch, 1988).[1/] This finding suggests that if trip harvest limits were increased systematically with a reduction in fleet capacity, we should see a decrease in the rate of regulatory discards for overfished and target groundfish species. In addition, a reduction in the fleet size can help in developing interest in the fishery's future and in enabling fishers to deal collaboratively and constructively with bycatch problems (Young, 2001).

Generally, capacity reduction in most forms reduces the need for other controls that may lead to regulatory bycatch in particular. Non-regulatory bycatch of groundfish may also be reduced if there are fewer boats to supply market demands. If there are delivery limits imposed on harvesters by processors, the reduced number of vessels is expected to result in an increase in those limits.[2/]

4.4.2.2 Effects on Commercial Harvesters

The Council's Science and Statistical Committee estimates that the Pacific groundfish trawl fleet would need to be reduced by 60-90% to achieve maximum

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1/ When the study by Pikitch (1988) was conducted, trip limits in the West Coast groundfish fisheries restricted landings for an individual fishing trip. It is likely that the study's conclusions apply to the current cumulative two-month trip limit, although this remains an empirical question.

2/ Processors may limit the amount of each species they are willing to accept in a given delivery in order to assure an even flow of product into the processing unit.

economic efficiency, where the marginal costs of production are equal to the marginal revenue. The Council endorsed a fleet reduction of at least 50% as a first step towards addressing overcapacity. This reduction would eliminate some (not all) of the extra capacity in the fishery and restore the fleet to some minimum level of profitability. In economic parlance, this implies that commercial harvesters would be able to capture at least some portion of their producer surplus or economic rent (which under the *status quo* has not been feasible). In part, this increase in profitability is derived from the reduction in excess capital and labor that is embodied in an overcapitalized fleet. If excess capital is removed from the fishery and trip limits are increased, we would expect to see increases in both average and overall net revenues to harvesters. The increase in trip limits would be expected to lead to increases in retention of fish caught. Higher catch levels (assuming prices remain constant) implies increases in revenues to harvesters remaining in the fishery.

Leipzig (2001) estimated that capacity reduction and the subsequent catch increase for the remaining participants could result in a 69.5% increase in exvessel revenues for the post-buyback trawl fleet. In addition, while overall total landings may stay the same, this alternative would lead to overall reduction in the variable costs to fishers. These cost savings are in part based on the reduction in the number of times an individual vessel catches its trip limit and is obliged to invest crew time in sorting and discarding fish caught over the limit.

NMFS estimates that for every $1.00 that fishers remaining in the fishery pay in buyback payment fees, they will receive $6.80 in additional revenue from the groundfish trawl fishery (Oregon State University, 2003). A trawl industry analysis prior to the buyback referendum (Leipzig, 2001) estimated a return of $22.42 for each dollar spent in fees. A hypothetical example illustrates how these estimates were derived. Suppose that a vessel in the pre-buyback fleet annually lands 200,000 lbs of groundfish, for which it earns $100,000 in exvessel revenue. The fixed costs and variable costs of the operation are $45,000 and $50,000, respectively. The net revenue of this vessels can be calculated to be $5,000. Now suppose that after the buyback the annual landings of the vessel increase to 400,000 lbs, and exvessel revenue increases to $200,000. The vessel's fixed costs remain at $45,000, and its variable costs double to $100,000. In addition, the vessel incurs a buyback repayment fee of $20,000. In this hypothetical example the vessel's net revenue grows to $45,000, nearly a 10-fold increase.

The magnitude of total economic benefits that could accrue to the Pacific coast trawl fishery from this alternative will also be affected by the distribution of vessels that retire and those that remain in service. As indicated in PFMC (2004), the number of vessels, vessel landings and ex-vessel values are unevenly distributed along the Pacific Coast. Therefore, if a predominance of vessels retires from areas of low ex-vessel value, net economic value increases to the fishery may be higher than would be the case if vessels were to retire in ports where ex-vessel values were relatively greater. This conclusion presumes that there will be a shift in landings to areas where ex-vessel values are higher. In addition, the distribution of wealth among those remaining in the fishery and among the communities in which they reside will depend on where (in terms of what port) vessels are retired and where vessels remain.

4.4.2.3 Effects on Recreational Fisheries

Currently, most recreational fishing along the Pacific Coast targets nearshore groundfish species such as black rockfish, lingcod and cabezon. Proposed capacity reduction under Alternative 2 will largely affect shelf and slope fisheries, thus having a limited impact on stocks of fish most frequently targeted by the recreational fleet. As such, Alternative 2 is predicted to result in minimal impact on recreational effort and/or the quality of the trips taken relative to the *status quo*.

4.4.2.4 Effects on Tribal Fisheries

The Federal government recognizes Tribal treaty rights to fish for groundfish and other marine species. The Council fulfills its legal requirement by subtracting Tribal allocations and anticipated harvests before establishing non-tribal harvest allocations, trip limits and other management measures. The trawl fleet reduction program does not apply to tribal vessels. However, tribal fisheries for species other than whiting may be favorably affected if the buyback program results in fewer non-tribal trawl vessels operating in the tribes usual and accustomed fishing areas and fewer groundfish are taken from those areas. Any change from the *status quo* is predicted to be moderate at most.

4.4.2.5 Effects on Buyers and Processors

A reduction in excess fishing capacity and higher trip limits are not expected to significantly affect the total amount of fish that harvesters will deliver to processors. As a consequence, it is unlikely that we would see any price effect on producers (unless harvesters coordinate and, through collective bargaining, demand higher prices from processors). With fewer trawl vessels in the fishery, processors would have fewer boats to schedule for deliveries and offloading. The related reductions in time spent unloading vessels is expected to result in cost savings to the processors. On the other hand, the seafood processors in those ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources. To ensure a steady supply of raw product, processors may bid up ex-vessel prices. Because processors operate in a global seafood market with many substitutes, it is unlikely they would be able to pass on their higher costs to consumers. Consequently, harvesters could capture some of the wealth that was previously retained by processors.

4.4.2.6 Effects on Communities

Depending on the geographic distribution of the remaining fleet, a fleet reduction may be a zero-sum game from the perspective of coastal communities: reduced landings and revenues in some ports may be matched by increases in landings and revenues in other ports (Schloz, 2003). The distribution of the post-buyback fleet under this alternative cannot be predicted because vessels will continue to respond to economic opportunities and management measures throughout the management area. Consequently, the direction and magnitude of many of the economic effects of this alternative on particular coastal communities are uncertain.

If a reduction in fleet capacity with higher trip limits is successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside are expected. As fishers' net revenues increase, we anticipate greater spending on basic goods and services. Increased spending on the part of fishers stimulates the local economy, generating more income, jobs and taxes within the communities. An increase in employment and income can also help avoid certain social costs. With higher trip limits, fishers may be employed more of the year so they may draw less unemployment compensation. In addition, instances of alcoholism and spousal abuse may decline, putting less strain on limited social service support networks (Young, 2001). In 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon, and Washington to mitigate the effects of the groundfish disaster. With improvement in the economic situation of individual fishers, such costs to society could be avoided to some degree (Young, 2001).

On the other hand, some communities may experience a significant reduction in fleet size and a consequent decrease in income, jobs, and taxes. These negative effects may be offset to some extent by the compensation that individuals leaving the groundfish fisheries receive from the buyback program. If these former groundfish fishers invest buyback funds in local businesses, additional economic growth may be generated in the community.[3/] However, if these individuals retire completely and leave the area, the economic impact on the community is likely to be negative.

4.4.2.7 Effects on Consumers of Groundfish Products

Because the decrease in fleet capacity is partnered with an increase in trip limits, it is assumed that total groundfish landings will not change significantly in comparison to the *status quo*. Under these conditions, we would expect to see

3/ In the short-run there may be an increase in social service costs while former participants adjust to their new economic situation.

little impact on consumers of groundfish because the price per unit would not likely change. Moreover, the demand for the two groundfish species most often purchased fresh (rockfish and sole) is highly elastic because there are numerous substitutes for these products. If the prices were to increase for these species, consumers would quickly switch to some other fish or protein product.

4.4.2.8 Effects on Fishing Vessel Safety

Fewer trawl vessels sharing the available harvest means average revenues per vessel will increase. Increases in net revenue to harvesters may lead to reductions in injury and loss of life relative to the *status quo* because of the harvesters' incentives to take fewer risks and use their best judgement in times of uncertain fishing conditions. In addition, higher earnings on the part of individual harvesters would increase funds for vessel maintenance and safety equipment.

4.4.2.9 Effects on Management and Enforcement Costs

A capacity reduction program results in a smaller fleet, and fewer vessels are generally easier and less expensive to monitor if the management of the fishery does not otherwise change. In addition, the fleet is expected to be more profitable — if fishing is profitable, fishers can afford investments in the future of the resource (Young, 2001). For example, they will not have the same incentives to push for maximum quotas as the current overcapitalized fleet does. A profitable fleet can also contribute to management, research and monitoring expenses that help assure the long-term stability of fishery resources. Finally, a smaller fleet may result in a certain amount of self-policing (such as is found in the current Maine lobster fishery). Self-enforcement could reduce to some extent the need for Federal and state enforcement programs.

However, the short term management costs borne by NMFS, the Council, and states would likely not be lessened by Alternative 2, and in fact certain costs would increase. For example, as described in the analysis for Alternative 1, fleet reduction has increased the uncertainty in the bycatch model at least in the near future. Further fleet reduction, as would occur under Alternative 2, would add to that uncertainty and increase management costs accordingly. As budget and personnel increases appear unlikely to keep pace, it is likely the cost will appear primarily as increased workload for agency personnel and the Council.

4.4.3 Social and Economic Impacts of Alternative 3 (Larger trip limits - shorter seasons)

This section examines the economic effects of the use of measures to reduce bycatch by reducing fishing time (shortening the season by 50%), thereby allowing for increased groundfish trip limits. In contrast to Alternative 2, Alternative 3 could be applied to all fishing sectors, including recreational and charter boats.

During the 1997 and 1998 annual management cycles, the Council considered the effects of and alternatives to the year-round fishery policy. The GMT prepared a number of reports and the issues were debated at length by the Council's advisory bodies, particularly the GAP. Several proposals would have revised the trip limit program by either shortening the entire season, establishing a series of shorter seasons, or setting different fishing periods for different vessels. After debating the pros and cons of the various alternatives, the Council decided to retain the policy and the use of trip limits to maintain fishing opportunities.

Recent data suggest that under the status quo, the average vessel makes only three to five fishing trips during a two month period (see Figures 4.4.5 - 4.4.7 in Section 4.4.1). If it is assumed that each fishing trip takes six days, a vessel that makes five trips in a two-month period is only active for 30 days (approximately 1 month) during that period. Therefore, it appears that the current management system leaves many vessels idle during each two-month period. Because vessels currently experience considerable down time during each two-month period, the economic effects of Alternative 3 will differ significantly depending on the way the fishing season is shortened. To clarify these differences, the analysis examines the effects of the following four possible subalternatives:

Subalternative 3a: One six-month fishing season - Condense the fishing year from 12 months to 6 months of continuous operations. Several options under this subalternative are possible — for example, groundfish fishing could begin in January and continue through June. Alternatively, fishing could begin in January and continue through March, then re-open in October and continue through December. The harvest amounts of cumulative two-month trip limits are assumed to double under this subalternative because the number of periods will be 50% of the number under the *status quo*.[4/]

Subalternative 3b: Two six-month fishing seasons - Split the fishing fleet into two groups and allow the first group to fish from January to June and the second group to fish from July to December. The harvest amounts of cumulative two-month trip limits are assumed to double under this subalternative because the number of potential participants in any given period will be 50% of the number under the *status quo*.

Subalternative 3c: Two fleets each with three two-month fishing periods - Split the fishing fleet into two groups and allow each group to fish in alternate two month periods. The harvest amounts of cumulative two-month trip limits are assumed to double under this subalternative because the number of potential participants in any given period will be 50% of the number under the *status quo*.

4/ Trip limits would increase, but it is unlikely they would double, because many vessel operate so far below their capacity. However, the assumption of doubling is used to simplify comparisons of the alternatives.

Subalternative 3d: Two fleets each with six one-month fishing periods - Split the fishing fleets into two groups and allow one group to fish odd-numbered months and the other group to fish even numbered months. The cumulative trip limits would be the same as under the *status quo*, but each vessel would have to catch its limit in half the time.

4.4.3.1 Effects on Fishers' Incentives to Reduce Bycatch

This alternative attempts to reduce bycatch by modifying the temporal pattern of fishing effort. As indicated in the analysis of Alternative 2, discard rates have been found to vary inversely with the harvest amounts of the trawl trip limits imposed (Pikitch, 1988; Methot et al, 2000). Higher trip catch limits result in less regulatory discards for overfished and target groundfish species because harvesters attain their trip limits fewer times in a given year. However, depending on the way that Alternative 3 would be implemented, higher trip limits may or may not occur. If Alternative 3 were implemented in a way that reduced the number of two-month periods in which any permit holder could fish (as in Subalternatives 3a-3c), cumulative two-month trip limits would likely to be higher, and discards would likely be reduced. If, however, the alternative were implemented so that every vessel could continue to participate in every two-month period (as in Subalternative 3d), higher trip limits would be unlikely and there may little reduction in bycatch. However, under all of the subalternatives it is likely that vessels would be able to increase the size of their landings per trip. Higher catches per trip would be expected to result in a lower percentage of discards relative to landed catch.

Some vessels may respond to the shortened groundfish seasons by shifting their effort to alternative fisheries rather than by increasing their effort during groundfish fishery openings. If this occurs, the level of bycatch may decrease due to a reduction in overall harvest levels.

Under Subalternative 3a, it is possible that market gluts could occur during the open months and/or existing processing capacity could be overwhelmed. These situations could drive down ex-vessel prices for certain species and/or lead to refusals by processors to take deliveries of certain species. The result could be an increase in economic discards, i.e., discards that occur even when cumulative landing limits are not attained.

4.4.3.2 Effects on Commercial Harvesters

A combination of higher trip limits and a 50% reduction in the length of the fishing season is expected to lead to an overall reduction in variable fishing costs. With larger trip limits, harvesters would be able to catch larger amounts of fish per trip. In addition, harvesters would be expected to discard a smaller percentage of total catch. The result would be a decrease in the average cost per pound caught (assuming there is no difference in the catchability of fish in various months of the year).

However, the overall impact of this alternative on the costs and revenues of commercial harvesters depends on when individual participants are allowed to fish. According to PFMC (2003d), groundfish has historically provided West Coast commercial harvesters with a relatively steady source of income over the year, supplementing revenues earned from more seasonal fisheries. Although groundfish accounted for only about 17% of total annual exvessel revenue during 2000, groundfish played a more significant role on a seasonal basis, accounting for one-fifth to one-third of monthly exvessel revenue coast wide during April and the three summer months. Flatfish harvest supplied 3%-9% of monthly exvessel revenue throughout the year, and rockfish catch contributed an additional 2.5% - 6.8% to monthly exvessel revenue. Along the northern areas of the West Coast, groundfish has been particularly important just before the start of the December crab fishery. Seasonal closures could disrupt the traditional annual round of fishing activities, thereby reducing the profitability of fishing operations. [5/]

If there are seasonal differences in catchability, Subalternatives 3a-3c could have negative overall impacts on variable harvesting costs. For example, fishers may be unable to fish for certain species at optimal times. Industry sources indicate that several major target species form large aggregations at certain times of the year. Subalternative 3d would be more likely to avoid these negative seasonal effects because all vessels would have some fishing time throughout the year.

Under Subalternatives 3a and 3b, in which each vessel operates for six straight months, it is more likely that vessel operators would be able to be able to find gainful employment during the off season. An individual who is available for six straight months is more likely to be hired than someone with an on-again/off-again schedule as would occur under Subalternatives 3c and 3d.

Under Subalternatives 3b-3d, the opportunity exists for skilled crew members to double their incomes, because they could get positions on two different vessels during the year. However, the number of crew members that work on more than

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5/ If current restrictions on limited entry permit ownership were relaxed, a number of options might become available that would mitigate the effects of Alternative 3 on commercial harvesters. For example, if permit stacking by trawl limited entry permit holders were allowed, a single permit holder and vessel could fish throughout the year. Another option would be for two permit holders to share a single vessel. The effect of this option on fleet size could be similar to that of Alternative 2 (except no buyback fees would have to be paid). Because one of the vessels could be retired or sold, fixed costs for the new operation would equal one-half the fixed costs of the two operations working independently. If all else were equal, the two permit holders could share the cost savings.

one vessel is likely to be equal to the number of crew members that will be unable to find positions on any groundfish vessel.

Under Subalternatives 3b-3d, it is also possible that trawl vessels would increase their participation in non-groundfish fisheries. For example, trawl vessel owners could increase their participation in the open access shrimp fishery during the periods in which they have no limited entry cumulative trip limits. Because there are groundfish bycatch issues in the trawl shrimp fishery, any reduction in bycatch in groundfish target fisheries that occurs under this alternative would be at least partially offset by increases in bycatch in the shrimp fishery.

4.4.3.3 Effects on Recreational Fisheries

The effects of shorter commercial seasons on recreational fishing opportunities is likely to be negligible because total commercial catch will not increase under this alternative. Alternative 3 is not intended to apply to the recreational fishery, but even if the scope of the alternative were expanded to include the recreational fishery, this fishery might not be significantly affected. Recent California state regulations have reduced its recreational groundfish season to as short as six months, and weather conditions in Oregon and Washington often limit the length of the recreational fishing season to around six months. Under Subalternatives 3a and 3b, the six-month closure of commercial fishing could occur opposite a six-month closure of recreational fishing. In this case, it is possible that the recreational fishing experience may be enhanced through higher catch rates.

4.4.3.4 Effects on Tribal Fisheries

The Federal government recognizes Tribal treaty rights to fish for groundfish and other marine species, and the Tribes, NMFS, states and the Council work to coordinate the groundfish management system. The Treaty Tribes typically manage their fisheries similarly to non-treaty fishing periods, with the exception of the Tribal sablefish and whiting fisheries. That is, Tribal regulations typically restrict Tribal hook-and-line vessels to trip limits very similar to those set for the non-tribal open access vessels. Likewise, Tribal trawl vessels are provided trip limits similar to limited entry trawl vessels trip limits. The Tribes are not required to manage in this way, and they might choose to concentrate their fisheries during periods closed to non-Tribal vessels off Washington. This could result in higher exvessel prices for Tribal fishers during those closed periods. However, given all the unknowns about the program design, any effects on Tribal fisheries from this alternative are predicted to be minimal.

4.4.3.5 Effects on Buyers and Producers

The effects of Alternative 3 on buyers and processors also depend on the way the closures are implemented. Increases in trip limits (as is possible with Subalternatives 3a-3c) and fewer vessels making deliveries during any period (as is possible under Subalternatives 3b-3d) would likely have positive economic impacts on buyers and processors. A shortened overall fishing season (as would occur under Subalternatives 3a) could have a negative effect.

Larger trip limits are not expected to substantially affect the total amount of fish that harvesters deliver to processors, although it may be possible to capture a fraction of the total catch that is currently discarded. Any change would be unlikely to cause a price effect for producers. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, depending on the timing and length of a particular platoon's seasons, a 50% reduction in the overall fishing season may result in increased costs to processors due to the fact that they may not be able to as easily control the flow of product throughout the year. Furthermore, processors may be leaving capital idle during the closed part of the year. A closure also has the negative effect of making it more difficult to re-hire filleters and other personnel when fish are again available. Moreover, buyers and processors may have difficulty maintaining markets if product is no longer available year round. Finally, the costs of starting up an idled plant, and shutting down an active plant are significant (BBEDC, 2003).

Another negative effect that a shortened season may have on processors is the flooding of the market for certain species when the season is open. The glut could overburden processing capacity and refrigeration/freezer space and result in waste due to spoilage. However, processing plants typically establish delivery limits to reduce the potential for such problems.

4.4.3.6 Effects on Communities

Community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions (PFMC, 2003). Consequently, the impact of this alternative on coastal communities is uncertain. If higher trip limits were successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside would be expected. As fishers' net revenue increases, greater spending on basic goods and services would be expected. Increased spending on the part of the fishers stimulates the local economy, generating more income, jobs, and taxes within communities. In addition, there would be a general sense of increased comfort and well being on the part of community members.

As indicated in the discussion of impacts on commercial harvesters, Alternative 3 (particularly Subalternatives 3b-3d) could result in a decline in the number of active crew members if the more skilled members seek to work full-time. Displaced crew members would be at least temporarily unemployed. Similarly, if there were a six-month seasonal closure, a large number of unemployed groundfish crew members could flood the job market. To the extent that crew members remain unemployed during the closed season, they are more likely to be a drain on community social services.

4.4.3.7 Effects on Consumers of Groundfish Products

If Alternative 3 were implemented through the use of a six-month fishing and processing season (as under Subalternative 3a), there would likely to be a noticeable negative effect on some consumers of groundfish products. Consumers of fresh or live groundfish would be unable to obtain their fish from the same sources for half of the year. While it is likely that these consumers would be able to substitute other products for fresh groundfish, they would likely experience a decline in consumer surplus. On the other hand, if Alternative 3 were implemented by splitting the harvest sectors into two groups with one group of vessels active at any given time (Subalternatives 3b-3d), there would be few if any noticeable effects on consumers of groundfish products.

4.4.3.8 Effects on Fishing Vessel Safety

The effect of Alternative 3 on safety is uncertain because so much depends on the implementation method. Increases in net revenue to harvesters resulting from increases in trip limits would likely lead to reductions in injury and loss of life relative to the *status quo* because of harvesters' incentives to take fewer risks and use their best judgment in times of uncertain weather conditions. In addition, higher earnings on the part of individual harvesters increase their available funds for maintenance and safety equipment. On the other hand, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish. Seasonal closures can potentially force harvesters to venture out in extreme weather or take other undue risks. This could lead to greater incidence of vessel accident or personal injury. This could be offset to some extent by the reduced overall time a vessel would be at sea fishing for groundfish. Reduced fishing time means less time in potentially dangerous conditions. The adverse effects on safety of human life would be greater for smaller vessels.

If the outcome of this alternative were net declines in revenues in the fishing industry (due to the inability to fish for certain species at optimal times), vessel owners and captains could find it even harder to find, hire and keep qualified crew. While there are many skilled and capable crew members working on West Coast commercial fishing boats, many who once would have been attracted to the industry have become discouraged by the apparent lack of a promising future. Conversely, the industry may attract people who are unable to find work elsewhere and who lack necessary skills and training. Some such individuals are itinerant and do not stay long enough in the industry to be fully trained or invested in vessel operations, including safety. Such individuals are at greater risk of bodily harm to themselves and may unintentionally cause accidents by generally creating unsafe conditions.

4.4.3.9 Effects on Management and Enforcement Costs

The effects of Alternative 3 on management and enforcement costs are uncertain. If Alternative 3 were implemented with a six-month closure of all groundfish fishing and processing (as in Subalternative 3a), some management and enforcement costs would decline because there would be no fishing activity to monitor for 6 months of the year.[6/] Under Subalternatives 3b-3d there would be increased costs to assign permit holders to each group and to assure that groups that are off are not fishing illegally. These higher costs could be offset by the reduced number of vessels and trips that would need to be monitored at any given time.

The ability to predict vessel participation patterns would be greatly compromised by Alternative 3, regardless of which suboption were adopted. Calculation of trip limits would be more complex and contentious because vessel participation could not be accurately predicted. Also, accuracy of inseason monitoring and projections would deteriorate because historic fishing patterns would not provide useful comparisons for new fishing patterns. NMFS and the Council depend on the NMFS bycatch model to determine appropriate trip limits for the limited entry trawl fishery. The model requires an accurate anticipation of vessel fishing patterns for every trawl vessel. Management changes that disrupt fishing patterns erode the model's predictive power by increasing uncertainty.

4.4.4 Social and Economic Impacts of Alternative 4 (Sector catch limits- vessel caps)

This alternative would continue the use of cumulative *TRIP LIMITS* for non-overfished groundfish stocks (as under Alternative 1) but would specify *CATCH LIMITS* for *OVERFISHED* groundfish species. In addition, Alternative 4 would establish specific annual limits on the amount of overfished groundfish that could be caught by each sector. If a vessel reaches an RSQ limit during a period, it must stop fishing for the remainder of that period. If a vessel reaches the trip (retention) limit of a groundfish species that is not overfished, further landings of that species would be prohibited, but the vessel could continue to fish for other species. When a sector reaches an annual catch limit for an overfished species, further fishing by that sector would be prohibited for the remainder of the year. In short, each sector would be responsible and accountable for all overfished (or otherwise restricted) groundfish caught. Nine fishing sectors are identified under the current regulations: limited entry trawl; limited entry longline; limited entry pot; three whiting sectors (catcher processors, motherships and shore-based); open access; tribal; and recreational. However, these sectors could be subdivided

6/ Under Subalternative 3a there is a possibility of increases in illegal fishing activity and the creation of a black market for valuable groundfish species. This could lead to increases in monitoring and enforcement costs.

to create additional sectors. For example, some sectors may be subdivided by geographical area or target species/species group.

4.4.4.1 Effects on Fishers' Incentives to Reduce Bycatch

Under this alternative, every limited entry vessel could continue to discard, but unlike the *status quo*, any overfished groundfish discarded would be recorded and counted against the vessel's catch limit for the period and the sector's annual catch limit. When a sector limit is reached, all vessels in that sector would have to stop fishing for groundfish for the remainder of the year (or until allowed to start again). Under this alternative one sector's harvest in excess of a limit does not affect the fishing opportunity of other sectors. However, the catch of overfished species by individual vessels within each sector can negatively affect other vessels in the sector. For example, a single disaster tow of an overfished species, if observed, could cause an entire sector to be shut down. In this situation, a race for fish could develop in which unobserved vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. However, observed vessels could have larger trip limits for non-overfished groundfish and would thus have incentive to carry an observer, even at its own expense.

Under this alternative, it is clearly in the best interest of all vessels within a sector to reduce the catch of overfished species. However, in the absence of individual limits, there may be economic factors that reduce the incentive of individual vessels to undertake actions to be more selective in what they catch. A vessel captain who undertakes actions to reduce bycatch bears the full costs of deploying more selective gear and searching for cleaner fishing grounds. While some benefits of minimizing the capture of unwanted fish (e.g., less handling time) accrue solely to the individual that incurs these costs, the benefits of avoiding closure of the fisheries to the sector are spread across all vessels. The free-riders that did not adopt more selective fishing methods (or even eschew bycatch reduction methods they use under the *status quo*) may develop a competitive advantage over those that do by incurring fewer operating costs and/or increasing their share of the catch limit. If the free-rider problem resulted in a noticeable redistribution of profits across the sector, no one would be motivated to continue to invest in fishing practices that reduce the catch of overfished species and other unwanted fish. However, only unobserved vessels could be free riders. By establishing individual vessel caps for overfished species, vessels have much greater incentive to avoid those species. The provision for individual vessel caps for overfished species was not initially included in this alternative but was added to increase the effectiveness (and therefore the acceptability) of this alternative. Without this provision, an observed vessel could close a sector just by continuing to fish and discard after reaching his trip limit for an overfished species. In the absence of vessel caps, vessels would be expected to move away from high bycatch areas, and peer pressure could be exerted on those who are reluctant to move. However, without formal constraints, there is always the temptation to bend the rules. If some vessels contribute to the joint bycatch reduction effort while others free-ride, the provision of the collective benefit is less than optimal (Ostrom, 1990). Individual caps for overfished species should effectively prevent the free rider issue, allowing cooperative patterns of behavior to emerge. For example, vessel owners and captains within a particular sector may be more willing to exchange fishing information, such as the location of bycatch hotspots (Gauvin et al., 1996).

The free rider problem would be less in sectors that consists of a relatively small number of participants with common interests, such as the whiting catcher-processor fleet. In such situations, negotiation of voluntary cooperatives might be feasible. The formation of cooperatives could further facilitate collective efforts by industry to reduce bycatch. For example, contractual arrangement among cooperative members may restrict the harvest of target species in areas of high bycatch to member vessels with low bycatch rates as an incentive to promote cleaner fishing practices. Cooperative members could rely on civil law to enforce contract terms. The catcher-processor sector of the Pacific whiting fishery currently uses a cooperative structure to limit salmon bycatch and actively shares information on incidental catch of other species as well.

An added economic incentive for fishers to take collective action to fish more selectively under this alternative is that a portion of the groundfish OY would be reserved for the sector (or sectors) with the lowest bycatch.

4.4.4.2 Effects on Commercial Harvesters

Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch-reducing fishing tactics. A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. On the other hand, healthy stocks could be more accessible if sector bycatch reduction efforts were successful. More desirable species such as yellowtail rockfish are often harvested below cumulative catch limits due to constraints associated with overfished species.

The expanded observer coverage would impose significant additional operating costs on vessel owners, especially if observers carried by vessels under this alternative are funded by a pay-as-you-go system similar that for the processing vessels in the Pacific whiting fishery. In a pay-as-you-go system, the vessel owner is responsible for making arrangement with an observer employment firm, which provides the required observer services, and for paying all associated costs (PFMC, 2003e). Even if the direct costs of increased observer coverage are paid by NMFS, vessels may incur substantial indirect costs. At a minimum, it is likely that observer food costs will be borne by the vessel. Limited bunk space may require vessel operators to reduce the number of crew in order to accommodate observers, resulting in a decrease in the operating efficiency of the remaining crew. Vessels may also incur costs if they choose to carry additional liability insurance. These costs would vary between individual vessels depending on the insurance carriers' minimum allowed coverage period, and the coverage approach that is taken (PFMC, 2003e).

It is likely that the smallest groundfish vessels would be most affected by the observer requirement (PFMC, 2003e). It may be determined that some vessels are simply too small to accommodate an observer. Unless these vessels were exempt from the observer requirement, they would have to end their participation in the groundfish fisheries. Similarly, vessels with the least revenue may be excessively burdened if required to carry an observer over an extended period of time. Electronic monitoring technology, such as the installation of tamper-proof video cameras on board vessels to record activities at sea, has the potential to substantially reduce the costs of monitoring catch and discards (Appendix C). However, further testing of the effectiveness of this type of electronic monitoring technology is needed before it can be adopted as a lower cost alternative to at-sea observers.

The economic effects of this alternative on commercial harvesters may also vary by sector, depending on the mechanism for allocating catch limits. For example, managers may consider gear impacts, efficiency and other factors in determining the percentage allocation of harvest for each sector. Sectors consisting of vessels that use relatively clean fishing methods and generate overall gains for the fisheries (e.g., produce a higher value product, have a lower impact on juvenile stocks, result in minimal habitat disturbance) could receive a larger allocation.

Such preferential allocations may induce each sector to engage in rent-seeking behavior. Lobbying efforts to acquire the maximum allocation possible may be costly. For instance, fishers may sacrifice even more valuable fishing time to attend Council meetings, and industry associations may acquire the services of lawyers and lobbyists to help the association influence decisions on the allocation of catch limits (Anderson, 1992).

The allocation of catch limits to individual sectors could lead to cooperative patterns of behavior besides those directly related to reducing bycatch. In particular, sector members may form private agreements allocating transferable harvesting privileges as was done by catcher processors in the Pacific whiting fishery. The allocation of transferable privileges through private agreement generates benefits for commercial harvesters similar to those that might be generated under an individual transferable quota (ITQ) program (See Alternative 5 effects on commercial harvesters). Unlike ITQs, however, the distribution of fishing privileges and the system for trading, selling, or enforcing them is decided by the parties to the agreement.

Sullivan (2000) states that the ability to negotiate private agreements allocating harvesting privileges depends on certain conditions being met, including 1) a relatively small number of participants, with a sufficient community of interest to make negotiations feasible; 2) an adequate system for gathering fishery harvest data, and adequate data verification and transparency to monitor compliance and enforce it in cases of non-compliance; 3) significant barriers to prevent new participants from entering after shares have been negotiated, or else free riders are almost certain to be predators on the fishermen who rationalize their harvest; 4) an opportunity to attain additional value through an allocation agreement; and 5) for antitrust law reasons, when the arrangement includes one or more vertically integrated producers operating in a U.S. fishery, assurance that the relevant fishery sector's target species or incidental catch allocation(s) will be limited and fully harvested.

Once an agreement is negotiated, the parties to the agreement must have internal rule-making capability and sanctioning authority to deter those who are tempted to break the rules (Ostrom,1990). Quota shares could be created by using contracts and relying on civil law to enforce contract terms, including penalties (e.g., expulsion from the agreement) for vessels that exceed their quota holdings.

Leal (2002) states that one advantage private harvesting agreements have over an ITQ program is avoidance of the expensive rent-seeking behavior that often accompanies allocation of ITQs. Although this process may not be free from controversy, it appears to be easier for the individual participants to allocate individual shares than to have the government do it. On the other hand, Leal (2002) notes that private harvesting agreements may also have some disadvantages in comparison to ITQs. A new entrant can simply buy or lease ITQs from a quota owner willing to sell or lease. In contrast, with a private harvesting agreement, the transfer of shares to a new entrant will require becoming a party to the agreement. In addition, ITQs are likely to remain in force, especially once they acquire value through the secondary market. By contrast, the durability of private agreements depends on the willingness of parties to maintain the agreement. Even when the arrangement has no sunset provisions, or requires a majority of members to rescind it, members may not retire as many redundant vessels or invest in as much of the product enhancement capital as they would under a system of ITQs.

The cooperative patterns of behavior that may develop under this alternative are expected to generate economic benefits for commercial harvesters. These benefits may render some commercial harvesters better able to sustain the costs of an observer requirement. In addition, increased observer coverage may allow more vessels to process seafood products at sea. State fishing regulations do not allow at-sea processing of any groundfish except Pacific whiting. On June 7, 2004 (69 FR 31751), NOAA Fisheries finalized a rule that requires all at-sea processors to carry and pay for observers. It is uncertain whether the presence of observers will lead to a relaxation of state restrictions on at-sea processing. If it does, investments in freezing capacity could lead to significant increases in revenues for some vessel owners (OCZMA, 2002). For example, sablefish commands substantially higher prices when frozen at sea. However, even if all the possible economic benefits under Alternative 4 are realized, it is likely that paying observer costs would not be economically feasible for many vessels.

4.4.4.3 Effects on Recreational Fisheries

This alternative may have a negative economic effect on recreational fishers relative to Alternative 1. If the sector catch limit is exceeded, a closure of the recreational fishery will occur. However, under Alternative 1 this potential exists as demonstrated in frequent recreational closures and other restrictions that have occurred in recent years. Improvements in the recreational catch monitoring program may either reduce or increase the likelihood of restrictions. Under Alternative 4, NMFS' ability to detect excessive catches within the sector would be enhanced by an onboard Commercial Passenger Fishing Vessel (CPFV) observer program and expanded port/field sampling program.

A closure of the recreational fishery would result in fewer fishing experiences for private anglers and charter fishing patrons. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants.

Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects of this alternative. For example, a resident of a state in which the recreational fishery has been closed would be allowed to fish in a state where the fishery remains open, provided he or she possesses a fishing license for that state.

4.4.4.4 Effects on Tribal Fisheries

Tribes are effectively a specified sector, with sablefish and whiting allocations that are functionally similar to species caps. The Tribes' allocations and anticipated catches of overfished species are not considered caps under the no action alternative. Alternative 4 would not change the amounts of any allocations.

If allocations were treated as caps under Alternative 4, they could have an adverse economic effect on Tribal fishers, especially if the Tribal Pacific whiting or sablefish fishery were closed as a result of early attainment of an overfished species cap. There has been some catch of canary rockfish, widow rockfish and dark-blotched rockfish in the whiting fishery. In most recent years, whiting provided the lion's share of harvest tonnage and a major portion of ex-vessel revenue. Consequently, the economic impacts of a fishery closure could be severe. However, given the experience of tribes in self-management with respect some aspects of the groundfish fisheries, their ability to avoid a fishery closure through cooperative efforts to control the catch of overfished species is expected to be relatively high.

4.4.4.5 Effects on Buyers and Processors

The economic effects on buyers and processing companies are uncertain because of the uncertainty as to whether vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, higher catches in the groundfish fisheries are expected. An increase in landings is likely to eliminate upward pressure on ex-vessel prices (unless harvesters can coordinate and through collective bargaining demand a higher price from processors), and greater throughput over constant fixed costs will result in lower average costs for processing facilities.

On the other hand, if a single disaster tow shut down an entire fishing sector, buyers and processors may experience significant shortages of fish. Current fish processing infrastructure could be disrupted if a race for fish developed under this alternative (although vessel caps would tend to prevent that.) Processors could be forced to increase capacity in order to process as much fish as possible before a major fishing sector shut down. Because the total volume of fish processed may not increase substantially under this alternative, any investments in additional processing capacity would be unlikely to result in net revenue gains for processors relative to the *status quo*.

4.4.4.6 Effects on Communities

To the extent that commercial harvesters were able to prosecute groundfish fisheries without being shut down, this alternative would not be expected to have a significant economic impact on communities. The groundfish fisheries would continue to benefit fishing communities as under the *status quo*. However, if sector closures did occur, there would likely be negative impacts in fishing communities, particularly if processing plants are also forced to close.

4.4.4.7 Effects on Consumers of Groundfish Products

If this alternative did not result in early closures of major harvesting sectors, it would be expected to have little impact on consumers relative to the *status quo*, as the price per unit, product availability, and product quality would be unlikely to change substantially. However, if major fishing sectors were shut down due to unexpected catches of overfished species, consumers could see a disruption in groundfish supplies. To the extent that supplies of fresh or live groundfish from West Coast fisheries were curtailed, a loss of consumer surplus could occur. A reduction in supplies of frozen West Coast groundfish would be likely to have a minimal effect on consumer surplus because this product form has many substitutes.

4.4.4.8 Effects on Fishing Vessel Safety

The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations may lead to reductions in injury and loss of life because of harvester's incentives to take fewer risks and use their best judgment in times of questionable weather conditions. However, if an intense race for fish developed, the increased competition among fishers would likely increase the risks they would be willing take to harvest fish. For example, vessels could be induced to fish in weather conditions that under the *status quo* would have kept prudent operators from fishing. The result would be a reduction in the safety of fishers while at sea.

On the other hand, early closure of a sector would reduce the amount of time those vessels were at sea, resulting in increased safety.

4.4.4.9 Effects on Management and Enforcement Costs

This alternative would be expected to notably increase management and enforcement costs for initial start up and over the long term. The sector allocations required by this alternative would take two to four years to develop, analyze and implement through the Council and NMFS management processes. However, certain other management costs would be reduced, particularly those associated with inseason catch projections.

As catch limits are allocated over an increasing number of sectors, NMFS would be required to manage increasingly small blocks of fish. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. Under Alternative 4, 60% commercial and recreational (CPFV) observer coverage, a logbook requirement for all commercial vessels and an expanded port/field sampling program to improve estimates of recreational catch would be used to monitor the harvest in each sector and ensure that catch caps are not exceeded. However, it would likely be necessary to have 100% coverage of trawl vessels to ensure the effectiveness of vessel and sector caps.

As discussed above in the analysis of the economic effects on commercial harvesters, the costs of expanded observer coverage would be borne mostly by industry, unless NMFS provided all observers at no cost to vessels. Funds for expansion of the observer program have not been identified. Nevertheless, the increase in the number of observers and its associated increase in the amount of data collected is expected to raise overall annual costs of the groundfish observer program. This budgetary increase may be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. Though computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the observer program have not been estimated.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about \$3.4 million (\$2.2 million in federal dollars and \$1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional \$1 million to develop a comprehensive coastwide marine recreational fisheries data system (personal communication, Russell Porter, Field Programs Administrator, PSMFC, October 2003).

4.4.5 Social and Economic Impacts of Alternative 5 (Vessel catch quotas, discard caps)

This analysis examines the economic effects of the use of measures to reduce bycatch that are collectively referred to as dedicated access privilege systems, as the allocation of shares of the total allowable catch for species or species groups to individuals or groups conveys an exclusive right or privilege to catch a given quantity and species of fish (Sutinen et al., 1992).[7/] The primary focus of this analysis is the economic effects of implementing transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (ITQs) for other groundfish species. However, this analysis will also briefly examine the potential economic effects of implementing group-based quota systems. The allocation of portions of the total allowable catch to fisheries cooperatives is one form of such a system (See Alternative 4 discussion of economic impacts on commercial harvesters). Another way to implement group-based quota systems is to modify an ITQ program to allow communities or other groups to enter into the market for quota shares. An example of such an approach is the measures the North Pacific Fishery Management Council approved in 2002 that would allow eligible fishing villages in the Gulf of Alaska to acquire ITQs for sablefish and halibut.

7/ The Magnuson-Stevens Act refers to an IFQ as an exclusive fishing privilege, rather than a right. In specific reference to authorizing IFQs or other limited access systems, the Act states that such an authorization, “ (A) shall be considered a permit for the purposes of sections 307, 308 and 309; (B) may be revoked or limited at any time in accordance with this Act; (C) shall not confer any right of compensation to the holder of such individual fishing quota or other such limited access system authorization if it is revoked or limited; and (D) shall not create, or be construed to create, any right, title, or interest in or to any fish before the fish is harvested” (Sec. 303(d)(3)).

The economic and social impacts of the use of rights-based management in the West Coast groundfish fisheries will be determined largely by the initial allocation of quota shares. Persons or groups who are provided an allocation will gain an exclusive fishing privilege that others who do not receive an allocation will be denied. The effects of alternative allocations are discussed throughout this analysis and highlighted in a section describing wealth distribution issues with rights-based management (Section 4.4.5.9).

4.4.5.1 Effects on Fishers' Incentives to Reduce Bycatch

Reductions in the catch of unwanted fish under a rights-based system are expected to be achieved more easily than under the *status quo* because vessels will be more willing to accept the reductions in target species catch rates that they may incur by fishing at different times. Reduced catch rates will no longer equate with a smaller share of total catch since the vessel is assured of its right/privilege to harvest a fixed or proportional share of the total allowable catch for the entire year (as opposed to two-month periods under the no action alternative). In addition, fishers will be better able to time their harvests to coincide with periods when the *CATCH PER UNIT OF EFFORT* (*CPUE*) of certain target species is higher and bycatch is lower. For example, Dover sole and petrale sole form large spawning aggregations in the late winter and spring (personal communication, Steve Bodnar, Coos Bay Trawlers' Association, November 2003). Concentrating fishing effort during such periods can lower levels of bycatch as well as decrease fishing costs.

Fishers under this alternative may also have more flexibility in their choice of boat/gear configurations and fishing methods over the course of a fishing season. For example, gear endorsements may be modified to allow trawl vessels to use nontrawl gear or to convert their trawl endorsement to a new category of longline, pot or generic gear endorsement. This relaxation of regulations could allow fishers to modify their fishing operations and/or gear to better use their quotas and could facilitate the adoption of more selective fishing strategies.

A potential negative effect of a rights-based system is that fishers may have a heightened incentive to high grade: by throwing less valuable fish overboard, they can save their quota for more valuable fish. Under Alternative 5, however, vessels are charged for their entire catch and high grading does not save any of their quota . Unlike Alternative 1, the amount of fish discarded by each vessel would be recorded by an at-sea observer and counted against the vessel's limit. When a vessel reaches any catch limit, further fishing by that vessel for any groundfish would be prohibited until it acquired additional RSQ or ITQ shares. This measure provides strong economic incentives to reduce the catch of unwanted fish because it internalizes the external costs of discarding that fish in the private economic returns of individual fishers (i.e., the costs of discarding are borne directly by the fishers that discard). Consequently, it would be worthwhile for each fisher to take steps to improve the selectivity of their fishing gear and techniques and avoid troublesome areas in the process. As a further economic incentive to fish more selectively, this alternative reserves a portion of some or all of the total allowable catch limits of overfished species for vessels with the best bycatch performance. Performance could be based on low incidental catch and/or bycatch rates or other factors.

4.4.5.2 Effects on Commercial Harvesters

Initial distribution of quota shares is a major policy issue that determines distribution of wealth and costs throughout the industry. Although there are many possible methods of determining initial allocation of shares, catch history is likely to be a major consideration.

Current vessel owners as a group are likely to benefit from a rights-based system that allocates freely transferable and leaseable quota shares to vessel owners on the basis of vessel catch histories. The overall increases in profitability for vessel owners will vary from fishery to fishery but could be substantial in many cases.

Not all vessel owners would benefit equally, and the relative benefits would depend on the formula that relates catch history to allocations. This formula is clearly of fundamental importance to individual operators in the industry, because it would affect both their wealth, through changes in the value of their fishing rights, and their income as affected by their catch (Geen et al., 1993). The fact that there is a history of trip limits under the *status quo* may facilitate the allocation of ITQs in the West Coast groundfish fisheries. The value of a limited entry permit currently reflects the potential earnings of a pre-determined catch amount. However, although no permit holder has the potential to land any more fish than any other permit holder given standard trip limits that apply, there is catch history variation due to vessel decisions, trip limits that vary by region, and trip limits that vary by gear (e.g., small footrope, large footrope). There can be a significant variation in the catch history within the fleet. In this situation, a relatively simple allocation formula, such as one that issues equal shares to all active permit holders, is unlikely to be considered fair and equitable. Now that the trawl buyback has occurred, however, an equal distribution of shares may not be fair and equitable. Some trawlers who were bought out may purchase new vessels and permits to again participate in the fishery. An allocation of equal shares would essentially doubly pay those vessel owners who were paid to the leave the fishery and who are now returning to the fishery by purchasing existing permits.

Another policy issue is who would be eligible to receive shares in the initial distribution. If a substantial portion of the initial quota shares is allocated to other groups (e.g., crew, processors, or community groups), vessel owners could potentially suffer an initial financial loss since they would have to purchase quota to conduct their historical level of fishing. Whether or not other gains in cost reduction or increased prices might offset the costs of acquiring quota can only be determined after the structure of the rights-based system and allocation formula are determined, and even then it would be difficult to assess.

It is also important to note that the level and distribution of the benefits and costs of a rights-based system may vary by fishery and sector. The extent of the gains would depend on the degree to which the current management and bycatch mitigation programs have been leading harvesters and processors to sacrifice quality, produce lower value products, use more costly production processes, endure higher bycatch rates, or maintain excess capital and labor in order to increase production. Experience with rights-based systems in other fisheries suggests that improvements in the economic performance of the groundfish fisheries due to increased value and reduced costs may be substantial. However, because landing limits have been used in the West Coast groundfish fisheries to smooth out fishing and landings over the year, these fisheries already experience some of the typical gains from rights-based systems that result from elimination of the race for fish phenomenon, such as longer fishing seasons, mitigation of market gluts, and opportunities to improve product quality.

Nevertheless, a rights-based system would be expected to increase the value of production in the West Coast groundfish fisheries for a variety of reasons. Currently, an annual landed catch OY must be set below the ABC to account for the expected bycatch. Under Alternative 5, this reduction would not be necessary because all catch mortality would be measured through expanded observer coverage. Consequently, the total amount of fish available for harvest would increase.[8/] Further, increases in the value of production may be achieved as the harvest volume increases in fisheries that were previously constrained by landing limits. For example, some fishers may successfully modify gear and/or purchase enough canary rockfish RSQ to take advantage of yellowtail rockfish ITQ.

The costs of harvesting are also expected to fall for a variety of reasons. The ability of harvesters to catch their entire quota of certain species during periods of time when the species aggregate could substantially reduce fishing costs. In addition, individual vessels will have the opportunity to select the least-cost combination of fishing inputs (Crutchfield 1979; Scott 2000). At the industry level, costs will fall because production is expected to shift over time toward the most cost-effective harvesting operations. Consolidating harvesting operations and retiring or selling off vessels will reduce fixed costs for the industry. The cost savings will depend both on the constraints put on the transfer and consolidation of harvesting privileges and on the level of excess capacity prior to implementation of a rights-based system. It is also important to note that many of

8/ Assuming that fishery managers have been risk averse when estimating discards under the *status quo*, it is likely a system of accurate accounting of discards in the groundfish fisheries would allow fishery managers greater certainty in setting ABCs and OYs.

the efficiency gains from the adjustment of the fleet following the introduction of a rights-based system may be lost if departing fishers shift their effort toward non-groundfish fisheries, which themselves are overcapitalized. One additional potential benefit to vessel owners from a rights-based system is that private banks and government agencies may come to treat quota shares as having financial value that may allow them to serve as collateral for loans, thereby improving the ability of quota holders to obtain financing for capital investments.

These economic benefits must be weighed against the additional operating costs that vessel owners will incur from the expanded observer coverage required under a rights-based system (See Alternative 4 discussion of effects of increased observer coverage on commercial harvesters). The increase in net revenues that commercial harvesters are expected to experience under a rights-based system may render them better able to sustain the costs of an observer requirement. However, even if the economic benefits of a rights-based system are fully realized, it is likely that paying observer costs would not be economically feasible for many vessels because they would not be able to generate enough cash flow to cover those additional costs. As noted in the effects analysis for Alternative 4, the installation of video cameras on board vessels to document vessel activities at sea has the potential to substantially reduce the costs of monitoring catch and discards. However, further testing of the effectiveness of this type of electronic monitoring technology is needed to determine whether and in which cases is may be adopted as a lower cost alternative to at-sea observers.

Implementing a rights-based system presents special difficulties for fisheries such as the West Coast groundfish fisheries in which multiple species are often caught together. Matching quota to actual harvests is problematic because of uncontrollable factors, such as ocean temperature and other environmental factors that can lead to variations in the mix of species caught from place to place and over different periods. Moreover, disaster tows can occur in which the dominant species is other than the target species. In theory, a rights-based system can address the problem through quota trading, either by purchase or lease of additional quota (Dewees and Ueber, 1990). In some cases, however, the fisher may be unable to buy or lease more quota. This might be because no other harvester has quota to sell or the trading price for quota is greater than the fisher is able to pay. (The prices of RSQ shares may become especially high as the fishing season progresses due to the constraints they may impose on harvests of target species.)

Pascoe (1997) describes a number of contingency systems that have been used to address these problems in multi-species fisheries with varying success. A permissible quota over-run is used as a bycatch management option in New Zealand and British Columbia (Larkin et al., 2003; Wheeler et al. 1992 cited in Pascoe, 1997). A permissible quota over-run policy allows fishermen to exceed their quota holding in a given year in return for a reduction in their quota the following year. In New Zealand, permissible quota over-runs are limited to 10%

of the original quota for all species. Another system used in New Zealand allows fishers to land species for which they do not hold quota and record it against the quota held by another fisher. This is effectively an informal quota leasing arrangement, because the catchers of the fish usually pay the holders of the quota for the use of their quota (Baulch and Pascoe, 1992 cited in Pascoe, 1997).

The need for such contingency systems can also indicate an inadequacy in the formal quota trading system. For example, if all quota purchases or leases are required to be recorded by NMFS, the transaction costs might be high due to bureaucratic inefficiencies. An alternative would be to allocate quota to a cooperative and allow its members to internally distribute the quota shares and develop a system for leasing and selling shares. When the quota trading system is decided by fishers themselves, transaction costs can be substantially lower.

In general, cooperatives can be expected to provide the same net benefits to vessel owners as an ITQ program. However, the rules governing cooperatives will be important in determining the distribution of benefits between harvesters and processors. For example, it has been argued by some fishing vessel owners in the Alaska pollock fishery that the rules for inshore cooperatives established under the American Fisheries Act have actually hurt independent vessel owners financially. Rules for these cooperatives restrict the ability of vessels to transfer between cooperatives and require members of a cooperative as a group to deliver 90% of their catch to one processing firm associated with that cooperative. Compared with cooperative rules that would allow for free movement of vessels between cooperatives, the present inshore cooperatives shift the balance of power in price negotiations toward the processors. Halvorsen, et al. (2000) reported that variations on the current rules that would allow smaller groups of fishing vessels to form cooperatives and easier movement between plants would tend to shift the balance of bargaining power to vessel owners. This shift, in turn, would increase their share of any net benefits resulting from increased efficiency and product value that might occur as a result of rights-based management. In short, the overall gains to vessel owners that might be expected in terms of increasing the value of catch and decreasing harvesting costs are likely to be smaller with cooperatives than with ITQs if the ability of vessel owners to form and transfer between cooperatives and to freely choose their point of delivery is limited.

The impacts of community quota programs on vessel owners is even less clear. Some vessel owners might gain if communities, in turn, grant them catch rights that enable them to slow down and choose fishing times; however, there is the potential that others might be harmed financially if their current ability to harvest resources is curtailed and they need to buy or lease catch rights from communities. Even if a community grants catch rights at no charge, the profitability of the vessel owners could still be undermined if their freedom to choose which buyers they sell their fish to is limited by the community.

4.4.5.3 Effects on Recreational Fisheries

An IFQ program would not apply to the recreational fishery, and an IFQ would not necessarily result in any change in the proportion of the total groundfish catch taken by or allocated to the recreational sector. However, in order to protect the IQ shares for the commercial fleet, Alternative 5 would require establishment of allocations for the recreational fishery similar to or the same as those in Alternative 4. In this respect, Alternative 5 may have a negative economic effect on recreational fishers relative to the *status quo*. A closure of the recreational fishery due to it reaching its allocation would result in fewer fishing experiences for private anglers and charter fishing patrons. Dividing the recreational sector into geographic (e.g., state-based) subsectors could mitigate some of the negative effects.

If the ITQ program were expanded to include the recreational sector, or if recreational fishers, fishing groups or charter companies were allowed to obtain quota shares, the economic effects of Alternative 5 relative to the *status quo* would be different. The following analysis of potential economic effects on the recreational and charter fishing sectors draws from Anderson's (1992) discussion of the possibility of creating ITQs for both recreational and commercial fishers.

Anderson notes that an advantage of fishery management with ITQs is that it is possible to simultaneously create tradable quota shares for various sectors, including the recreational, charter, and commercial fishing sectors. There are many options that could be developed. With full trading of ITQ shares permitted between sectors, users could determine the most desirable allocation of the stocks, based on their willingness to pay for shares of the resource. For example, recreational harvesters could increase their share of tota1 catch by purchasing ITQ shares from commercial harvesters or commercial harvesters could buy recreational ITQ shares.

An obstacle to establishing the initial allocation of quota shares for the recreational sector is that individual recreational landings are typically difficult to document. Anderson suggests that recreational ITQ shares could be given away on an equal basis through a lottery. Entities such as fishing clubs or state/local government agencies could also receive shares if it is decided these groups were proper representatives of recreational fishers. Part of the initial recreation allocation could also be assigned to non-ITQ bag limit fishing.

4.4.5.4 Effects on Tribal Fisheries

Alternative 5 would not change any Tribal allocations. If Tribal fishers are included in the IQ program, or allowed to purchase IQ from non-tribal fishers, they would receive similar benefits. Alternative 5 is expected to have a minimal economic effect on tribal groups. The coastal Treaty Tribes have negotiated allocations of sablefish and Pacific whiting, and there are several other groundfish species taken in Tribal fisheries for which formal allocations have not been established. Allocations of these species could be negotiated in a similar manner.

4.4.5.5 Effects on Buyers and Processors

Groundfish buyers and processors are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system as discussed in the effects on commercial harvesters. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Owners of processing plants (other than catcher-processors) have not been granted allocations of shares in prior ITQ programs in the United States, although such allocations may be granted under the Alaska crab fisheries rationalization program. Arguments have been made (e.g., Matulich and Server, 1999; Matulich and Clark, 2003) that harvester-only ITQ programs may lead to expropriation of quasi-rents from processors.[9/] This could result if excess processing capacity exists and there are no alternative uses for processing equipment. It is also possible that plant owners would share in the overall economic gains that could be made through fishery rationalization. The degree to which this might occur will likely depend on the level of excess capacity and the degree to which plant owners are engaged in competition with each other to gain market share. If processors are somehow guaranteed shares, they would naturally be more likely to benefit or less likely to suffer harm from implementation of a harvester-only ITQ program.

The discussion of the effects of Alternative 1 on buyers and processors indicates that processors have been able to maintain a steady flow of fish into their plants and, therefore, have been able resist the competitive pressure to outbid competitors for raw materials even in the face of declining harvests. Furthermore, even though each harvester is effectively guaranteed his or her trip limit in each two-month period under the *status quo*, fishers as a group have not been able to acquire a significant amount of bargaining power in exvessel markets. These factors suggest that the conditions in which harvesters can usurp processor quasi-rents, as described by Matulich and Server (1999), may not be present in the West Coast groundfish fisheries. While the absence of such conditions should not necessarily preclude the allocation of shares to processors, it is important to recognize that a significant loss of processor bargaining power does not appear to be likely under a harvester-only ITQ program.

As noted above, the structure of cooperatives in which harvesting agreements are negotiated can also affect the benefits that accrue to owners of processors from rights-based management. In general, processors can be expected to benefit more from a cooperative structure in which the ability of vessel owners to form and transfer between cooperatives, to sell or lease catch rights, and to freely choose

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9/ Quasi-rent is the difference between the selling price and the variable costs of a product. Expropriation here means some potential benefits would go to harvesters instead of processors.

their point of delivery is limited, though the absolute distribution of profits created by the move to cooperatives in any particular fishery is not clear.

Community fishery quotas might also provide protection to processors in small communities if the communities restrict the landing locations of their quotas. However, if the program worked similarly to the current western Alaska CDQ program, communities could lease out quota to operations that processed elsewhere and local processors might be preempted.

In summary, rights-based systems may have the potential to reduce the competitiveness of markets and shift the balance of bargaining power between harvesters and processors. Care must be taken to minimize threats to competitive markets and to avoid, or at least be aware of, shifts in bargaining power that may result in income transfers between processors and harvesters. Exvessel markets for fish may already be quite thin in the West Coast groundfish fisheries, with few buyers in a number of locations. Consolidation of harvest and processing sectors will make these markets thinner yet. The number of buyers competing for fish may be reduced to a few or a sole buyer in some cases, if restrictions were to be placed on where fish can be delivered. The possible result would be a shift in income from harvesters to processors.

On the other hand, without restrictions on where or to what plants fish can be delivered, income transfers may move in the other direction. The temporal spreading of fishing may cause processors to bid up prices in an attempt to lower average costs by increasing the amount and duration of their processing. As Matulich and Server (1999) point out, there is the potential under certain conditions that the quasi-rents of processors may be expropriated by harvesters in this process. The possibility also exists that harvesters with sufficient shares of the total allowable catch might have enough market power to make monopoly profits by reducing output below the catch limit. However, the danger of monopolistic practices is low, because West Coast groundfish are sold in regional, national, and international markets where they must compete with similar species produced in other regions of the world as well as with other seafood products.

4.4.5.6 Effects on Communities

Prior rights-based systems implemented in U.S. fisheries have not allocated initial quota shares to vessel crews or other employees of fishing or processing companies. If any of these individuals were allocated shares under a rights-based system, they would be expected to make financial gains similar to those made by vessel owners receiving shares.

If crew members are not allocated shares, it is uncertain whether they could expect their long-term earnings to rise or fall with a rights-based system. In the Alaska halibut and sablefish ITQ fisheries, crew members have sometimes been expected to contribute toward the cost of quota shares used, but increases in the value of production have led to higher crew incomes. Whether crew members and other seafood industry employees are likely to share in the net gains in profitability that result from an ITQ program or other rights-based system implemented in the West Coast groundfish fisheries will depend on the supply and demand for labor, which is likely to vary by fishery and area.

One likely impact in any type of rights-based system is a decrease in the number of crew members and processing workers employed. This is a natural consequence of the consolidation of fishing and processing activities to fewer vessels and plants. As a form of compensation for the potential loss of employment opportunities in the Alaska sablefish and halibut fisheries, the North Pacific Fishery Management Council made the provision that the only persons who could purchase IFQ shares that were not initial recipients had to be bona fide crew members with at least 150 days of fishing experience. With this provision, crew members who might otherwise lose their jobs can establish themselves in the fishery, and because the owner of the quota shares is required to be onboard when the IFQs are fished, these crew members can guarantee themselves a position (Hartley and Fina 2001b). Moreover, crew members who purchase quota shares increase their value as crew, because their quota shares add to the overall harvest limit of the vessel on which they work (Ginter and Muse, 2002).[10/]

On the other hand, rights-based systems could lead to the preemption or reduction of fishing, processing, and shoreside support activities in some traditional fishing communities unless restrictions are implemented to inhibit or prohibit a geographic redistribution of landings. This would be a natural consequence of consolidation in the industry as excess capital is scrapped or allowed to degenerate without replacement and production is shifted to more efficient operations. Even if reductions in harvesting and processing capacity were uniform across communities, one would expect a decrease in economic activities

10/ Both crew members and vessel owners have been assisted in purchasing sablefish and halibut IFQ shares by the North Pacific IFQ loan program, a financing mechanism authorized by the MSA in 1996. The Magnuson-Stevens Act specifies that 25% of the fees collected by NMFS to manage the sablefish and halibut IFQ program must be deposited in a U.S. Treasury Department account and made available for appropriation to support the loan program. To date, however, the program has largely been supported by a Congressional appropriation. The Magnuson-Stevens Act specifies that the loan program is to provide aid in financing: 1) the purchase of individual fishing quotas in that fishery by fishers who fish from small vessels; and 2) first-time purchase of individual fishing quotas in that fishery by entry level fishers. Currently, the program has approximately $5 million available for financing quota share purchases. In FY 2002, 39 loans were issued, mostly to vessel owners and crew members who fish from small (< 60 ft. LOA) vessels.

in fishery support sectors due to reductions in harvesting and processing capital. ITQ programs and cooperative programs can be designed to reduce or prevent this. Doing so could entail some sacrifice in overall efficiency gains, but this must be weighed against the social benefits of preserving traditional fishing communities.

Granting quota shares to community groups would be an alternative and more transparent way to assist traditional fishing communities in remaining involved in the fisheries or in providing them financial resources to develop new industries. Moreover, such group-based systems may lead to a more optimal concentration and reallocation of quota shares in the sense that broader social considerations could be internalized (Gréboval and Munro, 1999).

In conclusion, constraints on the restrictions on the use, transfer and accumulation of ITQs may serve to protect communities' or fishery sectors' opportunities and benefits. However, the social benefits of these measures should be weighed against the efficiency losses. The greatest increase in profits for the overall industry is likely to come from a system with a minimum of constraints on transferability and use of quota shares. For the industry as a whole, increases in profitability can be achieved by shifting harvesting and processing from less efficient operations to more efficient ones. Gains in economic efficiency may be made by concentrating production in fewer operations, especially if there are firms with excess harvesting or processing capacity—as continues to be the case in most sectors of the West Coast groundfish fisheries. Furthermore, it is possible, but by no means certain, that there are economies of scale that would favor larger firms and lead to greater concentration of the industry. At the same time, however, one must recognize that it is this potential for increasing profits by shifting and concentrating harvest and processing operations that poses the threat of preemption of sectors and communities.

4.4.5.7 Effects on Consumers of Groundfish Products

Because landing limits in the groundfish fisheries already maintain a year-round season, consumers are already experiencing some of the typical gains from rights-based systems, such as the availability of fresh fish in markets throughout the year. In addition, consumers are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system.

There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring depends both on the level of consolidation that might occur and the elasticity of demand for particular products. A decrease in competitiveness could result in higher product prices without accompanying increases in quality, which, in turn, would reduce consumer surplus.

4.4.5.8 Effects on Fishing Vessel Safety

Alternative 5 would be predicted to improve the safety of groundfish fishing operations compared to the *status quo*. As with a number of effects previously discussed, the gains in fishing vessel safety that are typically attributed to rights-based systems are partially realized under the *status quo*. These fishing safety benefits include the opportunity to fish at a more leisurely pace and avoid fishing in dangerous weather or locations, within the constraints of two-month fishing periods. However, under Alternative 5 the constraints of two-month periods would be eliminated, allowing vessels to operate in the best possible conditions. The result would be further reductions in injury and loss of life because of harvester's incentives to take fewer risks and use their best judgment in times of uncertain weather conditions. In addition, if higher net earnings are realized under a rights-based system, individual harvesters will have additional funds for vessel maintenance and safety equipment. At the same time, it is important to recognize that rights-based management does not guarantee that fishers will adopt safe fishing practices. Under an ITQ program, for example, market opportunities may still encourage fishers to fish at times or in places that are unsafe. For example, some fishers may still choose to fish in bad weather if the best price for catch is offered during and immediately after storm periods.

4.4.5.9 Distribution Issues with Rights-Based Management

As noted previously, the economic and social impacts of expanded use of rights-based management in the West Coast groundfish fisheries would be determined largely by the initial allocation of quota shares. Whether shares of the total allowable catch are allocated to individuals, cooperatives, or communities, the basis for determining the allocation would undoubtedly be controversial. The allocation mechanisms are likely to vary significantly, depending on the type of rights-based system or systems implemented. If the Council and NMFS decide to move towards a rights-based management program, consideration of specific alternatives and further analysis of impacts will be required.

During the development of a rights-based system, a wide variety of allocation mechanisms and formulas should be considered. Although past ITQ programs in the United States have allocated quota shares to vessel owners based on catch histories, other options should also be examined, such as those that attempt to incorporate objectives that maximize net benefits to society. For example, the criteria for initial allocation of quota shares could include a vessel’s acceptance of conservation goals (National Research Council, 1999). Further, retention of shares could be contingent on the vessel’s ability to pass a regular performance review.

When allocating quota shares, it is important to bear in mind that granting shares to individuals free of charge is likely to result in those individuals receiving substantial windfall gains. These windfall gains may be construed as a transfer of wealth from the public to certain individuals, since exclusive withdrawal rights to publicly owned resources are being gifted. Whether and to whom this wealth should be gifted is an important question that should be carefully considered.

It has been argued that vessel owners have invested their labor and risked their capital (and often their lives) to develop fisheries, and, in return, they should be given preferential access to those resources. However, vessel owners as a group are only one element of a diverse collection of stakeholders who might be viewed as possessing a right to benefit from resources harvested in federally-managed fisheries (or from other resources directly or indirectly affected by those fisheries). Possible other stakeholders include, but are not limited to, skippers who are not vessel owners, vessel crew, processors, fisheries scientists, persons with interests in marine conservation, and individuals in communities that support fishing and processing operations,. Clearly, there are equity reasons for considering whether and how these other stakeholders might be included in initial allocations of ITQ shares. Furthermore, the Magnuson-Stevens Act requires fishery managers to consider the allocation of a portion of the annual harvest in a fishery for entry level fishers, small vessel owners, and crew members who do not hold or qualify for individual fishing quotas.

While recognizing that the Magnuson-Stevens Act may currently restrict such actions,[11/] fishery managers might also consider the future prospect of selling or auctioning some or all of the ITQ shares to allow the public to capture all or a share of the windfall gains created by the ITQ system (Macinko and Bromley, 2002). A variety of tax mechanisms could also be used to capture a portion of the net economic returns that fish harvesting might generate and place them in the public coffer. The mechanism for collecting these profits should be implemented at the beginning of the ITQ program, as the windfall gains accrue to the initial holders of quota (Sutinen et al., 1992)

If cooperatives are expanded to other West Coast groundfish fisheries, the cooperatives themselves would likely be responsible for allocating quota shares among their individual members. However, an equitable method of allocating among cooperatives is still required. If quota shares are granted to communities, allocations might be based on the historic landings made in those communities and/or the pooled catch histories of the communities' residents. A variety of other formulas might be developed to meet particular social and economic objectives. Under the western Alaska Community Development Quota (CDQ) program, allocations to CDQ groups are not fixed in order to allow flexibility in directing benefits and achieving community development goals. In such an

11/ Section 304(d) of the Magnuson-Stevens Act places strict limitations on fees that can be levied on the fishing industry. These limitations effectively preclude auctions or other means of collecting some of the rents that may be created with ITQs (Anderson, 1992).

arrangement, it is of paramount importance that the process for allocating community quotas be stable and transparent (National Research Council, 1999).

Whether quota shares are allocated to individuals, cooperatives or communities, it may be prudent to put in place mechanisms that will allow the nature of the fishing privileges to be altered. A stable set of privileges and responsibilities with a long time horizon is important to promote the efficiency and stability of the fishery, but it is also important to maintain administrative flexibility for unforeseen eventualities that may oblige changes in the distribution of quota shares. One such mechanism discussed by the National Research Council (1999) is referred to as the Australian drop-through system. In this system, initial entitlements are defined and fixed for a long but finite period: 30 years in certain Australia fisheries. Periodically, perhaps every ten years, a comprehensive review of these entitlements takes place and changes can be made to the set of rights and obligations. Shareholders can switch to this new set of entitlements (whatever is currently on offer) any time before the term of their old entitlements expire, at which time they would automatically exchange entitlements for the current set on offer. Switching to the new entitlement package locks in the right to guard those entitlements for the remaining life of that entitlement. Other systems of balancing stability with flexibility are possible. The most important element is to strike the proper balance to protect the health and prosperity of the fishery and the authority of regulators to make appropriate management decisions in the best interest of the public.

4.4.5.10 Effects on Management and Enforcement Costs

This alternative would be expected to notably increase management and enforcement costs for initial start up and over the long term. The sector allocations required by this alternative would take two to four years to develop, analyze and implement through the Council and NMFS management processes. However, certain other management costs would be reduced, particularly those associated with inseason catch projections.

Experience with the ITQ programs in fisheries around the world indicates that such programs typically result in substantial increases in the costs of monitoring, enforcement, and administration. If ITQs and/or other rights-based systems are implemented in the West Coast groundfish fisheries, NMFS will be required to manage increasingly small blocks of fish. It will be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches of a large number of individual vessels. Under Alternative 5, 100% observer coverage is used to monitor the harvest of each participant and ensure that the harvest does not surpass the individual's current quota level. Even if the costs of this expanded observer coverage are largely borne by industry, the NMFS groundfish observer program can expect to see an increase in overall annual costs as a result of the increase in the number of observers and its associated increase in the amount of data collected. This budgetary increase can be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. With transferability, it will also be necessary to keep track of the current amount of quota owned or leased by each participant. Though computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the monitoring program are likely to be substantial.

Lastly, a rights-based management system requires additional agency resources to develop the process through which fishing rights are assigned and to adjudicate appeals about the assignment of fishing rights to individuals or groups.

The Magnuson-Stevens Act provides for cost recovery measures that can impose a fee on quota holders of up to 3% of the ex-vessel value of IFQ landings. Total fee collections cannot exceed the annual cost of management and enforcement. Such measures were implemented for the Alaska sablefish and halibut IFQ program in 2001. Seventy-five percent of fee payments are deposited in the Limited Access System Administrative Fund and made available to NOAA Fisheries to offset costs of management and enforcement of the halibut and sablefish IFQ program.

4.4.6 Social and Economic Impacts of Alternative 6 (Marine reserves, individual caps and full retention)

This alternative includes a wide array of measures to reduce bycatch, including a 100% groundfish retention requirement, marine protected areas and transferable RSQs for overfished species, and ITQs for other groundfish species. The mixture of measures complicates an analysis of the economic impacts of the alternative because the economic effects of some measures may be offsetting. For example, the decrease in costs that commercial harvesters are expected to experience under an ITQ program may render them better able to sustain possible reductions in harvests and revenues caused by the establishment of marine reserves (large portions of which are assumed to be set aside as no-take areas). However, in most cases there is insufficient information to determine the net economic effect of multiple management measures on various components of the human environment.

4.4.6.1 Effects on Fishers' Incentives to Reduce Bycatch

This alternative represents both a traditional command-and- control approach to reducing bycatch, and a market-based approach that removes the economic incentives that lead to bycatch. Marine reserves would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing bycatch outside of marine reserves. Forbidding discarding produces a strong incentive to develop and apply more selective gear because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. In addition, Alternative 6 is similar to Alternative 5 in that individual commercial groundfish vessels would be assigned transferable RSQs for overfished species and ITQs for other groundfish species. As described in the effects analysis for Alternative 5, RSQs and ITQs provide an economic incentive to avoid catching overfished species and unwanted fish, if an effective monitoring and enforcement program is in place.

4.4.6.2 Effects on Commercial Harvesters

Under this alternative, there are both measures that may significantly increase and decrease fishing costs. The level of these increases and decreases and extent to which they may be offsetting is uncertain. The 100% groundfish retention requirement as well as the establishment of marine reserves are likely to increase average costs, whereas the establishment of ITQs for groundfish species is likely to reduce costs and increase revenues.

The establishment of ITQs for groundfish species is expected to reduce the costs of harvesting (See Alternative 5 discussion of economic impacts on commercial harvesters). Individual vessels will have the opportunity to select the least-cost combination of fishing inputs. At the industry level, costs will fall because production is expected to shift over time toward the most cost-effective harvesting operations. Fixed costs will be reduced by consolidating harvesting operations and retiring or selling off vessels. These cost savings will depend both on the constraints put on the transfer and consolidation of harvesting rights and on the level of excess capacity prior to implementation of a rights-based system. Cost savings will also depend on the ability of harvesters to catch and sell a greater percentage of a particular species during periods when the species aggregate.

As discussed in Alternative 5, a rights-based system is also expected to increase exvessel revenues. Currently, a landed catch OY may be set below the ABC to account for the expected bycatch. Under Alternative 6, this reduction would not be necessary because all catch mortality would be counted against each vessels catch/mortality quotas and measured through expanded observer coverage. Consequently, the total amount of fish available for harvest would increase.[12/]

12/ Assuming that fishery managers have been risk averse when estimating discards under the *status quo*, it is likely a system of accurate accounting of discards in the groundfish fisheries would allow fishery managers greater certainty in setting ABCs and OYs.

These economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage required under a rights-based system (See Alternative 4 discussion of effects of increased observer coverage on commercial harvesters). The increase in net revenues that commercial harvesters would be expected to experience under a rights-based system may render them better able to sustain the costs of an observer requirement. However, even if the economic benefits of a rights-based system were fully realized, it is likely that paying observer costs would not be economically feasible for many vessels due to their inability to generate sufficient cash flow to cover the added expenses. As noted in the effects analysis for Alternative 4, the installation of video cameras on board vessels to document activities at sea has the potential to substantially reduce the costs of monitoring catch and discards. While further testing of the effectiveness of video monitoring is needed, it should be noted that the 100% groundfish retention requirement may enhance the practicality of this type of electronic monitoring technology (Appendix C).

The 100% groundfish retention requirement could also have a positive or negative effect on the commercial harvesting sector depending on how much the fish formerly discarded would decrease the vessel hold space available for more valuable product and the revenue earned from product derived from the additional fish retained. Revenue per trip may decrease if a large amount of hold space is taken up by lower-valued fish. Vessels may offset some lost revenues by taking additional fishing trips. However, the number of trips vessels can make would be strictly limited by the catch allowance for overfished groundfish species. When the catch allowance is reached, a vessel must stop fishing unless additional RSQ shares are obtained. It is also possible that markets could be expanded for some groundfish species that currently fetch lesser prices. However, the prospect of market development is uncertain.

The problem of damage to target species by mixing wanted and unwanted groundfish in the hold may be a problem for some vessels. For example, dogfish sharks have high levels of urea (or more generally, non-protein nitrogen - NPN - compounds) in their flesh and when the shark dies bacteria rapidly convert this to ammonia, contributing to spoilage. This problem may be avoided if sharks are segregated in a separate hold. However, most vessels are unlikely to be able to dedicate an entire hold to the dogfish sharks that are taken. The problem of contamination of target catch could also be avoided by on-board processing of the sharks in order to remove as much of the NPN compounds as possible. However, the costs involved in processing and preserving dogfish shark meat currently outweigh the revenue that might be garnered from doing so. For some species there is currently no established market. If vessels cannot sell the additional fish retained, they may face delivery costs for shipment to a disposal site. Smaller trawl vessels may be disproportionately affected by the groundfish retention requirement, because they are more likely constrained by hold space during a fishing trip.

The possible spatial displacement of fishing effort resulting from the establishment of marine reserves may also have a negative economic impact on many fishing operations. Displaced fishers would have the option of relocating their fishing activities to groundfish grounds that remain open. However, open areas may be less productive, and competition for remaining good fishing locations would increase. Consequently, catch rates will likely fall, translating into less harvesting revenue for any given effort level. In addition, the area closures may force some fishers to travel further than previously, increasing operating costs.

The marine reserves established under this alternative could also cause product quality to decline. It is reasonable to assume that, subject to regulatory constraints, harvesters target certain species in areas that maximize value either by increasing the quality of the fish or by decreasing the harvesting cost or both. Consequently, a measure that prohibits vessels from using historical fishing grounds may result in a decline in product quality (e.g., fish may be smaller or a less uniform size). In addition, the quality of some groundfish species may deteriorate as the time from harvest to processing lengthens. To the extent that the establishment of marine reserves results in vessels traveling farther distances from processors, and thereby lengthening the time between harvest and processing, the quality of product would be adversely affected.

On the other hand, marine reserves have the potential to enhance exploited populations and benefit fisheries by: 1) dispensing larvae that replenish fishing grounds removed from marine reserve source populations; 2) exporting biomass to adjacent fishing grounds in the form of emigrating juveniles and adults; and 3) protecting portions of exploited stocks from genetic changes, altered sex ratios, and other disruptions caused by selective fishing mortality (Murray et al., 1999). These benefits could potentially mitigate, in part, deleterious effects of overfishing and restore, stabilize, or enhance fishery yields for some stocks (Dugan and Davis, 1993). In addition to higher catches, possible gains to the groundfish fisheries from marine reserves include reduced variability of catch and reduced probability of fishery closures due to overfishing (Thomson, 1998). However, it should be noted that even if marine reserves have the potential to have a positive effect on fish populations and fishery productivity, it may take several years after the area closures are established for this effect to be realized. For example, considering the longevity and erratic recruitment of many rockfish, it might be decades before marine reserve benefits to rockfish stocks and outside fisheries are demonstrated (Yoklavich, 1998 cited in Murray et al., 1999). Given this time lag, it is improbable that the potential economic benefits of marine reserves would accrue to the current generation of groundfish fishers. Even if the lag is considerably shorter, it is likely to be perceived as too long for most fishers whose social and economic well-being is contingent on shorter schedules (Murray, et al., 1999).

Reductions in fishery landings associated with the establishment of marine reserves and the resulting social and economic adjustments required by fishers may be partially mitigated by phasing in marine reserves to distribute the loss of fishing grounds and related catches throughout several years. During this period, the benefits obtained from marine reserves may begin to offset losses due to displacement of fishing activities (Sladek, et al., 1997 cited in Murray et al., 1999).

4.4.6.3 Effects on Recreational Fisheries

An IFQ program would not apply to the recreational fishery, and an IFQ would not necessarily result in any change in the proportion of the total groundfish catch taken by or allocated to the recreational sector. However, in order to protect the IQ shares for the commercial fleet, Alternative 6 would require establishment of hard caps (catch limits) for the recreational fishery similar to or the same as those in Alternatives 4 and 5. In this respect, Alternative 6 may have a negative economic effect on recreational fishers relative to the status quo. A closure of the recreational fishery due to reaching its allocation would result in fewer fishing experiences for private anglers and charter fishing patrons. Dividing the recreational sector into geographic (e.g., state-based) subsectors could mitigate some of the negative effects.

Alternative 6 also includes the measure of establishing no-take reserves, which will create additional impacts. As with commercial fishers, participants in recreational fisheries could potentially benefit over the long term from increases in local catch rates and fish size due to spillage of adults out of the marine reserves (Parrish et al., 2001).

On the other hand, if the establishment of marine reserves results in a geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open may lead to localized depletion of stocks and a decline in catch per unit effort and individual harvests. Lower individual catches would mean a reduction in the quality of the fishing experience to a number of recreational fishers and charter fishing patrons. The value of the fishing experience would be further reduced if marine reserves increase the distance that recreational fishers must travel to reach productive fishing grounds.

While not completely immobile with respect to a port of operation, charter boat operations are location dependent both in terms of their reliance on location-specific marketing channels to bring them customers and the effects of distance to fishing grounds on profit (Parrish et al., 2001). Increased distance to fishing grounds may affect both the cost and revenue side of their profit function (increased distance and travel time increases the fuel and labor opportunity costs and at the same time would likely decrease willingness of customers to take a trip). Charter vessels that work as independents rely on charter offices to book their clients, and have somewhat more locational flexibility than those vessels that serve as their own booking agents. Charter booking offices, on the other hand, are more closely tied to the fishing opportunities available in the port that they serve.

Recreational fishers would face the same situation as described for charter vessels, except that recreational fishers may be more mobile in their choice of fishing ports (Parrish et al., 2001). The likelihood that fishers would change fishing ports depends on the degree to which fishing is the primary purpose of a trip and the distance to alternative ports.

4.4.6.4 Effects on Tribal Fisheries

The individual vessel catch limit provisions of Alternative 6 would not change any Tribal allocations. If Tribal fishers were included in the ITQ program, or allowed to purchase ITQ from non-tribal fishers, they would receive similar benefits. In this respect, Alternative 6 is expected to have a minimal economic effect on tribal groups. The coastal Treaty Tribes have negotiated allocations of sablefish and Pacific whiting, and there are several other groundfish species taken in Tribal fisheries for which formal allocations have not been established. Allocations of these species could be negotiated in a similar manner.

Any marine reserves that overlap usual and accustomed (U&A) fishing areas would have to be approved by the Tribes or would not apply to Tribal fishers. Fishing restrictions in marine reserves could conflict with federally recognized treaty rights of tribes to fish in their U&A fishing areas (Parrish et al., 2001). Under these circumstances, it may be possible that NMFS and tribal authorities could negotiate a co-management arrangement whereby tribes were granted preferential access to marine reserves for selected purposes, and certain responsibilities related to marine reserve management were delegated to the tribes.

4.4.6.5 Effects on Buyers and Processors

As with commercial harvesters, the net economic effect of Alternative 6 on buyers and processors is uncertain. In general, buyers and processors are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. While some fish are currently discarded because trip limits are exceeded, other fish are discarded for economic reasons. It is likely that over time buyers and processors will be able to develop new markets and expand existing markets to more fully absorb the increased supply of groundfish that would be associated with 100% retention in the groundfish fisheries. At a minimum, some processors already have the capability of processing low-grade fish as fish meal. There may be concerns that increased retention will overwhelm existing infrastructure and supplies of potable water (Radtke and Davis, 1998). However, it is expected that over the long term processors will be able to carry out the market development, structural changes, and operational adjustments required to accommodate the additional groundfish retained. To facilitate this transition, a multi-year phased-in program for retention of groundfish could be adopted. For example, the program could start at 25% retention the first year and increase in fixed increments over subsequent years until 100% retention is achieved.

Because of their lack of mobility, we would expect the possible negative impacts of marine reserves on buyers and processors to be greater than the impacts on fishers as a group. However, the effects of Marine reserves on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations (Parrish et al., 2001). Processors that have continued to rely on local supply to maintain operations at a particular plant will be most affected by any change in local supply. Processors that have adapted to current fishery conditions by centralization of processing and distribution activities may be somewhat less affected. By shipping raw product to centralized locations, these processors are able to maintain a more consistent product supply and better use their factory capital and work force. They are likely to be less affected by localized disruption in supply, but will still be affected by marine reserves that change the total amounts of fish available for harvest.

4.4.6.6 Effects on Communities

The effects on communities of implementing a rights-based management system in the groundfish fisheries are described in Alternative 5. The establishment of marine reserves would create additional impacts. Marine reserves would be expected to have a positive effect on the long-term productivity of groundfish stocks, which affects the abundance of fish in the future. Consequently, this measure could help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, marine reserves resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of West Coast fishing communities are experiencing under the *status quo* would be worsened.

4.4.6.7 Effects on Consumers of Groundfish Products and Other Segments of the American Public

Consumers would also be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. In addition, over the long term, marine reserves that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large marine reserves could substantially decrease seafood supply enough to make consumers worse off, at least in the short term (Carter 2003). Both the intensity of this negative effect and the probability of its occurrence are uncertain. The most likely result of a decrease in the groundfish catch would be a negative effect on the U.S. seafood trade balance, because more groundfish products would be imported to offset the reduced domestic supply. For example, similar products from South America, Mexico and Canada could potentially substitute for West Coast production.

The price elasticity of demand for groundfish products is fairly high in the U.S. market, but assuming that demand is not perfectly elastic, the decreased production could result in higher product sales prices and a loss of consumer surplus (i.e., net benefits) to the American public. The magnitude of that loss would depend on price elasticities that are not quantifiable at this time and on the degree to which production shifted toward or away from the export markets.

Marine ecosystems and species associated with them provide a broad range of benefits to the American public (National Research Council 2001). Some of the goods and services these ecosystems produce are not exchanged in normal market transactions but have value nonetheless. For example, in addition to supporting commercial fisheries, these ecosystems support an array of recreational fishing and subsistence activities as well as non-consumptive activities such as wildlife viewing and research and education (Carter 2003; Parrish et al. 2001). Furthermore, some people may not directly interact with the marine environment, but derive satisfaction from knowing that the structure and function of that environment is protected.

A primary result of this alternative would be to provide increased protection for habitat and the overall ecosystem. In particular, the marine reserves increase protection for a large number of species and their interrelationships and provide for the maintenance of natural processes. In turn, these positive effects on marine ecosystems and associated species would be expected to lead to a significant increase in the levels of the range of benefits these ecosystems and species provide. However, changes arising from no-take reserves are difficult to predict and cannot be quantified at this time. Further research in these effects is needed.

It is also important to note that some individuals may hold religious or philosophical convictions that humankind has an ethical obligation to preserve species and ecosystems, notwithstanding any utilitarian benefits. While additional surveys and polls are needed to better understand the values and motives underlying public support of measures that protect marine species and ecosystems, Parrish et al. (2001) note that a 1999 survey conducted by the Mellman Group for SeaWeb found a high level of approval for the establishment of marine reserves. Seventy-five percent of the individuals surveyed favored having certain areas of the ocean as protected areas; 60% believed that there should be more marine sanctuaries; and 3% believed there were already too many marine sanctuaries. Survey respondents cited the following as convincing reasons for creating MPAs: 1) distinctive areas should be protected similar to what is done for national parks (65%); 2) less than 1% of U.S. waters are in MPAs

(63%); 3) MPAs would be an important step in improving the health of oceans (58%); 4) harmful activity should be restricted to preserve ocean beauty for future generations (57%). Support for MPAs diminished by only 1% when respondents were first read a statement outlining potential negative socioeconomic effects of creating MPAs and increased by 6% when respondents were first read a statement outlining potential positive effects of creating MPAs.

4.4.6.8 Effects on Fishing Vessel Safety

The establishment of ITQs for groundfish species would be expected to promote vessel safety compared to the *status quo* by reducing the pressure to fish under dangerous conditions and increasing the ability of fishers to pay for vessel maintenance and safety equipment (See Alternative 5 discussion of fishing vessel safety.) On the other hand, the establishment of marine reserves may result in a reduction in fishing vessel safety (compared to the *status quo*) if the closure of fishing grounds results in vessels fishing farther from port and possibly in more hazardous areas. The adverse effects on safety of human life at sea would be more extreme for smaller vessels. For example, recreational boats are typically smaller than commercial or charter boats, and, if marine reserves force recreational boats to travel greater distances or further offshore, risks to this group could increase substantially. The net effect of the various measures on fishing vessel safety is uncertain.

4.4.6.9 Effects on Management and Enforcement Costs

The tracking, monitoring and enforcement activities associated with a rights-based system are expensive (See Alternative 5 discussion of management and enforcement costs). Full (100%) observer coverage would be used to monitor the harvest of each participant and ensure that all catch and bycatch is monitored and recorded. This level of observer coverage would also facilitate enforcement of a full retention regulation. Any observed discarding of groundfish would be an offense. A possible concern to NMFS is the implications of having observers directly involved in monitoring compliance with discard restrictions. Doing so may require observers to assume an enforcement role, which is not consistent with current objectives of the groundfish observer program.

According to Parrish et al. (2001), the enforcement costs of establishing MPAs will vary with the following factors:

1) the number, size, and shape of the MPAs;
2) types of activities restricted and allowed;
3) degree of change the MPAs require as compared to current usage of the area;
4) proximity of the MPAs to other activities such that public surveillance can occur or there will be an enforcement presence in the area for other reasons; and
5) the types of activities enforcement is diverted from in order to enforce MPAs (unless new funds are made available for enforcement).

The costs of enforcing marine reserves and other MPAs have been declining due to the decreasing costs of technologies such as vessel monitoring systems (VMS) (See Alternative 1 discussion of management and enforcement costs).

Restricting recreational fisheries in MPAs would increase regulatory complexity and the monitoring and enforcement costs associated with these fisheries. Although many recreational vessels carry the necessary electronic equipment to chart their location, monitoring compliance in the recreational fisheries may be costly. Unless VMS requirements were extended to include recreational vessels, the existing methods of patrolling sea areas either by airplane or ship would have to be used to monitor and enforce closed areas. At-sea monitoring would be more expensive and less effective than using VMS.

Comprehensive baseline and post-implementation studies of marine reserves are necessary to determine their biological effects (Parrish et al., 2001). The costs of monitoring MPA effectiveness are difficult to evaluate at this general level of discussion and will primarily be dependent upon the number and size of reserves and the number of significant types of habitat encompassed in the marine reserves. As an example of expected costs, $80,000 was spent for a one-time only survey of the bottom habitat in deep water (25 m to 100 m) inside and outside the Big Creek Ecological Reserve off central California; this represented about 25 square kilometers of total study area (Parrish et al. 2001). An additional $300,000 was spent to collect baseline information on fish abundance, diversity, and size composition in and out of the reserve in deep water over two years following establishment of the reserve. Parrish et al. (2001) note that with larger MPAs, there is potential for using cooperative industry/agency research platforms for extractive monitoring.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data collection system (Russell Porter, PSMFC, pers. comm., Oct. 30, 2003).

4.4.7 Social and Economic Impacts of Alternative 7 (*Preferred - Sector allocations, vessel catch limits, future IFQ*)

Alternative 7 combines features of Alternatives 1, 4 and 5. The policy goal of this alternative is to reduce bycatch by setting annual catch limits for the various fishery sectors and then rewarding those sectors with the least bycatch with greater fishing opportunities. Fishery sectors would become the primary management unit and overfished species mortality limits would be set for each sector. The definition of "trip limit" would be revised to include catch limits, which would refer to a species mortality limit as opposed to a retention limit. Initially, catch limits would likely be established for overfished groundfish stocks; over time, as the monitoring infrastructure comes online, additional species could be added. Ultimately, individual fishing quotas or *DEDICATED ACCESS PRIVILEGES* would be established for those sectors and vessels the Council deems appropriate. Vessel catch limits would established for vessels that carry an observer at the vessel's expense. These would be set for each two-month period (or other amount of time), and would expire at the end of each period (just as trip limits expire). Trip (retention) limits for non-overfished groundfish would be used in combination with vessel catch limits. Vessels with catch limits and observers would have larger trip limits for non-overfished species than those vessels that do not. A fishing sector would be closed when any catch limit for that sector is reached or projected to be reached. Other sectors would continue fishing unless an overall OY is reached.

Vessel catch limits are expected to be an incentive to carry observers, because eligible vessels would get a guaranteed portion of the sector allocations for overfished species and larger trip limits for other groundfish. These catch limits would enable the vessel to alter its strategy and gear to stay within the cap without the risk of being closed by other vessels' high bycatch rates. This could be especially important if sectors are large and include diverse fishing strategies. For example, vessels predominantly fishing deepwater species (e.g., Six-month complex) may want not to be lumped with vessels fishing nearshore flatfish. The sectors themselves may not be limited entry units; that is, once a sector is closed, a vessel having permits to fish within another open sector may be free to do so.

Fishery monitoring would be increased over Alternatives 1 through 3, thus costs would be higher. Alternative 7 would allocate specific annual amounts of overfished groundfish to each identified fishery sector and treat these as hard limits that may not be exceeded (as Alternative 4).

Eight commercial fishing sectors are identified under the current regulations: limited entry trawl; limited entry longline; limited entry pot; three whiting sectors (catcher processors, motherships and shore-based); open access; and tribal. In addition, the recreational sector must be addressed and limited to protect the other sectors' allocations. These sectors could be subdivided or combined and may be subdivided by geographical area.

4.4.7.1 Effects on Fishers' Incentives to Reduce Bycatch

Under this alternative, those limited entry vessels without catch limits could continue to discard, but observers would record bycatch data which would be used to update the NOAA Fisheries bycatch model. When a sector reaches (or is projected to reach) any limit, all vessels in that sector must stop fishing for groundfish for the remainder of the year (or until otherwise allowed to start again). Under this alternative, the risk is reduced that one sector's harvest would affect the fishing opportunity of other sectors. However, the catch of overfished species by individual vessels within each sector could negatively affect other vessels in the sector. In the short term, observer bycatch information will not be available during the fishing season, and landings data of non-overfished species would be monitored as proxies for overfished species. (It is assumed that unobserved vessels would consider it prudent to discard overfished species so that catch would not enter the PacFIN landings data system.) As under the no action alternative, the Council's GMT would monitor landings of target species throughout the season and apply the assumed bycatch rates. Under this alternative, these data would be evaluated sector by sector. Post-season analysis using updated bycatch rates will be necessary to determine if any sector exceeded any allocation; trip limits for the upcoming season would be adjusted as appropriate to maintain the allocation shares. Allocations could also be adjusted. Over time, as the observer program is upgraded to provide inseason bycatch data, bycatch rate adjustments could be made during the season as well. That could result in greater insecurity about how long the season will remain open. For example, a single disaster tow of an overfished species, if observed, could cause an entire sector to be shut down. Although the possibility of a race for fish would be limited by the continued use of trip limits, it is likely that unobserved vessels would attempt to maximize their revenues as early in the year as possible.

Observed vessels would have larger trip limits for non-overfished groundfish and would thus have incentive (and increased revenues) to pay the costs of observer coverage.

It is clearly in the best interest of all vessels within a sector to reduce the catch of overfished species. However, in the absence of individual limits, there may be economic factors that reduce the incentive of individual vessels to be more selective in what they catch. A vessel captain who takes actions to reduce bycatch bears the full costs of deploying more selective gear and searching for cleaner fishing grounds. While some benefits of minimizing the capture of unwanted fish (e.g., less handling time) accrue solely to the individual that incurs these costs, the benefits of avoiding closure of the fisheries to the sector are spread across all vessels. The free-riders that did not adopt more selective fishing methods (or even eschew bycatch reduction methods they use under the *status quo*) may develop a competitive advantage over those that do, by incurring fewer operating costs and/or increasing their share of the catch limit. Continued use of trip limits would limit the likelihood of this occurring. If the free-rider problem resulted in a noticeable redistribution of profits across the sector, no one would be motivated to continue to invest in fishing practices that reduce the catch of overfished species and other unwanted fish. However, only unobserved vessels could be free riders.

Vessels opting to provide for their observer coverage would be protected from not only free riders, but also from other vessels of the sector they would otherwise be part of. By establishing individual vessel caps for overfished species, vessels have a much greater incentive to avoid those species. In addition, they would also have access to larger amounts of non-overfished species so long as they avoided reaching any catch limit. In the absence of vessel caps, vessels within a sector would be expected to move away from high bycatch areas, and peer pressure by other vessels in the sector could be exerted on those who are reluctant to move. However, without formal constraints and due to the lag time in availability of observers' bycatch data, there may be enough incentive to ignore the bycatch reduction goals. If some vessels contribute to the joint bycatch reduction effort while others free-ride, the provision of the collective benefit is less than optimal (Ostrom, 1990). Individual caps for overfished species would effectively prevent the free rider issue, allowing cooperative patterns of behavior to emerge. For example, vessel owners and captains within a particular sector may be more willing to exchange fishing information, such as the location of bycatch hotspots (Gauvin et al., 1996).

The free rider problem would be less in sectors that consist of a relatively small number of participants with common interests, such as the whiting catcher-processor fleet. In such situations, negotiation of voluntary cooperatives might be feasible. The formation of cooperatives could further facilitate collective efforts by industry to reduce bycatch. For example, vessels could pool their catch limits to provide a larger buffer in case of an unpredictable bycatch encounter. Also, contractual arrangement among cooperative members may restrict the harvest of target species in areas of high bycatch to member vessels with low bycatch rates as an incentive to promote cleaner fishing practices. Cooperative members could rely on civil law to enforce contract terms. The catcher-processor sector of the Pacific whiting fishery currently uses a cooperative structure to limit salmon bycatch and actively shares information on incidental catch of other overfished groundfish species as well.

An added economic incentive for fishers to take collective action to fish more selectively under this alternative is that, in addition to the larger trip limits, a portion of some OYs could be reserved for the sector(s) or vessels with the lowest bycatch.

4.4.7.2 Effects on Commercial Harvesters

Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring healthier groundfish, especially if sector participants ignored incentives and did not apply bycatch-reducing fishing tactics. A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. On the other hand, more desirable species such as yellowtail rockfish are often harvested below cumulative catch limits, due to constraints associated with overfished species. This and other healthy stocks could be more accessible if sector bycatch reduction efforts were successful. In addition, the total amount of fish available for harvest would be expected to increase slightly as assumed/estimated bycatch rates are replace by actual counts. Currently, an annual landed catch OY may be set below the ABC to account for the expected bycatch. (In 2004, only total catch OYs were set; in some previous years, landed catch OYS were set.) By improving bycatch/discard monitoring and reporting, in the longer term Alternative 7 could reduce the need for bycatch adjustments because discarded fish could be counted towards OYs in-season through real-time observer reporting.

Expanded observer coverage would impose significant additional operating costs on vessel owners opting for a pay- as-you-go system. (Processing vessels in the Pacific whiting fishery operate this way.) Depending on implementation measures, the vessel owner could be responsible for making arrangement with an observer employment firm that provides the required observer services and for paying all associated costs (PFMC, 2003e). Even vessels that do not opt for catch limits and larger trip limits, and therefore do not pay the direct costs of observer coverage, may incur substantial indirect costs. At a minimum, it is likely that observer food costs will be borne by the vessel. Limited bunk space may require vessel operators to reduce the number of crew in order to accommodate observers, resulting in a decrease in the operating efficiency of the remaining crew. Vessels may also incur costs if they choose to carry additional liability insurance. These costs would vary between individual vessels, depending on the insurance carriers' minimum allowed coverage period, and the coverage approach that is taken (PFMC, 2003e).

It is likely that the smallest groundfish vessels would be unable to use the catch limit/larger trip limit for a variety of reasons. Some vessels are simply too small to accommodate an observer. Also, they might be unable to generate enough additional revenue to cover the additional costs. Vessels with the least revenue may be excessively burdened if required to carry an observer over an extended period of time, even if the observer is provided by NMFS. Electronic monitoring technology, such as the installation of tamper-proof video cameras on board vessels to record activities at sea, may prove to be a viable option for monitoring catch and discards (Appendix C).

The economic effects of this alternative on commercial harvesters may also vary by sector, depending on the mechanism for allocating the allowable catch. For example, managers may consider gear impacts, efficiency, and other factors in determining the percentage allocation of harvest for each sector. Sectors consisting of vessels that use relatively clean fishing methods and generate overall gains for the fisheries (e.g., produce a higher value product, have a lower impact on juvenile stocks, result in minimal habitat disturbance) could receive a larger allocation.

Such preferential allocations may induce each sector to engage in rent-seeking behavior. Lobbying efforts to acquire the maximum allocation possible may be costly. For instance, fishers may sacrifice even more valuable fishing time to attend Council meetings, and industry associations may acquire the services of lawyers and lobbyists to help the association influence decisions on the allocation of catch limits (Anderson, 1992).

The allocation of catch limits to individual sectors and the opportunity to pool individual vessel catch limits could lead to cooperative patterns of behavior besides those directly related to reducing bycatch. In particular, sector members may form private agreements, allocating transferable harvesting privileges, as was done by catcher-processors in the Pacific whiting fishery. The allocation of transferable privileges through private agreement generates benefits for commercial harvesters similar to those that might be generated under an ITQ program (See Alternative 5 effects on commercial harvesters). Unlike ITQs, however, the distribution of fishing privileges and the system for trading, selling, or enforcing them is decided by the parties to the agreement.

Sullivan (2000) states that the ability to negotiate private agreements allocating harvesting privileges depends on certain conditions being met, including: 1) a relatively small number of participants, with a sufficient community of interest to make negotiations feasible; 2) an adequate system for gathering fishery harvest data, and adequate data verification and transparency to monitor compliance and enforce it in cases of non-compliance; 3) significant barriers to prevent new participants from entering after shares have been negotiated, or else free riders are almost certain to take advantage of the fishermen who rationalize their harvest; 4) an opportunity to attain additional value through an allocation agreement; and 5) for antitrust law reasons, when the arrangement includes one or more vertically integrated producers operating in a U.S. fishery, assurance that the relevant fishery sector's target species or incidental catch allocation(s) will be limited and fully harvested.

Once an agreement is negotiated, the parties to the agreement must have internal rule-making capability and sanctioning authority to deter those who are tempted to break the rules (Ostrom,1990). Quota shares could be created by using contracts and relying on civil law to enforce contract terms, including penalties (e.g., expulsion from the agreement) for vessels that exceed their quota holdings.

Leal (2002) states that one advantage private harvesting agreements have over an ITQ program is avoidance of the expensive rent-seeking behavior that often accompanies allocation of ITQs. Although this process may not be free from controversy, it appears to be easier for the individual participants to allocate individual shares than to have the government do it. On the other hand, Leal (2002) notes that private harvesting agreements may also have some disadvantages in comparison to ITQs. A new entrant can simply buy or lease ITQs from a quota owner willing to sell or lease. In contrast, with a private harvesting agreement, the transfer of shares to a new entrant will require becoming a party to the agreement. In addition, ITQs may be likely to remain in force, especially once they acquire value through the secondary market. By contrast, the durability of private agreements depends on the willingness of parties to maintain the agreement. Even when the arrangement has no sunset provisions, or requires a majority of members to rescind it, members may not retire as many redundant vessels or invest in as much of the product enhancement capital as they would under a system of ITQs.

The cooperative patterns of behavior that may develop under this alternative are expected to generate economic benefits for commercial harvesters. These benefits may render some commercial harvesters better able to sustain the costs of an observer requirement. In addition, increased observer coverage may allow more vessels to process seafood products at sea. It is uncertain whether the presence of observers would lead to a relaxation of state restrictions on at-sea processing. Investments in freezing capacity could lead to significant increases in revenues for some vessel owners (OCZMA, 2002). For example, sablefish commands substantially higher prices when frozen at sea. However, even if all the possible economic benefits under Alternative 7 are realized, it is likely that paying observer costs would not be economically feasible for many vessels.

4.4.7.3 Effects on Recreational Fisheries

This alternative may or may not have negative economic effects on recreational fishers relative to Alternative 1. Under the no action alternative, the recreational fishery is managed under harvest guidelines for canary rockfish, bocaccio, lingcod and other species. The Council and states try to keep recreational catches from exceeding these amounts, often resulting in unexpected closure of the recreational fishery. Improvements in the recreational catch monitoring program may either reduce or increase the likelihood of restrictions. Under Alternative 7, NMFS' ability to detect excessive catches within the sector may be enhanced by improvements to the recreational monitoring program.

Closure of the recreational fishery results in fewer fishing experiences for private anglers and charter fishing patrons. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, because there are many and diverse participants.

Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects of this alternative, particularly for Washington and Oregon. Recreational catches in those states have been relatively steady and predictable compared to California. Recreational fishers in the north could have greater security about their fishing opportunities if separate allocations were established.

4.4.7.4 Effects on Tribal Fisheries

Tribes are effectively a specified sector, with sablefish and whiting allocations that are functionally similar to species caps. The Tribes' allocations and anticipated catches of overfished species are not considered caps under the no action alternative. Alternative 7 would not change the amounts of any allocations. However, it could establish allocations of overfished species such as canary, yelloweye and widow rockfish. If allocations were treated as caps under Alternative 7, they could have an adverse economic effect on Tribal fishers, especially the Makah Tribe, if the Tribal Pacific whiting or sablefish fishery were closed as a result of early attainment of an overfished species cap. There has been some catch of canary rockfish, widow rockfish, and dark-blotched rockfish in the whiting fishery. In most recent years, whiting provided the lion's share of harvest tonnage and a major portion of ex-vessel revenue. Consequently, the economic impacts of a fishery closure could be severe.

4.4.7.5 Effects on Buyers and Processors

The economic effects on buyers and processing companies are uncertain because of the uncertainty as to whether vessel owners within sectors and those with individual catch limits can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, higher catches in the groundfish fisheries are expected. Any substantial increase in landings could eliminate upward pressure on ex-vessel prices; however, the potential for large increases appears unlikely in the near future. Greater throughput over constant fixed costs will result in lower average costs for processing facilities.

On the other hand, if a single disaster tow shut down an entire fishing sector, buyers and processors may experience significant shortages of fish. Current fish processing infrastructure could be disrupted if the trawl fishery accelerated early in the season under this alternative (although trip limits would tend to prevent that.)

4.4.7.6 Effects on Communities

To the extent that commercial harvesters were able to prosecute groundfish fisheries without being shut down, this alternative would not be expected to have a significant economic impact on communities. The groundfish fisheries would continue to benefit fishing communities as under the *status quo*. However, if sector closures did occur, there would likely be negative impacts in fishing communities, particularly if processing plants are also forced to close.

4.4.7.7 Effects on Consumers of Groundfish Products

If this alternative did not result in early closures of major harvesting sectors, it would be expected to have little impact on consumers relative to the *status quo*, as the price per unit, product availability, and product quality would be unlikely to change substantially. However, if major fishing sectors were shut down due to unexpected catches of overfished species, consumers could see a disruption in groundfish supplies. To the extent that supplies of fresh or live groundfish from

West Coast fisheries were curtailed, a loss of consumer surplus could occur. A reduction in supplies of frozen West Coast groundfish would be likely to have a minimal effect on consumer surplus because this product form has many more substitutes.

4.4.7.8 Effects on Fishing Vessel Safety

The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations may lead to reductions in injury and loss of life because of harvester's incentives to take fewer risks and use their best judgment in times of questionable weather conditions. An intense race for fish appears unlikely; although fishers would likely increase their effort early in the year when weather conditions may increase risks. The could result in a reduction in the safety of fishers while at sea. On the other hand, early closure of a sector would reduce the amount of time those vessels were at sea, resulting in increased safety.

4.4.7.9 Effects on Management and Enforcement Costs

Alternative 7 would be expected to notably increase management and enforcement costs for initial start up and over the long term. The sector allocations required by this alternative would take two to four years to develop, analyze, and implement through the Council and NMFS management processes. In addition, human costs associated with inseason catch projections would be greatly increased in order to track multiple sectors inseason. As catch limits were allocated over an increasing number of sectors, NMFS would be required to manage increasingly small blocks of fish. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. In the short term under Alternative 7, the PacFIN quota species monitoring (QSM) program would have to be revised to track each sector's landings independently. Catches of overfished species would be projected based on landings of target species; each sector would likely have different assumed bycatch rates. If sectors are open, meaning vessels would be free to move from one to another without warning, catch monitoring could become even more complex and difficult. Over time, as observer coverage and associated infrastructure improves (at additional cost), sectors may be managed in real time. This would increase the pressure on observer data whenever new information indicated increased bycatch rates. An expanded port/field sampling program could improve inseason estimates of recreational catch. It would also be necessary to have adequate observer coverage of every sector's vessels to ensure the effectiveness of sector caps.

As discussed above in the analysis of the economic effects on commercial harvesters, the costs of expanded observer coverage would be borne mostly by industry, unless NMFS provided all observers at no cost to vessels. Federal funds for expansion of the observer program have not been identified. In addition, the increase in the number of observers and its associated increase in the amount of data collected is expected to raise overall annual costs of the groundfish observer program. This budgetary increase can be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. Computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management. However, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the observer program have not been estimated.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data system.

4.4.8 Data Gaps and Information Needs

As discussed previously, there may be insufficient information to comprehensively assess the economic consequences of existing or expanded measures to mitigate bycatch in the groundfish fisheries. This section will outline the data requirements needed to frame a more complete economic impact assessment.

The following quantitative data would support the analysis of the economic effects of the alternatives. In some cases, time series data would be useful to compare the economic status of the groundfish fisheries before and after implementation of existing management measures that have affected the level of bycatch. These data would also provide a benchmark that would allow before-and-after comparisons if alternative measures were implemented.

- Estimates of excess harvesting and processing capacity (including latent capacity of inactive vessels) derived from information on the quantities of capital equipment purchased and maintained by plants and vessels, their activity levels in various fisheries, and variable input use (for items such as labor, fuel, fishing gear, and other essential inputs). These estimates should be by sector and vessel length category.
- Average sale price of groundfish license by vessel designation, length category, gear type, and area endorsement, 1995-2004.
- Estimates of the economic effects of groundfish bycatch in groundfish and other fisheries using bio-economic, multi-species models that incorporate data on biological interactions, effort levels, catch and bycatch rates, and catch values.

- Model-based estimates of the economic effects of introducing dedicated access privileges (catch limits and ITQs) in the fisheries, including changes in the size, structure, location, and profitability of the fleet.
- Information on the current economic performance of the fleet and individual vessels and processors, including disaggregated income, cost, and employment information from harvesting and processing firms.
- Vessel and processing facility ownership data to monitor changes in concentration of ownership in the harvesting and processing sectors, the structure of ownership (including proprietorships, publicly traded corporations, and privately held corporations) and the relationships both within firms (i.e., the amount and nature of vertical and horizontal integration) and among firms.
- Data to measure the willingness to pay (demand) for recreational fishing experiences of varying quality.
- Data on the relative economic importance of fisheries (salmon, crab, groundfish, and pelagic species) to individual fishing vessels and processing companies in various ports, and information on the amounts of product processors acquire from local and outside sources.
- Model-based estimates of the economic effects of establishing marine reserves using information on the location and magnitude of current harvest and effort, travel costs to different fishing grounds and the extent to which fishermen can relocate to other areas.
- Estimates of the existence value and other non-consumptive values attributed to resources within proposed marine reserves.
- Information on the dependence of families in various communities on income from fishing, alternative sources of income, and resources available in communities to assist families in adapting to change.
- Information on the costs and effectiveness of alternative onboard electronic monitoring technology to monitor catch and discards, including video recording devices.
- Information on the costs and effectiveness of alternative industry reporting and recordkeeping requirements to monitor catch and discards, including vessel logbooks.

4.5 Summary of Impacts of Alternative Monitoring Programs

Data Reporting, Record-keeping, and Monitoring are summarized in Table 4.5.1 and briefly described below:

1. **Alternative 1** 10% coverage of commercial fleet, 100% coverage of at-sea whiting catcher/processor fleet.
2. **Alternative 2** Same as Alternative 1, except some marginal increase in coverage due to fewer vessels.
3. **Alternative 3** Same as Alternative 1, except some marginal increase in coverage due to fewer trips**.**
4. **Alternative 4** Significant increase in observer coverage with allocation among fishery sectors and increased recreational sampling
5. **Alternative 5** 100% observer coverage of commercial fleet and charter boats.
6. **Alternative 6** 100% observer coverage of commercial fleet and charter boats.
7. **Alternative 7** Significant increase in observer coverage with allocation among fishery sectors and increased recreational sampling

Effectiveness of tools to improve accountability are ranked by alternative in Tables 4.5.1 and 4.5.2

Table 4.5.1. Monitoring tools and effects on improving accountability and cost impacts of each tool. Effects scaled as follows: Y (definitely, substantially), y (probably, moderately), n (probably not, minor), and N (no, none); L = lower cost, M = moderately higher cost, H = highest cost.

Monitoring/Reporting Requirements	**Alternatives**	Program	Identify fishing locations	Identify fishing depths	Provide tow by tow data	good data quality	Increase quantity and timeliness of data	Identify groundfish discards	Provide groundfish biological data	Provide non-groundfish data	Provide other non-finfish data	Provide mammal and seabird data	Ease of enforcement	Administrative Costs	Compliance Costs (to industry)
fish tickets	1-6	state	N	N	N	y	Y	N	N	y	N	N	Y	L	L
logbooks	1-2,4-6	state	y	y	y	y	n	N	N	N	N	N	Y	M	M
logbooks	3	federal	y	y	y	y	y	y	N	N	N	N	Y	M	M
observers															
commercial 10%	1-3	federal	Y	Y	Y	Y	n	Y	Y	Y	Y	Y		H	M/H
commercial 60%	4	federal	Y	Y	Y	Y	y	Y	Y	Y	Y	Y		H	M/H
commercial 100%	5,6	federal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		H	M/H
CPFV	4-5	(state)	Y	y	-	Y	Y	Y	Y	Y	Y	y		H	M/H
sport		n/a			-		-							HH	
port sampling															
commercial	1-6	state	y	y	N	Y		n	y	N	N	N		M	L
CPFV	1-6	state	y	y	-	Y		n	y	y	N	N		M	L
sport	1-6	state	y		-				y?	y?				M/H	L
VMS	1-6	federal	Y	y	N	Y	Y	N	N	N	N	N	Y	L	M
mandatory retention	5,6	federal				Y	Y	y	y	n	n	N	N	H/M	M/H
Enforcement cost			H	H	H			H		H	H				

Table 4.5.2. Monitoring alternatives and rank of effects on improving accountability, and cost impacts of each alternative.

RELATIVE RANK OF ALTERNATIVES BY EFFECTIVENESS AT IMPROVING ACCOUNTABILITY, EASE OF ENFORCEMENT, REDUCING COMPLIANCE COSTS	Alternative 1 10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	Alternative 2 10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	Alternative 3 10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, 100% log coverage, log verification, VMS.	Alternative 4 60% commercial and recreational (CPFV) observer coverage, increased commercial and recreational port sampling, catch projections based on fishtickets and some in season estimates of discard and in-season observer data, VMS.	Alternative 5 100% commercial and recreational (CPFV) observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	Alternative 6 100% commercial and recreational (CPFV) observer coverage, commercial and increased recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	Alternative 7 >10% commercial and recreational (CPFV) observer coverage, increased commercial and recreational port sampling, catch projections based on fishtickets and some in season estimates of discard and in-season observer data, VMS.
Indentify fishing locations (VMS)	1	1	1	1	1	1	1
Identify fishing depths (VMS)	1	1	1	1	1	1	1
Provide tow by tow data	2	2	1	1	1	1	1
Provide good quality data	4	4	3	2	1	1	2
Increase quantity of data	5	4	3	2	1	1	2
Allow inseason use of data	3	3	3	2	1	1	2
Identify groundfish discards	5	4	3	2	1	1	2
Provide groundfish biological data	6	5	4	3	2	1	3
Provide non-groundfish biological data	3	3	3	2	1	1	2
Provide non-finfish biological data	3	3	3	2	1	1	2
Provide mammal and seabird data	3	3	3	2	1	1	2
Ease of enforcement	5	4	3	2	1	1	2
Keep administrative costs low	2	3	4	5	6	6	4
Keep industry compliance costs low	2	3	4	5	6	6	4
Rank of location	2	2	1	1	1	1	1
Rank of quality, quantity, timeliness	5	4	3	2	1	1	2
Rank of groundfish biological data	6	5	4	3	2	1	3
Rank of non-groundfish biological data	3	3	3	2	1	1	2
Rank of ease of enforcement	5	4	3	2	1	1	2
Rank of cost	1	2	3	4	5	5	3 to 4
Number of first place scores	2	2	4	4	15	17	4
Number of last place scores	15	8	5	0	3	3	0
Overall Rank	6	5	4	3	2	1	3

Overfished Groundfish Under the Alternative 1 observer program, total catch estimates of overfished species are highly variable for several reasons. Most of the species are highly aggregating rockfish and population abundance is low, thus tow by tow variability is quite high. WCGOP was initiated in the fall of 2001 and depends on accumulation of observed tows to stabilize variability (NMFS 2003). A complete estimate cannot be made until after logbook and fish ticket data are acquired, some months after the fishing season is over. Status quo monitoring improves previous bycatch estimates, which were based on dated studies. In spite of sampling limitations, these estimates better reflect current population levels, management, and fishing strategies.

Amendment 16-2 (PFMC 2003c) discusses status quo bycatch monitoring of overfished species (see section 4.3.1.2). One of the primary concerns with bycatch monitoring is that rebuilding of overfished species is sensitive to actual bycatch rates. Total catch must be accounted for accurately for rebuilding to be successful. Under status quo, observer coverage is available for about 10-20% of the commercial fleet. (100% of at-sea Pacific whiting catcher processors have observer coverage.) As was pointed out in the Amendment 16-2 EIS, if bycatch estimates are underestimated, rebuilding progress will be compromised (PFMC 2003c). On the other hand, if they are overestimated, trip limits and available harvest of overfished and healthy stocks of groundfish will be lower, bycatch and bycatch mortality will be higher, and there will be indirect negative socioeconomic impacts. Low OYs for some species make it imperative to improve accounting of catch and bycatch.

Alternatives 2 and 3 assume the same number of observer days would be applied to fewer trips, due to either a reduced fleet size (Alternative 2) or reduced seasons (Alternative 3). This would have the effect of increasing the proportion of total trips having observer coverage. Some marginal improvements should occur in tracking of overfished species.

In Alternatives 4 and 7, the observer program would be modified to ensure adequate coverage of all sectors. In addition, the data compilation and analysis functions would be augmented with the intent to move towards providing catch and bycatch data for inseason management. Costs associated with both aspects would be significantly higher than expected under Alternatives 1, 2 and 3. Under Alternatives 4 and 7, observers would be placed on a subset of each sector, and observed catch rates extrapolated (expanded) to the entire sector. Recreational sampling would also be increased. These modifications would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Bycatch mortality of overfished species may also be reduced in the commercial fishery compared to the first three alternatives, as fishers are likely to retain catches.

Alternatives 5 and 6 provide 100% observer coverage of the commercial fleet and increased monitoring of the recreational charter boat fleet. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given fishing vessel. These controls would have a direct effect of reducing bycatch of overfished species compared to the first four alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the first four alternatives, because fishers are more likely to retain catches.

Although coverage of the charter boat fleet is increased, some bycatch mortality of rockfish caught and released in the recreational fishery would occur. Bycatch mortality of lingcod is thought to be less than for rockfish, because lingcod do not possess a swim bladder.

Costs for Alternatives 5 and 6 are significantly higher than Alternatives 1-3 and somewhat higher than Alternative 4. Costs for Alternative 7 would fall somewhere between Alternatives 4 and 5.

Emphasis Species Several species of groundfish co-occurring with overfished species or species under precautionary management are constrained in an effort to control harvest of species of concern. Ratio management seeks to predict catch of overfished species and those under precautionary management relative to target species in order to scale and proportion trip limits. Under Alternative 1, if observer coverage and monitoring efforts result in over estimation of the bycatch of overfished species or species under precautionary management, trip limits for healthy stocks such as shelf rockfish, Petrale sole, Dover sole, sablefish, and longspine thornyhead could be constrained more than they need to be (see discussion above under *Overfished Groundfish*) resulting in an increase in bycatch and bycatch mortality as well as negative socioeconomic impacts. Nevertheless, it is critical to improve estimates of catch and bycatch in order to provide accurate catch ratios and set trip limits that reflect these ratios.

As was described above under *Overfished Groundfish*, Alternatives 2 and 3 should have a positive impact on catch reporting of other groundfish as compared to Alternative 1. Discard information on other healthier stocks of groundfish may be improved. Currently, observers do not always collect data on the reasons for discarding fish. Managers may wish to allocate some of time spent accounting for overfished species and other groundfish (ratio estimation) towards gathering additional important data on the reasons for discard.

Alternatives 4 and 7 would improve reporting of catch over the previous Alternatives 1, 2 and 3, and should produce more precise information about regulatory, size, and market induced discard of other groundfish. The improved information should have a positive indirect impact on stock assessments of other groundfish.

Discarding of other groundfish would still be legal under Alternative 5 but not Alternative 6. Some nearshore species (such as black rockfish and cabezon) could still be discarded by nearshore commercial and recreational fleets. Thus, the monitoring program under Alternative 5 may be slightly less effective than under Alternative 6. Full (100%) observer coverage of the limited entry commercial fleet and increased coverage of the open access and recreational fleets would provide better data on total catch of other groundfish, including discards. These alternative should substantially improve information and accountability compared to the first four alternatives. Another impact of 100% observer coverage would be timely and accurate accounting of most of the catch. Indirect impacts of 100% observer coverage would include improved stock assessments and improved data on reasons for discard that may led to new methods of avoiding bycatch.

Potential impacts to the resource due to bias in catch estimates are thought to be minimal for more abundant species such as petrale sole and English sole, because current exploitation rates are thought to be low, thus catch and bycatch are low with respect to OY.

4.6 Summary of Impacts to Biological Environment

The relative effectiveness of each alternative in reducing bycatch and bycatch mortality is summarized and compared in Tables 4.6.1 and 4.6.2.. Effect on individual fisher accountability is included.

Table 4.6.1. Relative rank of bycatch reduction methods (tools) for each alternative used to reduce bycatch and bycatch mortality, and to address accountability issues.

RELATIVE RANK OF ALTERNATIVES BY BYCATCH REDUCTION TOOL TYPE	Alternative 1 Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	Alternative 2 Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	Alternative 3 Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	Alternative 4 Reduce all groundfish bycatch by establishing sector caps	Alternative 5 Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	Alternative 6 Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements	Alternative 7 Reduce all groundfish bycatch by establishing sector caps, develop individual vessel caps and increased observer coverage.
FISHERY MANAGEMENT TOOLS							
Harvest Levels							
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	1	1	1	1	1	1	1
Set **overfished groundfish catch caps** by **fishing sector**	2	2	2	1	2	2	1
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	4	2	3	2	1	1	2
Use **catch limits** to control groundfish bycatch	3	3	3	2	1	1	2
Set individual vessel/permit catch caps for overfished groundfish species	3	3	3	1	2	1	1 to 2
Set groundfish **discard caps** (require increased retention)	2	2	2	2	1	1	2
Establish **IQs** for other groundfish	2	2	2	2	1	1	1 to 2
Establish bycatch **performance standards**	3	3	3	2	1	1	2
Establish a reserve for fishers who achieve performance standards	3	3	3	1 to 2	1	1	1 to 2
Gear Restricitons							
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	2	2	2	2	3	1	2
Time/Area Restrictions	3	3	3	3	2	1	3
Establish **long term closures for all groundfish**	3	3	3	3	2	1	3
Establish **long term closures for on-bottom fishing**	2	2	2	2	1	1	2
Capacity reduction (mandatory)	3	1	3	3	2	2	3
Monitoring/Reporting Requirements							
Trawl logbooks	2	2	1	2	2	2	2
Fixed-gear logbooks	2	2	1	2	2	2	2
CPFV logbooks	2	2	2	1	1	1	1
Commercial **port sampling**	3	3	3	2	1	1	1
Recreational port sampling	3	3	3	1	2	1	1
Observer coverage (commercial)	5	4	3	2	1	1	1 to 2
CPFV observers	3	3	3	2	2	1	2
VMS	1	1	1	1	1	1	1
Post-season observer data OK	3	3	3	2	1	1	1 to 2
Inseason observer data required	3	3	3	2	1	1	1
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	2	2	2	2	1	1	1
Discount fish ticket records of overfished species landings due to the low likelihood they accurately reflect actual catch and mortality.	2	2	2	1	1	1	1
Number of first place scores	2	3	4	7 to 8	16	22	9 to 14
Number of last place scores	23	20	18	12	3	3	11
Overall Rank	5	5	5	4	2	1	3

Table 4.6.2. Alternatives ranked by their effectiveness at reducing bycatch, enforcing and monitoring bycatch measures, and reducing compliance costs to industry.

RELATIVE RANK OF ALTERNATIVES BY POTENTIAL BYCATCH REDUCTION, EASE OF ENFORCEMENT AND COST	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector caps and individual vessel restricted species quotas (RSQs)	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements	**Alternative 7** Reduce all groundfish bycatch by establishing sector caps and individual vessel restricted species catch caps (RSCs)
Reduce catch in excess of vessel limits?	5	4	5	3	2	1	2 to 3
Reduce proportion of overfished species?	5	3	4	2	1	1	2
Reduce encounters with overfished species?	5	3	4	2	1	1	2
Reduce fishing in high relief seafloor areas?	5	3	4	2	2	1	2
Reduce catch proportion of on-bottom species?	5	3	4	3	2	1	3
Reduce catch proportion of off-bottom species?	6	4	5	3	2	1	3
Reduce catch proportion of small fish?	3	3	3	3	2	1	3
Reduce catch of unwanted finfish species?	3	3	3	3	2	1	3
Reduce potential for "ghost fishing"?	1	1	1	1	1	1	1
Reduce catch of marine mammals?	2	1	2	2	2	2	2
Reduce catch of seabirds?	2	1	2	2	2	2	2
How easily enforced/ monitored?	5	4	3	2	1	1	2
Compliance Costs (to vessel)	1	2	3	4	5	6	4 to 5
Rank of Groundfish Bycatch Reduction	6	4	5	3	2	1	3
Rank of Other Bycatch Reduction	2	1	2	2	2	2	2
Rank of Enforcement	5	4	3	2	1	1	2
Rank of Cost	1	2	3	4	5	6	4
Number of first place scores	2	3	1	1	4	10	1
Number of last place scores	11	2	4	4	2	3	4
Overall Rank	7	5	6	4	2	1	3

4.7 Summary of Impacts to the Socioeconomic Environment

Table 4.7.1(a) summarizes the social and economic impacts of Alternatives 1, 2 and 3. Table 4.7.1(b) summarizes the social and economic impacts of Alternatives 4, 5, 6 and 7. The significance of the impacts of all the alternatives is described in Table 4.7.2.

Table 4.7.1(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment (Alternatives 4, 5, 6 and 7 in following table).

	Alternative 1	Alternative 2	Alternative 3
Incentives to Reduce Bycatch	Quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards are expected to increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely. However, in comparison to a race for fish allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards.	Reducing the level of effort in the groundfish fisheries and increasing trip limits would likely reduce the level of groundfish bycatch (discard).	If trip limits increase, the level of groundfish bycatch (discard) would be expected to decline.
Commercial Harvesters	By spreading out fishing more evenly over the year, the current management regime helps maintain traditional fishing patterns. However, landings of major target species (other than Pacific whiting) are expected to continue to decline as OYs are reduced to protect overfished species. Declining harvests lead to significant decreases in total groundfish ex-vessel value.	Further fleet reduction would be expected to reduce (but not eliminate) extra capacity in the fishery and to restore the fleet to some minimum level of profitability.	A combination of higher trip limits and a reduction in the length of the fishing season would be expected to lead to an overall reduction in variable fishing costs. With larger trip limits, revenues per trip are expected to increase. However, the overall impact of this alternative on costs and revenues would depend on when individual participants were allowed to fish. For example, fishers may be unable to fish for certain species at optimal times.
Recreational Fishery	Landings of major target species are not expected to increase and may decline further if OYs are reduced to protect overfished species. Decreased harvests lead to significant decreases in recreational value.	Changes in landings of major species targeted in the recreational fishery would be expected to be insignificant.	Effects as described in Alternative 2
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1
Buyers and Processors	The current management regime reduces the likelihood that processing lines will be idle by fostering a regular flow of product to buyers and processors. However, decreased deliveries of groundfish to processors and buyers will result in significant decrease in groundfish product value.	No significant changes in the total amount of fish delivered to processors is expected. With fewer vessels in the fishery, processors would have fewer boats to schedule for landings. The related reductions in time spent unloading vessels is expected to result in cost savings. However, processors in ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources	Larger trip limits would not be expected to affect the total amount of fish that harvesters deliver to processors. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, costs could increase if processors were unable to control the flow of product throughout the year and capital is idle during closed periods.

Table 4.7.1(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment (Alternatives 4, 5, 6 and 7 in following table).

	Alternative 1	Alternative 2	Alternative 3
Communities	By maintaining year-round fishing and processing opportunities, the current management regime promotes year-round employment in communities. However, groundfish employment and labor income are expected to continue to decline, resulting in economic hardship for businesses involved in the groundfish fisheries. These businesses are expected continue to diversify to reduce dependence on groundfish fisheries.	The direction and magnitude of many of the economic effects on particular coastal communities are uncertain, as the distribution of the post-buyback fleet is uncertain. If further reduction in fleet capacity with higher trip limits were successful in increasing net revenues or profits to remaining commercial fishers, positive economic impacts on the communities where those fishers land their fish, home port and reside would be expected. On the other hand, some communities may experience a significant loss of vessels and a consequent decrease in income, jobs and taxes.	The impacts are uncertain, as community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions. If higher trip limits were successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside would be expected. On the other hand, seasonal closures could leave crew members at least temporarily unemployed.
Consumers	The current management regime allows buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers. Consumers of fresh or live groundfish may be adversely affected by reduced commercial landings. However, changes in benefits to most consumers of groundfish products would be expected to be insignificant due to availability of substitute products.	Effects as described in Alternative 1	Consumers of fresh or live groundfish could be unable to obtain fish from the same sources for half of the year unless the harvest sectors are split into two groups, with one group of vessels active at any given time.
Fishing Vessel Safety	Some gains in fishing vessel safety are at least partially realized under the current management regime, as fishers are able to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. However, safety of human life at sea may decrease if reduced profits induce vessel owners to forgo maintenance, take higher risks or hire inexperienced crews.	Increases in net revenue to harvesters resulting from increases in trip limits may enhance their ability to take fewer risks and use their best judgment in times of uncertainty, thereby increasing vessel safety.	The effects on vessel safety may be mixed. Increases in net revenue to harvesters resulting from increases in trip limits may lead to reductions in injury and loss of life because of harvester's incentives to take fewer risks and use their best judgment in times of uncertainty. However, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish.
Management and Enforcement Costs	The management regime is expected to continue to be contentious, difficult and expensive. Technological developments such as VMS may mitigate the rate at which management costs escalate.	Costs are expected to decrease, as fewer vessels are generally easier and less expensive to monitor.	Effects will vary depending on the way the seasonal closure is structured. Costs are expected to decline if there is no fishing activity to monitor for 6 months of the year. However, there will be increased costs if permit holders are divided into groups.

Table 4.7.1(b). Summary of effects of Alternatives 4, 5, 6 and 7 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Incentives to Reduce Bycatch	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, a race for fish could develop in which individual vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.	The amount of fish discarded by each vessel would be counted against the vessel's limit. This measure provides strong economic incentives to reduce the catch of unwanted fish because it internalizes the costs of discarding fish.	Marine reserves would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing groundfish bycatch (discard) outside of marine reserves. Prohibiting discard would produce a strong incentive to avoid unwanted catch because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. If vessel groundfish quotas are transferable, Alternative 6 would be similar to Alternative 5; if not transferable, negative effects would be much more significant and more similar to Alternative 4.	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, individual vessels may forgo fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.
Commercial Harvesters	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. The allocation of catch limits to individual sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.	Current vessel owners as a group would likely benefit from a system that allocates freely transferable quota shares to vessel owners on the basis of catch histories. Moreover, the total amount of fish available for harvest would increase, as bycatch would be measured more accurately through expanded observer coverage. Not all vessel owners would benefit equally, and the relative benefits would depend on the allocation formula. In addition, the economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage.	Some measures would significantly increase fishing costs, while other would reduce them. For example, 100% groundfish retention, full observer coverage, and establishment of marine reserves would increase average costs, whereas the establishment of ITQs for groundfish species would reduce costs.	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. Establishment of allocations among sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.

Table 4.7.1(b). Summary of effects of Alternatives 4, 5, 6 and 7 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Recreational Fishery	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by a CPFV observer program and expanded port/field sampling. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants. Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects.	The creation of tradable quota shares for the commercial fishing/processing sectors is not expected to apply to the recreational fishery. The possibility of creating ITQs for recreational fishers may exist, but any discussion of how such a allocation would be achieved or its effects on recreational fishers would be speculative.	Rights-based system effects would be as described in Alternative 5. Marine reserves could benefit recreational fishers over the long term if local catch rates and fish size increased due to spillage of adults out of the marine reserves. On the other hand, if marine reserves resulted in geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open could lead to localized stock depletion, reduced recreational catch per unit effort, and reduction in the quality of the fishing experience.	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by improved port/field sampling. Incentive programs are likely to be limited, as there are many and diverse participants. Dividing the recreational sector along geographical boundaries could mitigate some of the negative effects.
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant. However, potential effects of overfished species allocations are significant
Buyers and Processors	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.	Buyers and processors would be expected to benefit from the anticipated increases in fish landings. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Arguments have been made that harvester-only ITQ programs may result in stranded capital in the processing sector and a shift in the balance of bargaining power toward harvesters. These potential adverse effects could be mitigated if processors were also allocated quota shares.	The net economic effect on buyers and processors is uncertain. In general, buyers and processors would be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. Because of their lack of mobility, buyers and processors may be especially negatively affected by marine reserves. However, the effects of marine reserves on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations.	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well vessel owners manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.

Table 4.7.1(b). Summary of effects of Alternatives 4, 5, 6 and 7 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Communities	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.	Consolidation of fishing and processing activities to fewer vessels and plants would likely result in reductions in the numbers of crew members and processing workers employed. Granting quota shares to community groups could help maintain existing harvesting and processing patterns and serve to meet concerns about employment in communities.	Effects of a right-based management system as described in Alternative 5. Marine reserves would be expected to help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, marine reserves resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of communities are experiencing under Alternative 1 (no action) would be exacerbated.	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.
Consumers	If no early closures of major harvesting sectors occur, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.	Consumers would be expected to benefit from the anticipated increases in fish landings. There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring would depend both on the level of consolidation that might occur and the elasticity of demand for particular products.	Consumers would benefit from the anticipated increased landings that result from a rights-based system. In addition, over the long term, marine reserves that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large marine reserves could substantially decrease seafood supply enough to make consumers worse off, at least in the short term. Marine reserves could have a positive effect on those consumers who derive non-consumptive benefits from marine ecosystems, including non-market benefits (e.g., existence value).	If supplies of fish remain consistent, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.
Fishing Vessel Safety	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' incentives to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. If fishers within a sector perceive a greater likelihood of premature closure, vessels would likely be more active early in the year (winter	Possible increases in the profitability of harvesting operations would likely lead to reductions in injury and loss of life because of harvesters' incentives to maintain equipment, take fewer risks and use their best judgment in times of uncertainty.	The net effect of the various measures included in this alternative on fishing vessel safety is uncertain. The establishment of ITQs for groundfish species is expected to promote vessel safety by reducing the pressure to fish under dangerous conditions. On the other hand, the establishment of marine reserves may result in a reduction in fishing vessel safety if the closure of fishing grounds results in	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' incentives to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. With individual vessel catch limits, some vessels will have more choice of when and where to fish. Winter and early

Table 4.7.1(b). Summary of effects of Alternatives 4, 5, 6 and 7 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6	Alternative 7
	and early spring) when conditions may be more dangerous.		vessels fishing farther from port and possibly in more hazardous areas.	spring fishing may increase if vessels in a sector anticipate premature closures.
Management and Enforcement Costs	Costs would be expected to increase as catch limits were allocated over an increasing number of sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.	The costs of monitoring, enforcement and administration would be expected to increase significantly. Cost recovery measures such as a fee on quota holders would be expected.	Full (100%) observer coverage would be required, which would facilitate enforcement of a full retention regulation. The enforcement costs of establishing marine reserves vary with several factors, including the location, number, size, and shape of the marine reserves and types of activities restricted and allowed.	Costs would be expected to increase with allocations to multiple sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.

Table 4.7.2. Significance of indirect effects of the alternatives on the social and economic environment.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Incentives to Reduce Bycatch	S+/S-	I	I	CS+	S+	S+	CS+
Commercial Harvesters	S-	S+	CS+	CS+/CS-	S+/S-	S+/S-	CS+/CS-
Recreational Fishery	S-	I	I	CS-	CS-	S+/S-	CS-
Tribal Fishery	I	I	I	CS-	CS-	CS-	CS-
Buyers and Processors	S-	CS+/CS-	CS+/CS-	CS+/CS-	CS+	CS+/CS-	CS+/CS-
Communities	S-	CS+/CS-	CS+/CS-	CS+/CS-	CS+	CS+/CS-	CS+/CS-
Consumers	I	I	CS-	CS+/CS-	CS+	CS+/CS-	CS+/CS-
Fishing Vessel Safety	CS+/CS-	S+	S+/S-	CS+/CS-	S+	S+/S-	CS+/CS-
Management and Enforcement Costs	S-	S+	CS+/CS-	S-	S-	S-	S-

Significance Ratings:

Significantly Adverse (**S-**): Significant adverse impact based on ample information and the professional judgment of the analysts.

Significantly Beneficial (**S+**): Significant beneficial impact based on ample information and the professional judgment of the analysts.

Conditionally Significant Beneficial (**CS+**)/Conditionally Significant Adverse (**CS-**): Conditionally significant is assigned when there is some information that significant impacts could occur, but the intensity of the impacts and the probability of occurrence are unknown.

Insignificant Impact (**I**): No significant change based on information and the professional judgment of the analysts..

Unknown (**U**): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

Significantly Beneficial/Significantly Adverse (**S+/S-**): Both significant adverse impacts and significant beneficial impacts are expected to occur. The net effect may be uncertain.

4.8 Cumulative Effects of the Alternatives

Cumulative effects must be considered when evaluating the alternatives to the issues considered in this EIS. Cumulative impacts are those combined effects of an action on the quality of human environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of whether a federal or non-federal agency undertake such actions (40 CFR 1508.7).

Cumulative effects may be either direct or indirect effects of an action on the environment, or some combination thereof. Direct effects of the alternatives include: potential reductions of bycatch and bycatch mortality; increased bycatch accountability; and, improved information about stock removals and stock condition. Indirect effects are related to longer term changes such as changes in species abundance, diversity, and habitat.

Of the past, proposed and foreseeable future actions that are also expected to affect these same waters and fishers, the most notable recent actions were the annual specifications and management measures for the groundfish fisheries in 2003, 2004, and 2005-2006, the passage of eight rebuilding plans for overfished groundfish species (FMP Amendments 16-2 and 16-3), and completion of the trawl buyback program.

For most overfished species, directed harvest has been eliminated. This means that incidental harvest must be reduced for Council actions to reduce total mortality of overfished groundfish species. Incidental take of overfished groundfish species has been reduced through gear regulations, seasonal restrictions, and area closures. The Council has used its 2003, 2004 and 2005-2006 specifications and management measures processes to develop and implement these protective regulations. In 2003, the Council introduced the RCAs, large coastwide area closures intended to protect overfished groundfish from fishing activities in areas where they commonly congregate. In 2004, NOAA Fisheries implemented a requirement for all limited entry vessels to carry and use VMS units in order to better enforce area closures. The Council is contemplating expanding this requirement to the open access fisheries and other sectors. All of the alternatives in this EIS would continue the use of closed areas for groundfish management. Under these alternatives, GCAs would continue to be used to reduce bycatch of overfished species. The EFH EIS, now under development, is considering the FMP's long term goals for habitat management and area closures. Under that EIS, the Council will consider area closures as management tools to address a range of issues, not just bycatch reduction. The effects of the 2003, 2004, and 2005-2006 groundfish specifications and management measures, including cumulative impacts, have been described and analyzed in EISs prepared by the Pacific Council. VMS alternatives and cumulative impacts are described in the EA/RIR for *A Program to Monitor Time-Area Closures in the Pacific Coast Groundfish Fishery* (PFMC, 2003e).

In 2003, NOAA Fisheries implemented a trawl permit buyback program, reducing the number of limited entry trawlers by 35%. Several of the alternatives to this EIS contemplate further capacity reduction. The Council is also in the process of considering a dedicated access privileges program for the limited entry trawl fishery. Vessel owners with dedicated access privileges are better able to plan for and invest in their future, including optimizing their product marketing opportunities. Implementing a dedicated access privilege program in the trawl fishery would improve the financial standing of the fishery's participants, making bycatch monitoring devices and personnel a more easily borne vessel cost. Effort reduction could reduce the impacts of fishing on the environment in the long run. However, the trip limit management program has prevented many commercial fishing vessels from operating near their harvest capacity. Even with a smaller fleet, restrictions will be necessary to prevent vessels from increasing their efficiency and fishing power. Bycatch mitigation tools, such as individual fishing quotas can exert a powerful influence on harvest capacity by changing the basic incentive structure of the industry. Over time, such rights-based programs can substantially reduce effort levels and better respond to natural population fluctuations.

Alternatives considered in this EIS incorporate many bycatch mitigation tools and other measures currently used to manage the groundfish fishery. Depth-based and marine protected areas, coupled with effort reduction, are among the mitigation tools that reduce bycatch and bycatch mortality. Measures that increase accountability and recording of all catch will also help mitigate the effects of bycatch.

The area that would be affected by actions discussed in this document is the Pacific Coast Groundfish Fishery in the EEZ (3 to 200 nautical miles offshore). External factors dominating the Pacific Coast groundfish fishery[13/] include meso-scale climate events and climate changes such as the El Niño and La Niña events, coupled with longer term Pacific Decadal Oscillation regime shifts. These factors drive much of the productivity of resources within the management area. Factors related to ecosystem structure also may influence cumulative effects. For example, past fishing activities (both for groundfish and other marine fishes) have altered species composition and abundance of many species. This is most apparent with respect to the eight overfished groundfish species. Rebuilding plans and bycatch alternatives that seek to conserve and restore these rockfish to their former abundance will have significant beneficial impacts on these and other marine animals. However, because marine food webs have multiple competitors in each trophic level, some species may be unsuccessful in regaining their previous dominance, especially if their niche has been colonized by a productive and successful competitor.

Tables 4.8(a) and 4.8(b) summarize cumulative effects of the proposed action and alternatives.

4.8.1 Cumulative Effects on the Marine Ecosystem, Habitat, and Biodiversity

When combined with the external factors identified above, most of the alternatives are

13/ These have been described in the 2004 Groundfish Annual Specifications EIS (PFMC, 2003e), which is incorporated by reference.

likely to have modest but probably indistinguishable effects on the marine ecosystem, habitat, and biodiversity. Alternative 6 would establish long-term no-take marine reserves which would be closed to most or all groundfish fishing. Elimination of such human disturbances may result in both anticipated and unexpected changes to the ecosystem: certain habitats would be expected to return to a more natural state, and biodiversity would likely increase within these areas. The degree of change would be expected to be proportional to the size of the closed areas. The greatest effects would be expected with stationary and relatively immobile benthic species that would typically flourish in the habitats protected by such reserves. Because this alternative would affect only groundfish fishing activities, habitat impacts from non-groundfish fisheries could continue to occur within the closed areas.

4.8.2 Cumulative Effects on Groundfish

As was noted in the 2004 Groundfish Annual Specifications EIS (PFMC, 2003e), overfished stock status is a cumulative effect, since it results from past over fishing that reduced the stock size. Under Alternative 1, management measures including those used to address bycatch issues have not always been successful in keeping catches from exceeding sustainable levels. In the case of overfished species such as canary rockfish, the result is severely depleted stock status for several decades to come. Alternatives 2 and 3 could also fail to achieve the rebuilding objectives and result in delayed rebuilding. However, the Council now practices more risk-averse, adaptive management of groundfish. Thus, cumulative impacts are expected to be mitigated compared to what would have been predicted even a few years ago.

Alternatives 4, 5, 6 and 7 complement rebuilding efforts by better accounting for and reducing bycatch and bycatch mortality. They would accomplish this through catch caps and increased monitoring. Cumulative adverse effects of fishing and bycatch would tend to diminish for overfished and healthy stocks of groundfish in proportion to effort reduction. Under Alternative 6 and perhaps Alternative 4-7, long-term protected areas may result in increased species diversity and an increase in average size of groundfish within the protected areas.

4.8.3 Cumulative Effects on Protected Species

Cumulative effects generally correlate with direct and indirect effects and external environmental factors. Alternatives that result in reduced fishing effort would result in smaller adverse cumulative effects on halibut, salmon, seabirds, and marine mammals (Alternatives 2, 5, and 6). These effects would likely be insignificant across all alternatives, because impacts are considered low under the no action alternative, Alternative 1. Cumulative impacts of Alternative 3 are more difficult to predict, because the timing of seasonal openings and closures may influence interactions with protected species.

4.8.4 Cumulative Effects on Groundfish Fisheries

Alternative 1 is likely to have generally adverse cumulative effects. Efforts to rebuild some overfished species may not be successful under the no action alternative. Additional restrictive management measures may result in reduced future harvest opportunities for healthy stocks or a concentration of effort outside of closed areas or within shorter time periods. Discard/bycatch rates may increase as a result of increased competition during open periods and areas. Accountability would be lower than other alternatives, resulting in greater uncertainty. The cumulative effects of increased regulation, lower fishery yields, uncertainty, and disruption of fishing patterns would be anticipated to be adverse and significant. Alternative 3, and to a lesser extent Alternative 4, has the potential to create a race for fish due to a shortened season. Thus, Alternative 3 may also result in adverse cumulative effects on the fishery if shortening the season failed to increase trip limits or reduce bycatch.

Alternatives 2, 4, 5, 6, and 7 should have beneficial incremental effects when combined with other management alternatives supportive of rebuilding overfished stocks. Alternatives 4, 5, 6 and 7 have beneficial cumulative effects in reducing bycatch, bycatch mortality, and increasing accountability. These results are likely to have a long-term beneficial effect if stocks return to levels capable of producing higher sustainable harvests. Trawl fleet capacity would be reduced under Alternative 2; even greater consolidation would be expected under Alternatives 5 and 6. Under Alternative 2, latent effort could lead to increased harvest rates in spite of fleet reduction. Additional restrictive management measures may still be required to maintain rebuilding. Alternatives 5 and 6 have the greatest potential to reduce latent capacity, followed by Alternative 7. Over the long-run, this would result in reductions in latent effort, healthier stocks, and a reduced need for additional restrictive management measures.

4.8.5 Cumulative Effects on Safety

VMS, used to increase accountability, should make fishing vessels inherently easier to locate, and therefore safer if the vessel and crew are in jeopardy. Various kinds of area closures used in the all of the alternatives may cause vessels to fish further off shore and may increase risk. There may be a significant positive cumulative benefit and increased fleet safety for those alternatives that reduce effort (Alternatives 2, 5, and 6) or establish transferable catch quotas (Alternatives 5 and 6) because these bycatch reduction tools would tend to reduce the race for fish. Alternatives 4 and 7 provide a mechanism for greatly reducing inter-sector competition, and intra-sector competition in the form of individual vessel catch limits.

Table 4.8(a). Summary of direct, indirect and cumulative effects of Alternatives 1, 2 and 3.

Resource Issue or Category	Alternative 1	Alternative 2	Alternative 3
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish			
Direct/Indirect	Catch rates of overfished species such as canary and bocaccio rockfish may delay or prevent rebuilding. Discard/bycatch of other groundfish could remain high due to constraints for overfished species.	Reduced fishing effort expected to reduce bycatch and bycatch mortality of overfished and other groundfish. Latent capacity remains and could negate any savings.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Cumulative	Canary and bocaccio rockfish may not be sustainable.	Higher probability of rebuilding overfished species. Reduced bycatch and bycatch mortality of other groundfish may allow fuller resource utilization but not necessarily increased abundance.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.			
Direct/Indirect	No change from baseline	No change from baseline	Interactions are thought to be low, but may be completely absent during seasonal closures. Halibut bycatch depends on timing of seasonal closures.
Cumulative	No change from baseline	No change from baseline	Interactions with birds depend on timing of seasonal closures.

Table 4.8(a). Summary of direct, indirect and cumulative effects of Alternatives 1, 2 and 3.

Resource Issue or Category	Alternative 1	Alternative 2	Alternative 3
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.			
Direct/Indirect	Provides for statistically reliable measures of bycatch on an annual basis, but not inseason.	Marginal improvement in monitoring coverage of trips.	Marginal improvement in monitoring coverage of trips
Cumulative	Lack of timely inseason data may lead to unsustainable fisheries for some overfished species.	Similar to Alternative 1 - data cannot be used in-season.	Similar to Alternative 1 - data cannot be used in-season

Table 4.8(b). Summary of direct, indirect and cumulative effects of Alternatives 4, 5, 6and 7 for West Coast groundfish fisheries.

Resource Issue or Category	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure				
Direct/Indirect	No change from baseline	Reduction in closed areas	Reduction in closed areas	No change from baseline
Cumulative	No change from baseline	Increased growth of living benthic habitat (sponges and corals) in closed areas.	Increased growth of living benthic habitat (sponges and corals) in closed areas.	No change from baseline
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.				
Direct/Indirect	No change from baseline	Increased growth and abundance of some species in closed areas	Increased growth and abundance of some species in closed areas	No change from baseline
Cumulative	No change from baseline	Increased biodiversity in closed areas	Increased biodiversity in closed areas	No change from baseline
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish				
Direct/Indirect	Reduces bycatch and bycatch mortality of overfished species in particular - due to RSQ caps for overfished species.	Reduces bycatch and bycatch mortality of overfished and other groundfish through use of MPAs, RSQs and IFQs for overfished and other groundfish.	Reduces bycatch and bycatch mortality of all groundfish through use of no-take reserves, RSQs, IFQs, and 100% groundfish retention requirement.	Reduces bycatch and bycatch mortality of overfished species in particular - due to sector allocations and vessel catch limits for overfished species.
Cumulative	Higher likelihood and rate of rebuilding, with possible exception of bocaccio rockfish.	Higher likelihood and rate of rebuilding of overfished groundfish, possible increases in other groundfish populations.	Highest likelihood and rate of rebuilding of overfished groundfish. Increased size and diversity of groundfish within closed areas.	Higher likelihood and rate of rebuilding, with possible exception of bocaccio rockfish.

Table 4.8(b). Summary of direct, indirect and cumulative effects of Alternatives 4, 5, 6and 7 for West Coast groundfish fisheries.

Resource Issue or Category	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.				
Direct/Indirect	No change from baseline.	Small reductions in bycatch and bycatch mortality within protected areas.	Small reductions in bycatch and bycatch mortality within protected areas.	No change from baseline.
Cumulative	No change from baseline.	No change from baseline.	No change from baseline.	No change from baseline.
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.				
Direct/Indirect	Significantly improved monitoring coverage. In-season data can be used to make in-season adjustments. Accurate in-season accounting of overfished stocks of groundfish.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of groundfish. Discard/ bycatch of overfished groundfish nearly eliminated.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of all groundfish catch. No groundfish discard/bycatch.	Significantly improved monitoring coverage. Over time, catch and bycatch data would be available inseason for management of overfished stocks of groundfish and other species.
Cumulative	Reduced risk and higher likelihood of rebuilding overfished stocks of groundfish.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.	Reduced risk and higher likelihood of rebuilding overfished stocks of groundfish.

4.9 Practicability

4.9.1 Background

The Magnuson-Stevens Act's National Standard 9 states that "[c]onservation 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." 16 U.S.C. 1851(a)(9). The National Standard Guidelines implementing National Standard 9 state that "[a] determination of whether a conservation and management measure minimizes bycatch or bycatch mortality to the extent practicable, consistent with the other national standards and maximization of net benefits to the Nation, should consider the following factors:

(A) Population effects for the bycatch species.
(B) Ecological effects due to changes in the bycatch of that species (effects on other species in the ecosystem).
(C) Changes in the bycatch of other species of fish and the resulting population and ecosystem effects.
(D) Effects on marine mammals and birds.
(E) Changes in fishing, processing, disposal, and marketing costs.
(F) Changes in fishing practices and behavior of fishermen.
(G) Changes in research, administration, and enforcement costs and management effectiveness.
(H) Changes in the economic, social, or cultural value of fishing activities and non-consumptive uses of fishery resources.
(I) Changes in the distribution of benefits and costs.
(J) Social effects."

50 C.F.R. 600.350(d)(3).

The meaning of "practicable" as the term is used in National Standard 9 was recently discussed in Conservation Law Foundation v. Evans, 360 F.3d 21, 27-28 (1st Cir. 2004). In that case, the court stated:

> Moreover, the plaintiffs essentially call for an interpretation of the statute that equates "practicability" with "possibility," requiring NMFS to implement virtually any measure that addresses EFH and bycatch concerns so long as it is feasible. Although the distinction between the two may sometimes be fine, there is indeed a distinction. The closer one gets to the plaintiffs' interpretation, the less weighing and balancing is permitted. We think by using the term "practicable" Congress intended rather to allow for the application of agency expertise and discretion in determining how best to manage fishery resources.

Taking into account the considerations described above, all of the alternatives analyzed in this EIS are possible to implement, to varying degrees. Some alternatives are more or less practicable to implement, depending on the perspective from which practicability is considered. Alternative 7 (preferred) is one of the most practicable alternatives from a variety of perspectives and when considering both near- and longer-term practicability.

4.9.2 Population and Ecosystem Effects

In recent years, West Coast groundfish management has been primarily concerned with, and driven by, the need to rebuild the eight overfished groundfish species. The FMP and its implementing regulations must continue to meet the overfished species rebuilding requirements of the Magnuson-Stevens Act. Thus, any bycatch mitigation program must foster the rebuilding of overfished species. Although Alternative 1 (status quo) meets overfished species rebuilding requirements, other alternatives would provide even better protection for overfished species. All of the alternatives to status quo would either reduce capacity, reduce an individual vessel's fishing time, or require greater individual vessel total catch accountability. These alternatives would also have the effect of increasing the amount of available total catch data, and improving information used for inseason catch monitoring and for stock assessments. More and better information about overfished species would allow the agency to better track its achievement of rebuilding plan goals, and better meet the agency's long-term goals for gathering data on and protecting a broad range of marine species. More and better information about non-groundfish species taken incidentally in the groundfish fisheries, including data on structure-forming invertebrates and other non-commercial species, would allow the agency to better characterize and monitor the West Coast ecosystem as a whole.

4.9.3 Social effects as costs to the fishing industry, and changes in fishing practices and behavior of fishermen

The cost of bycatch management program is of great importance to participants in the West Coast groundfish fisheries, who have seen the value of their groundfish landings (commercial) and charter trip sales (recreational) decline notably in recent years.

For fishing communities and the fishing industry, practicability of a bycatch management program may be assessed in terms of: whether it allows community members to make longer-term business plans; whether the cost of the program to fishery participants is prohibitive when compared against profits from that fishery; whether it encourages fishery participants to innovate with respect to bycatch mitigation measures; whether regulations are easy to understand and apply; and whether fishers and processors are required to keep fish that they cannot sell. Alternative 1 (status quo) is less practicable than other alternatives in terms of providing a stable business-planning environment. Groundfish fisheries management in recent years has become increasingly more restrictive and complex, with much seasonal and year-to-year variation in available catch of different species. None of the alternatives could be expected to reduce natural year-to-year or decade-to-decade variations in available catch. However, Alternatives 5-7 would provide fishery participants with greater control over their own fishing activities. These alternatives include dedicated access privilege programs that would move more of the decisions on when and where to fish which species away from governmental agencies and to individual fishery participants.

Alternative 4 may be the least practicable alternative in terms of its cost to fishery participants, because it would require high levels of per vessel monitoring without increasing per vessel profits through a capacity reduction program. Alternatives 2 and 5-7 would each include some measure of capacity reduction, and Alternatives 5-7 would include increased monitoring levels, the cost for which could be somewhat recouped by increased fishing opportunities. Alternative 3 would be less practicable than the other alternatives when considering both longer-term planning and program costs because it would allow each vessel to fish only six months of the year, which would reduce the vessel operator's flexibility to fish in ways that improve the likelihood of recouping program costs.

NOAA Fisheries and West Coast states currently encourage innovations in bycatch-reducing gear designs through EFPs and research programs. However, the current management program provides fewer gear experimentation incentives than Alternatives 4-7. Those alternatives implement sector/vessel bycatch caps and/or dedicated access privilege programs. Both of these programs give vessel operators more incentive to improve their individual vessel's bycatch reduction performance. Gear modifications have often proven useful in reducing bycatch. However, an individual skipper's ability to use that gear appropriately, or conduct fishing operations in certain areas or weather, may have a greater influence on the vessel's ability to reduce its bycatch. Alternatives 1-3 provide fewer of these individual incentives for fishery participants to think creatively about how to increase their vessel profits through reducing bycatch.

Current groundfish regulations (Alternative 1) are already quite complex. Seasons, trip limits, and area closures vary along the length of the coast. Alternative 2 would likely be similar to Alternative 1 in terms of regulatory complexity, although those regulations would have to be understood by fewer people. Alternatives 3-7 would increase regulatory complexity overall, although regulatory complexity would likely be reduced for some sectors within the fishery. Complex regulations governing the use and transfer of individual vessel quotas would replace complex trip limit and season regulations. Alternative 6 may have the least regulatory complexity because it would require long-term, fixed-boundary closed areas.

Under the Magnuson-Stevens Act, the amount of fish that is dumped overboard is considered bycatch and that amount must be reduced to the extent practicable. One simple way of reducing the amount of fish that is dumped overboard it to require vessels to land all of their catch. For some fishery sectors, such a requirement would simply transfer the discarded biomass from sea to land. NOAA Fisheries can require vessels to bring in all of their catch, but it cannot require markets to accept all of the species landed. The best way to prevent fishers and processors from having to keep fish they cannot use may be to give them the flexibility to avoid bycatch of species they cannot use, and to create new markets for species they normally catch but have not historically used. As stated above, Alternatives 4-7 would provide fishers greater incentives to change their fishing practices to reduce bycatch and Alternatives 5-7 would provide the greatest flexibility for business planning by individual fishery participants.

4.9.4 Social effects as costs to non-consumptive users of fishery resources

For non-consumptive users of fishery resources, the practicability of a bycatch management program may be assessed in terms of: whether these users may have longer-term expectations that marine species' populations will continue to be healthy and productive (existence and bequeathal values); whether a portion of the marine ecosystem is set aside from consumptive use because of its intrinsic and/or educational values; whether the action may be expected to result in increasing or decreasing biodiversity, based on the assumption that higher biodiversity represents a more sophisticated and more healthy marine ecosystem. Alternative 1 is less practicable than the other alternatives because it does not make any longer-term plans for bycatch reduction and management, simply expecting that bycatch reduction will occur through overfished species rebuilding programs. All of the alternatives to status quo could be expected to be more practicable in terms of rebuilding and maintaining healthy populations of marine species. Alternatives 4-7 are expected to have greater bycatch and capacity reduction effects than Alternatives 1-3, and thus are more practicable for maintaining healthy and productive marine species populations. Alternative 6 combines marine area closures to groundfish fishing with capacity reduction, thus may be the most practicable alternative for longer-term maintenance of healthy marine species populations, groundfish and non-groundfish. The Council's preferred alternative, Alternative 7, combines capacity reduction with sector-specific management and ongoing use of RCAs for the protection of overfished groundfish. Thus, Alternative 7 is practicable in terms of maintaining groundfish stocks, but relies on incidental benefits to protect non-groundfish species other than those specifically targeted for protection such as halibut, salmon, seabirds, and marine mammals.

None of the alternatives set aside any species or areas from all consumptive use. Alternative 6, however, would set aside large areas from consumptive use of groundfish and from impacts of groundfish fishing gear on habitat within those areas. Under the current FMP, cowcod is set aside from consumptive use. None of the alternatives would alter the FMP's protection for cowcod. NOAA Fisheries will be considering action alternatives within its EFH EIS that would set aside ocean areas from all consumptive use, a draft of which is scheduled for completion in February 2005.

All of the alternatives to status quo may be expected to reduce the overall level of dead discards in the fishery relative to status quo. Some of the alternatives, such as Alternatives 4-7, provide greater incentives for fishery participants to be innovative in designing bycatch-reducing gear. If undesired or illegal species are less frequently caught because of better gear design, then more live biomass remains in the marine environment, ultimately improving the health and biodiversity of the marine ecosystem. Some bycatch management programs simply require retention of all that is caught. If a full-retention program is applied or monitored inappropriately, dead marine biomass may be removed from the marine ecosystem and disposed of on land, ultimately harming the health and biodiversity of the marine ecosystem. Given this potential challenge, Alternative 7 is more practicable than Alternatives 4 and 5, because it requires a closer look at fishery-specific management to determine which bycatch reductions tools are most appropriate for different sectors of the fishery.

4.9.5 Management Costs and Effectiveness

In addition to being a concern to fishermen, bycatch program costs are also an important consideration for federal and state agencies with pessimistic outlooks for near-future fisheries management budgets. The fishery management agencies are also concerned that costs of micro-managing the fishery to minimize and avoid bycatch could overwhelm the economic benefits from the fishery. Two management reponsibilities that pose significant cost and effectiveness concerns are enforcement, and data gathering and analysis.

Different alternatives are more or less enforceable depending on their complexity and/or the technological requirements for their enforcement. Enforcement of West Coast groundfish fisheries regulations became notably more complex when the Council and NOAA Fisheries introduced the coastwide Groundfish Conservation Areas in 2003. To improve area closure enforcement, NOAA Fisheries implemented a VMS program on January 1, 2004. Alternatives 1-3 and 6 would all continue to include area closures, although those closures would have less complex boundaries under Alternative 6. Alternatives 4, 5, and 7 could include closed areas for bycatch mitigation, but could also provide vessels with enough incentives to reduce individual vessel bycatch such that closed areas for bycatch mitigation would become unnecessary. Tracking of catch and landings limits would continue to be complex under all alternatives. Alternatives 4-7 would likely require increased enforcement presence and technological improvements in catch and landings tracking systems over Alternatives 1-3. Because new technologies may need to be researched and introduced, Alternatives 4-7 are also not as immediately practicable as Alternatives 1-3. This should not be taken to mean that they are necessarily less practicable over the longer-term.

With respect to data gathering and analysis, each of the different alternatives requires different levels of scientific information to implement. Some alternatives are more practicable in terms of available scientific information because they do not require additional science program expenses beyond those already expected to be committed for the near-term. Alternative 1 (status quo) is practicable from this perspective, as it would simply continue our current science and management programs. Some alternatives are less practicable because they would require notable new science time and effort to implement. Alternatives 4-7 are less practicable from this perspective because they would require splitting the groundfish fleets into ever-smaller units, which would likely require historical catch analyses for fleets or individuals. For some fisheries or individuals, historic catch data may either not exist or may not be in an appropriate format for use in the desired management program. (For example, one of the challenges of implementing the limited entry program was accurately attributing gear-specific catch to vessels from historic fish tickets that did not specify certain gear types.) Some bycatch minimization goals may also be impracticable. For species that occur infrequently, such as cowcod and yelloweye rockfish, it is often not possible to attain highly precise estimates of bycatch rates given the relatively large quantity of groundfish observed in total catch monitoring programs like WCGOP.

Alternative 7, the Council's preferred alternative, calls for the use of sector catch cap and dedicated access privilege programs where practicable. This alternative would require the evaluation of individual sectors for practicability of bycatch program application. Thus, it would encourage near-term implementation of those measures most scientifically practicable given our current information. Alternative 7 would also encourage regular re-consideration by the Council of what is practicable, such that as new bycatch mitigation programs would continue to be implemented as new scientific information becomes available. None of the alternatives would have any effect on funding for NOAA Fisheries and West Coast state scientific programs. Even if more data is gathered under Alternative 7, participating agencies may not have the funding to process and analyze that data.

4.9.6 Conclusion

The Council's preferred alternative, Alternative 7, reduces bycatch to the extent practicable from a variety of perspectives. It encourages fisher innovation, uses capacity reduction to reduce the overall effect of fisheries on the marine environment, and would improve the quantity and quality of scientific data gathered on marine species. The Council is scheduled to begin an FMP amendment to implement Alternative 7 at its November 2004 meeting. The amendatory language will provide guidance on future sector cap and full retention programs, and on designing dedicated access privilege programs so that they achieve bycatch reduction. This guidance should be useful to the Council as it develops its first IFQ program, for the limited entry trawl fisheries. The Council is also scheduled to finalize a full retention program for the shorebased Pacific whiting fishery, which was developed with the principles discussed in this EIS in mind. At its September and November 2004 meetings, the Council is scheduled to consider a

VMS requirement for the open access groundfish fisheries. Implementing that requirement for the open access fisheries would provide fisheries managers a more clear and consistent picture of which vessels are participating in the open access. With improved participant information, the Council will be better able to consider which sectors of the open access fishery may be appropriate for capacity reduction, full retention, or sector bycatch cap programs.

In addition to the programs growing out of this EIS, the Council has just completed Amendments 16-2 and 16-3 to the FMP. These amendments incorporated eight overfished species rebuilding plans into the FMP and reaffirmed the FMP's focus on rebuilding overfished species as the driving policy behind many of its groundfish management programs. Further, NOAA Fisheries will be bringing draft alternative for its EFH EIS before the Council at its September meeting. The agency expects that the FMP amendment that develops from this EFH EIS will set new groundfish habitat management and protection protocols. Together, these three management foci – bycatch reduction, overfished species rebuilding, and habitat protection – form the basis for the Council's current and future groundfish management program.

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Contents

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 alternatives address each objective is briefly described.

Goal 1: Conservation. Prevent overfishing and rebuild overfished stocks by managing for appropriate harvest levels and, to the extent practicable, prevent any net loss of the habitat of living marine resources.

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.*

Alternative 1 (status quo/no action) employs the same data sources that have been used in past years to monitor groundfish fisheries. In addition, data from the first year of the NMFS observer program (August 2001 to August 2002) became available in early 2003 and were used for inseason management. In particular, observer data were used to determine more accurate bycatch rates for overfished species, which were used to develop management measures for 2004. A vessel monitoring system for the limited entry fishery went into effect January 1, 2004, providing real-time location information on participating vessels. These information sources would also apply to all the alternatives. However, Alternatives 4, 5, 6 and 7 would require changes to the observer program. Alternatives 4 and 7 would modify the observer program so that all sectors would be monitored throughout the year, and a higher percentage of commercial vessels would be monitored. In addition, observer reporting would be accelerated to make data available for inseason management. Alternatives 5 and 6 would expand the monitoring program so that all limited entry vessels would be monitored whenever fishing for groundfish, and perhaps at other times as well (for example, if fishing for pink shrimp).

Objective 2. *Adopt harvest specifications and management measures consistent with resource stewardship responsibilities for each groundfish species or species group.*

None of the alternatives would modify the current procedures for determining harvest specifications. Under each alternative, harvest specifications would emphasize rebuilding overfished stocks. Bycatch mitigation tools would be used to ensure the rebuilding goals and objectives were achieved. Alternatives 1, 2 and 3 would emphasize traditional management measures to mitigate bycatch. Alternatives 4 and 7 would establish catch/mortality limits for each sector of the groundfish fishery, which would make each sector more directly accountable for its overfished species catch and bycatch mortality. In addition, those alternatives would provide incentives for individual vessels to provide observer coverage of all their fishing activities in conjunction with catch limits and more traditional management tools. Alternatives 5 and 6 would establish individual fishing quotas in conjunction with greatly expanded monitoring of catch and bycatch. Alternative 5 also raises the possibility that other management restrictions might be relaxed because those restrictions might prove to be redundant and unnecessary for fully-observed vessels with catch limits.

Objective 3. *For species or species groups that are overfished, develop a plan to rebuild the stock as required by the Magnuson-Stevens Act .*

All of the alternatives would maintain the policy of risk averse harvest levels for overfished species.

Objective 4. *Where conservation problems have been identified for non-groundfish 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 non-groundfish 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.*

This objective may be inconsistent with the Sustainable Fisheries Act mandate to reduce bycatch to the extent practicable. The objective was intended to limit restrictions on groundfish fishing that would primarily be intended to make more halibut and non-ESA salmon available to directed fisheries for those species. That is, the Council did not want to restrict groundfish fishing for non-groundfish allocation reasons. However, non-groundfish species include turtles, corals, sponges and many other species of fish that may be affected by groundfish fishing activities. Alternatives 1-5 specifically address bycatch of groundfish species and collection of information about bycatch of other species. Alternative 6 would establish a higher priority to mitigate bycatch of non-groundfish species through no-take marine reserves and restriction of on-bottom fishing gears.

Objective 5. *Describe and identify 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 use of MPAs under all alternatives will reduce EFH impacts to by eliminating many groundfish fishing-related impacts in those areas. Alternative 5 could reduce reliance on area management of groundfish fishing activities, while Alternative 6 would establish no-take reserves that would reduce all groundfish fishing-related impacts within whatever boundaries might be established. Redistribution of effort into open areas could intensify fishing effort in some areas under all the alternatives. Alternatives 5 and 6 would likely result in fewer vessels participating in the fisheries as an effect of rights-based management. In addition to the MPAs included in Alternatives 1-5, bottom trawlers are currently required to use small footropes shoreward of GCAs. This tends to lessen impacts in rocky areas of the continental shelf, which is preferred habitat for some overfished groundfish species.

Goal 2: Economics. Maximize the value of the groundfish resource as a whole.

Objective 6. Attempt to achieve the greatest possible net economic benefit to the nation from the managed fisheries.

Calculating net costs and benefits (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 overall net benefit. Because of the programmatic nature of this EIS, and the absence of data for such analysis, no quantitative analysis is attempted. The elements of such an analysis are identified and described in Chapter 4. Due to the overfished status of several groundfish stocks, and reduced abundance of others, the net economic benefit from the groundfish fisheries will remain far below the gross value for the foreseeable future. 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 any of the other alternatives would achieve the greatest possible net economic benefit. However, all the program alternatives fall within a 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, Alternatives 1, 2 and 3 would appear most likely to result in higher short term revenues than Alternatives 4, 6 and 7. By establishing a rights-based management program and potentially relaxing redundant management measures, Alternative 5 would be the most likely to increase net benefits most quickly. Although Alternative 6 would also establish a rights-based management program, application of no-take marine reserves would tend to reduce the potential economic efficiency gains for an extended period. That could be compensated in the longer term by increased biological productivity and/or production that results from eliminating human interference within the reserves.

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.

None of the alternatives explicitly identifies particular sectors for which a year-round fishery may be beneficial. Alternatives 1 and 2 simply maintain the current year-round fishery for all sectors, using two-month cumulative limits. Alternatives 3, 4 and 7 could be managed to distribute sector-by-sector effort across the year. However, Alternatives 5 and 6 specifically allow the market to determine the distribution of groundfish deliveries over the year and thus may come closest to achieving this objective.

Alternatives 1, 2, 4, 5, 6 and 7 would maintain the priority for year-round commercial fisheries, 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. Alternative 2, by reducing effort, would be expected to improve the likelihood of year round fishing. Alternative 3 specifically reduces the priority of that objective. Alternative 5, by replacing seasonal constraints with market-based opportunities, would be expected to promote year-round fishing.

Objective 8. *Gear restrictions to minimize the necessity for other management measures will be used whenever practicable.*

Alternatives 1, 2, 4, 5, 6 and 7 would continue the reliance on gear restrictions to minimize bycatch to the extent practicable. Alternatives 1, 2 and 3 would rely on gear restrictions in combination with trip limits. Alternatives 4 and 7 in combination with both retention and catch limits, and Alternative 6 in combination with vessel catch limits would also rely on gear restrictions. Alternative 5 would relax reliance on gear restrictions and provide incentives for vessels to adopt their own best practices to reduce bycatch, including using different gear configurations and types. Under all the alternatives, a portion of the OY for certain species could be allocated to vessels fishing under EFPs. Some of these EFPs are being used as a means to test new gear configurations that reduce bycatch of overfished species. Under Alternatives 4 and 7, a portion of the OYs for certain species could be made available to vessels and sectors with low bycatch rates as additional incentive to reduce bycatch.

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.

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.

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.*

Bycatch mitigation tools under each programmatic alternative would address groundfish species groups and relationships in time and space. Alternative 5 would establish a program where individual fishers would be responsible for self-managing their activities to achieve their harvest goals, rather than the Council and NMFS dictating how it should be done. Alternative 6 could be interpreted as expanding management of the groundfish fishery to take into account non groundfish species as well. The focus on establishment of MPAs would be intended to address broader ecosystem issues and to reduce deleterious impacts on a broader spectrum of marine life.

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.

Alternatives 1, 2 and 3 continue the reliance on trip limits to control bycatch and bycatch mortality. However, trip limits rely on regulatory bycatch (discard) and may contribute to economic discard as well. Alternatives 2 and 3 are intended to increase the size of trip limits, which would be expected to reduce regulatory bycatch. Catch limits, as proposed in Alternatives 4, 5, 6 and 7, provide much stronger incentives to avoid take of non-target species and to increase the utilization of all fish that are caught. Alternative 5 would establish a rights-based management program to mitigate bycatch, removing many of the economic incentives (and requirements) to discard. This alternative is the most consistent with Objective 11, especially if other fishing restrictions were lifted that might increase regulatory and/or economic bycatch. The expected result would be that vessels would have greater incentive to avoid take of non-target species and also to increase their use of all fish they catch. Alternative 7 provides a similar opportunity for commercial limited entry vessels to obtain individual catch limits for overfished species and larger trip limits of other species if they voluntarily pay for observer coverage. Thus Alternative 7 (as well as Alternative 4) is also more consistent with this objective than the other alternatives. While these alternatives do not provide some benefits of IFQs (such as transferability), they may be more practicable because they would not require establishment of a 100% mandatory observer program. However, because the provision would be voluntary, the bycatch mitigation effects would be less than Alternatives 5 and 6.

Objective 12. Provide for foreign participation in the fishery, consistent with the other goals to take that portion of the 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.

<u>Objective 13</u>. *When conservation actions are necessary to protect a stock or stock assemblage, attempt to develop management measures that will affect users equitably.*

Alternative 5 would establish a market-driven quota program. The Council and NMFS role would be to determine the initial allocation of fishing privileges and establish the rules and process for the market to operate. Thereafter, the market would largely determine what is equitable. Alternatives 1, 2, 3, 4 and 7 would continue reliance on the Council public process for determining equatability on a case-by-case basis. Alternative 6 would likely be some combination of the two approaches.

<u>Objective 14</u>. *Minimize gear conflicts among resource users.*

This objective initially referred to conflicts between fixed-gear and trawl gear use of certain fishing grounds; it has also been more broadly applied to other conflicts. Alternatives 4 and 7 would establish sector allocations of the most limiting species. In the short term, this would increase allocation debates and conflicts until those allocations were established, and could result in ongoing conflicts if the allocations were subject to annual or biennial revision. Once established, these sector caps would insulate each sector from competitive pressures from other sectors. This would tend to reduce the "race for fish" and reduce disincentives to take actions to reduce bycatch, further reducing conflicts among users. Similar to Alternatives 4 and 7, Alternatives 5 and 6 would require initial catch allocation between user groups that would likely be controversial. Alternatives 5 and 6 would establish a market system that would provide a means for users to resolve conflicts over the longer term.

<u>Objective 15</u>. *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.*

Alternatives 1 and 3 are the most similar to current fishing conditions, but also do the least to improve the current situation. Alternative 2, by further reducing the number of trawl participants, would improve conditions for those remaining in the fishery. Alternatives 4 and 7 would establish trip limits by sector (similar to the status quo) but would make each sector more accountable for bycatch reduction. In the longer term, this could be refined to rely more on individual vessel or sector catch limits for fully-monitored vessels and sectors. Alternative 5, by establishing an IFQ program, would be expected to provide the best long-term opportunities for the industry as a whole. However, it is likely an IFQ program would result in further consolidation of the commercial fleet by reducing the number of small or inefficient vessels. Alternatives 7 supports development of IFQ programs "where appropriate," which could exempt certain vessels or groups from IFQs, full observer requirements, and other provisions that might adversely affect them more than larger vessels.

Objective 16. Avoid unnecessary adverse impacts on small entities.

Adverse impacts on small entities continue to occur under *status quo* management and are unavoidable in the short-term. Alternatives 2 and 3 are most similar to the current bycatch mitigation and management programs and will thus have the least effect (both beneficial and adverse) on small entities. Alternatives 4, 5, 6 and 7 would have greater short-term adverse effects but result in more beneficial long-term effects. Alternative 5 is predicted to provide the greatest benefit to small entities over time by reducing government regulatory constraints and allowing market-driven solutions. However, rights-based management would be more likely to eliminate some small entities from the groundfish fishery and the industry becomes more consolidated. The smallest vessels that cannot efficiently carry an observer would likely be the most disadvantaged by observer requirements. Alternative 6 would impose substantial constraint on fishing locations (due to marine reserves), and those changes would be more permanent.

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 4.4. Adverse impacts on West Coast fishing communities continue to occur under *status quo* management. Alternatives 2 and 3 are most similar to the current bycatch mitigation and management programs and will thus have the least effect (both beneficial and adverse) on fishing communities. Alternatives 4, 5, 6 and 7 would have greater short-term adverse effects but result in more beneficial long-term effects; Alternative 5 is predicted to provide the greatest benefit to communities over time by reducing government regulatory constraints and allowing market-driven solutions. However, rights-based management would be more likely to redistribute benefits among fishing communities; this could result in some communities losing their reliance on groundfish fishing. Small, isolated communities with less fishing infrastructure or a higher cost structure would be the most likely affected. Establishment of community quotas under Alternatives 5 or 6 could mitigate these effects at the cost of overall economic efficiency. Alternative 6 would impose substantial constraint on fishing locations, due to implementation of marine reserves, and those changes would be more permanent. Fishing communities near marine reserves would bear the heaviest impacts of them due to increased travel costs for reaching fishing grounds.

Objective 18. Promote the safety of human life at sea.

Smaller vessels may be the least mobile and may be at greater risk in severe weather conditions. Those vessels are most affected by current MPAs (Alternatives 1-4 and 7), in that they may have to travel farther offshore to reach open fishing areas. Alternative 5 provides the option of reducing the use of MPAs, as bycatch and overfishing concerns would be addressed through the quota program. Alternative 6 would establish no-take marine reserves that would tend to increase the risk for those vessels home-ported nearby. The rights-based management established by Alternatives 5 and 6 would tend to reduce safety risks by allowing vessels more choice of fishing conditions.

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 program alternatives would all reflect harvest rates below the overfishing thresholds 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. Alternatives 4, 5, 6 and 7 would require modifications to the Observer Program. Alternatives 4 and 7 require faster data compilation for inseason application. Alternatives 5 and 6 would expand coverage to all limited entry vessels. These latter alternatives would thus more accurately measure total groundfish catch and reduce the likelihood that any overfishing would occur (or go unnoticed).

National Standard 2 states that conservation and management measures shall be based on the best scientific information available.

Each of the program alternatives would be expected to rely on the best scientific information available. However, those alternatives that would expand the extent of monitoring would improve the amount and quality of information. Alternatives 4 and 7 would provide incentives for vessels to pay for observer coverage. Over time, to achieve best results of sector management, Alternatives 4 and 7 would require increased observer coverage to verify catch and bycatch (groundfish discard) rates inseason. Alternatives 5 and 6 would require 100% monitoring of the commercial limited entry fisheries and expand monitoring of other fisheries, thereby resulting in the greatest improvements.

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.

Under the no action alternative (Alternative 1), groundfish are managed through a combination of individual and multispecies units. These units are managed throughout the region covered by the FMP. However, any stock is not necessarily in the same condition over its range, due to environmental, ecological and fishery-related influences. In some cases, the current bycatch mitigation program uses the best scientific information available to address different conditions or species distributions. This approach is carried forward into all the alternatives.

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.

None of the alternatives would discriminate between residents of different states. Under all the program alternatives, management measures would continue to be developed through the Council process, which facilitates substantial participation by state representatives. Generally, state proposals are brought forward when action alternatives are crafted and integrated to the degree practicable. Alternatives 4, 5, 6 and 7 would allocate specific shares or privileges to individuals or corporations with the specific intent to promote conservation through individual accountability for catch and bycatch. When allocating such shares, the Council and NMFS would need to ensure consistency with this National Standard.

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.

Current and previous bycatch mitigation measures in the groundfish fishery have not been designed specifically for the purpose of efficient utilization. To the contrary, many have been intended to reduce efficiency in order to prevent overfishing and achieving other management objectives. Alternative 2 would improve efficiency by further reducing the number of commercial trawl participants, resulting in larger average individual vessel catch levels. Alternative 3 would tend to increase harvest efficiency by increasing the size of trip limits, but would result in less efficient use of processing capacity. Alternatives 4 and 7 would promote efficient harvest of healthy stocks while placing more stringent limits on catches of overfished groundfish stocks. Alternative 7 moves towards development of rights-based management by authorizing non-transferrable catch limits on a voluntary basis. Alternative 5 would promote efficiency above all the other alternatives by establishing a rights-based, market-driven program and relaxing restrictions that contribute to inefficiency. Alternative 6 would achieve some of the advantages of a rights-based program but would continue the use of bycatch mitigation tools that tend to reduce efficiency.

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 that capacity reduction in some sectors is needed to rationalize fisheries. A capacity reduction (buyback) program for the limited entry groundfish trawl fleet has been approved, resulting in retirement of an estimated 92 permits and vessels while compensating owners of retired vessels. Further fleet consolidation may be necessary to achieve a profitable, efficient fishery.

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.

Under the current bycatch mitigation program (Alternative 1), management measures reflect differences in catch, and in particular bycatch of overfished species, among different fisheries. Alternatives 1, 2 and 3 would continue the traditional approach of calculating and predicting trip limits to address such variations and contingencies. Alternatives 4 and 7 would take a step towards this by grouping similar vessels into sectors while providing ways to gain autonomy from sectors. This would allow individual fishers to address some of these variations and contingencies by establishing individual catch limits for overfished species and increasing trip limits for healthier stocks, contingent on individual vessel monitoring. Alternatives 5 and 6 further assign individual opportunity, responsibility and accountability; through individual catch quotas, vessels would have the means to modify their activities to address the full range of harvest opportunities. Alternative 6 would continue to apply bycatch mitigation tools that would restrict the ability to account for variations among, and contingencies in, fisheries, fishery resources and catches.

The Council and NMFS have worked with the States of Washington, Oregon and California to manage non-groundfish fisheries to minimize bycatch of overfished groundfish species. None of the proposed program alternatives would modify that approach.

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The current groundfish management program has become extremely complicated for all involved fishery participants, management entities, and interested public. This is due in large part to the programmatic decision to minimize reliance on inseason monitoring of fishery catch, relying instead on monitoring retention levels. Alternatives 1, 2 and 3 continue this program approach. Alternative 4 would increase reliance on catch monitoring and the use of real-time catch data during the season, rather than post-season. This would come at increased costs to individual vessels, NMFS, or both. Alternatives 5 and 6 would establish 100% monitoring of all commercial limited entry vessels and other commercial fishing vessels. Monitoring programs that emphasize the use of fishery observers and implementation of a vessel monitoring system increase management costs but are necessary for effective management. Alternative 5 would emphasize more intensive and extensive fishery observation, reducing the need for other bycatch mitigation measures related to overfished groundfish stocks. Alternative 6 would tend to increase duplication by retaining much of the current bycatch mitigation program , increasing the level of monitoring, and closing large areas to reduce the potential for observed and unobserved bycatch.

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.

Generally, there are tradeoffs between allowing fishers and communities to access healthy, harvestable stocks and minimizing catch of overfished stocks. The alternatives address these tradeoffs differently. Alternatives 1, 2, 3 and (to a lesser extent) 4 and 7 would continue the approach of assessing and resolving these tradeoffs through the Council public process on an ongoing basis. Under Alternative 5, the Council and NMFS would establish the basic policies, procedures and parameters of an IFQ program and thereafter allow market forces to determine sustained participation of fishing communities. This approach has both advantages and risks. The risk is that communities that may be less well-suited for groundfish fishing may see their participation reduced. Under the other alternatives, political intervention through the Council process could forestall such changes. However, that would undoubtedly be at the cost of some other objectives, such as efficiency, fairness, or overall management stability.

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.

Each of the programmatic alternatives directly addresses this National Standard. Alternatives 1, 2, 3 and, to a lesser extent, 4 and 7 would do this from a command-and-control approach. Alternative 6 also would continue this approach, increasing the emphasis on reducing bycatch and bycatch mortality to levels approaching zero. Alternative 5 (and to a lesser degree Alternatives 4 and 7) would replace command-and-control with individual accountability, setting bycatch mortality limits for every commercial limited entry vessel. Under Alternatives 4 and 7 this would be voluntary. Thus, Alternatives 4 and 7 would fall between Alternatives 1-3 and Alternative 5. Alternative 6 would likely result in the greatest reduction in bycatch and bycatch mortality at the highest cost to the nation (i.e., costs to fishers and public management costs).

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

Alternatives 1, 2, 3, 4 and 7 would continue reliance on MPAs as a primary bycatch mitigation tool, which could affect safety if more vessels elect to fish seaward of the closed areas and are more exposed to bad weather conditions. Implementation of a vessel monitoring system capable of sending distress calls would mitigate this safety issue. Alternative 4 and 7 would establish individual vessel catch allowances for overfished species, in combination with larger trip limits for other species, enabling participating vessels more flexibility to choose when to fish. Alternative 5 would further increase that flexibility and allow vessels to choose to operate during the best weather conditions. Also, by reducing reliance on area closures and gear restrictions, vessels would likely find fishing opportunities nearer shore than the current RCA seaward boundaries. Alternatives 4 and 7, if trip limits or individual vessel catch limits were not included, would tend to accelerate the race for fish as vessels would attempt to maximize there catches before their sector limit is reached.

6.0 Other Federal Laws and Executive Orders

In addition to being prepared in accordance with the requirements of the *MAGNUSON-STEVENS ACT* and *NEPA*, this document also addresses requirements of other applicable federal laws and Executive Orders (EOs). These laws and orders are described here and their applicability to this action assessed.

The Regulatory Flexibility Act (RFA) and EO 12866 do not apply to programmatic EISs, such as this one, that will not immediately result in regulations. However, information and analysis in Chapter 4 of this EIS would be relevant to RFA and EO 12866 analyses on future regulations developed from this EIS. When the Council and NOAA Fisheries develop regulatory programs to implement the preferred alternative, RFA and EO 12866 analysis requirements would apply to those programs.

6.1 Other Federal Laws

6.1.1 Coastal Zone Management Act

Section 307(c)(1) of the federal Coastal Zone Management Act (*CZMA*) of 1972 requires all federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. Any alternative adopted by the Council would be implemented in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved coastal zone management programs of Washington, Oregon, and California. 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.

Under the CZMA, each state develops its own coastal zone management program which is then submitted for federal approval. This has resulted in programs which vary widely from one state to the next. None of the alternatives under consideration is expected to affect any state's coastal management program.

6.1.2 Endangered Species Act

NMFS issued *BIOLOGICAL OPINIONS* (BOs) under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley spring, California coastal), coho salmon (Central California coastal, southern Oregon/northern California coastal), chum salmon (Hood Canal summer, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, central California coast, California Central Valley, south-central California, northern California, southern California). During the 2000 Pacific whiting season, the whiting fisheries exceeded the chinook bycatch amount specified in the Pacific whiting fishery BO (December 15, 1999) incidental take statement estimate of 11,000 fish, by approximately 500 fish. In the 2001 whiting season, however, the whiting fishery's chinook bycatch was about 7,000 fish, which approximates the long-term average. After reviewing data from, and management of, the 2000 and 2001 whiting fisheries (including industry bycatch minimization measures), the status of the affected listed chinook, environmental baseline information, and the incidental take statement from the 1999 whiting BO, NMFS determined in a letter dated April 25, 2002 that a re-initiation of the 1999 whiting BO was not required. NMFS has concluded that implementation of the FMP for the Pacific Coast groundfish fishery is not expected to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS, or result in the destruction or adverse modification of critical habitat.

6.1.3 Marine Mammal Protection Act

The MMPA of 1972 is the principle federal legislation that guides marine mammal species protection and conservation policy in the United States. Under the MMPA, NMFS is responsible for the management and conservation of 153 stocks of whales, dolphins, porpoise, as well as seals, sea lions, and fur seals; while the U.S. Fish and Wildlife Service is responsible for walrus, sea otters, and the West Indian manatee. Off the West Coast, the Steller sea lion (*Eumetopias jubatus*) Eastern stock, Guadalupe fur seal (*Arctocephalus townsendi*), and Southern sea otter (*Enhydra lutris*) California stock are listed as threatened under the ESA and the sperm whale (*Physeter macrocephalus*) Washington, Oregon, and California stock, humpback whale (*Megaptera novaeangliae*) Washington, Oregon, and California - Mexico Stock, blue whale (*Balaenoptera musculus*) Eastern north Pacific stock, and Fin whale (*Balaenoptera physalus*) Washington, Oregon, and California stock are listed as depleted under the MMPA. Any species listed as endangered or threatened under the ESA is automatically considered depleted under the MMPA.

The West Coast groundfish fisheries are considered a Category III fishery, indicating a remote likelihood of or no known serious injuries or mortalities to marine mammals, in the annual list of fisheries published in the Federal Register. Based on its Category III status, the incidental take of marine mammals in the West Coast groundfish fisheries does not significantly impact marine mammal stocks. None of the programmatic alternatives would be expected to increase impacts on any marine mammal stock.

6.1.4 Migratory Bird Treaty Act

The *MIGRATORY BIRD TREATY ACT* of 1918 (*MBTA*) was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished populations of many native bird species. The MBTA states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico, and Russia to protect a common migratory bird resource. The MBTA prohibits the directed take of seabirds, but the incidental take of seabirds does occur. As discussed in Section 4.3.3.2, the preferred alternative is unlikely to affect the incidental take of seabirds protected by the MBTA.

6.1.5 Paperwork Reduction Act

The Magnuson-Stevens Act requires collection of information on bycatch and bycatch mortality, and each of the program alternatives addresses this requirement to some degree. Regulatory programs to implement the preferred alternative would likely result in increased reporting, whether via logbooks or through carrying an electronic monitor or human observer. Requirements to fill out logbooks or to carry electronic monitors or human observers are subject to review under the PRA. No regulations subject to the PRA are proposed to immediately be implemented via this EIS. When future regulatory programs are proposed, the appropriate PRA analysis would be completed at that time.

6.2 Executive Orders

6.2.1 EO 12898 Environmental Justice

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires federal agencies to identify and address "disproportionately high adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations in the United States." 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 factors 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 is 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.

This EIS describes tribal communities affected by the program alternatives and impacts to those and other communities (see Sections 3.4.4 and 3.4.6). 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 alternatives are not available. Treaty tribes harvesting West Coast groundfish are part of the Council's decision-making process on groundfish management issues, and tribes with treaty rights to salmon, groundfish, or halibut have a seat on the Council.

The preferred alternative could affect groundfish allocations or harvest levels that could in turn disproportionately impact low income and minority populations.

6.2.2 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 must be accompanied by a "federalism summary impact statement." The Council process offers many opportunities for states (through their agencies, Council appointees, consultations, and meetings) to participate in the formulation of management measures. This process encourages states to institute complementary measures to manage fisheries under their jurisdiction that may affect federally-managed stocks. The preferred alternative does not have federalism implications subject to EO 13132.

6.2.3 **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 upon Indian tribes.

The Secretary recognizes the sovereign status and co-manager role of Indian tribes over shared federal and tribal fishery resources. At Section 302(b)(5), the Magnuson-Stevens Act reserves a seat on the Council for a representative of an Indian tribe with federally-recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes the four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish. In general terms, the quantification of those rights is 50% of the harvestable surplus of groundfish available in the tribes' usual and accustomed fishing areas (described at 50 CFR 660.324). Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives. The alternatives in this EIS were developed in consultation with the affected tribes and the Council's tribal representative participated in the review and adoption of the preferred alternative.

6.2.4 EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)

EO 13186 supplements the MBTA (above) by requiring federal agencies to work with the U.S. Fish and Wildlife Service to develop memoranda of agreement to conserve migratory birds. NMFS intends to develop its memorandum of understanding in 2005. 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 NEPA.

Section 4.3.32 evaluates impacts to seabirds and concludes that the none of the program alternatives would significantly impact seabirds.

7.0 SUMMARY OF OTHER ENVIRONMENTAL MANAGEMENT ISSUES

Based on the environmental impacts disclosed in Chapter 4, this chapter summarizes a range of issues that an EIS must address. These issues are identified at 40 CFR 1502.16, describing the analysis of environmental consequences in an EIS. The last two sections in this chapter describe mitigation measures (as required by 40 CFR 1502.16(h)) and identify unavoidable adverse impacts (as required by 40 CFR 1502.16).

7.1 Short-Term Uses Versus Long-Term Productivity

The Council manages the groundfish fisheries to keep total mortality within sustainable harvest levels. Current harvest policies were set first through Amendment 11 to the FMP, and then revised in 2001 to account for recent scientific information on the need for more conservative harvest levels for low-productivity rockfish. The bycatch and bycatch mortality minimization programs examined in this EIS are intended to reduce bycatch mortality but do not address overall harvest policies. To the extent that bycatch mortality of a particular species is reduced, more of that species is available for directed harvest, meaning that these programs do not directly affect short-term resource uses. The area where bycatch mitigation programs can positively affect long-term productivity is in accountability. For fisheries where bycatch estimates are too low or nonexistent, it is possible for total mortality to exceed intended amounts without notice. Over time, total mortality would be higher each year than had been expected, potentially affecting long-term productivity of unmonitored stocks. The Council's preferred alternative would link bycatch reduction incentive programs to vessel monitoring, increasing quantity and quality of bycatch in both the near and longer term. As these data are used to improve bycatch estimates, unaccounted-for bycatch will decrease, ultimately improving long-term productivity through more informed management of total mortality limits.

7.2 Irreversible Resource Commitments

An irreversible commitment represents some permanent loss of an environmental attribute or service. The use of non-renewable resources is 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 7.4.

The preferred alternative action does not by itself represent an irreversible commitment because renewable resources are being managed within an adaptive framework. If a stock were extirpated or species went extinct, this would represent an irreversible resource commitment. The preferred alternative is intended to reduce bycatch and bycatch mortality in the groundfish fisheries, as well as to increase the quantity and quality of data available on bycatch in the groundfish fisheries. Under the preferred alternative, particular fisheries and sectors within those fisheries will be examined for applicability of full retention, sector/vessel bycatch caps, and dedicated access privileges programs. Future full retention programs will have to be examined for the portion of the catch that is expected to be non-target and not desired or useable for retention. Full retention programs that result in moving the disposal of fisheries waste from the marine to terrestrial environment may represent an irreversible resource commitment. Dead biomass from discarded offal or bycatch in marine fisheries feeds marine animals. Were that dead bycatch disposed of on land, a food source would move from the marine to terrestrial environment. Sector/vessel cap programs and dedicated access privilege programs may only present the same possible irreversible resource commitment if they include full retention requirements.

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 preferred alternative would lead to an FMP amendment that would require bycatch reduction measures to be included in future full retention, vessel/sector cap, and dedicated access privilege programs. The preferred alternative also supports the Council's Strategic Plan goal of reducing overcapacity in commercial fisheries. The fisheries themselves that would be altered by bycatch reduction programs are managed to allow harvest at sustainable levels. However, the fish that are harvested in these fisheries 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.

7.4 Energy Requirements and Conservation Potential of the Alternatives

The proposed action indirectly affects energy use primarily in the form of fossil fuels used to power surveillance craft and fishing vessels. Energy used in at-sea and aerial monitoring and enforcement activities is a direct effect. Change in the level of this type of monitoring is hard to predict because it depends on the types of management measures that will be implemented biennially and inseason. Generally, the RCAs, which were first implemented in late 2002, require more surveillance to be effective. However, VMS, implemented at the beginning of 2004, will compensate for the increased surveillance need because vessel positions can be remotely monitored. Finally, the availability of ships and aircraft to conduct surveillance, which is partly contingent on U.S. Coast Guard mission priorities, will also dictate the level and the number of patrols, affecting energy use. For these reasons, it is difficult to predict how energy use would change from baseline conditions. The proposed action indirectly affects fishing activity, and thus, the consumption of fuel by fishing vessels. Fuel consumption is likely to correlate with harvest levels and with the number of vessels participating in the fishery. The preferred alternative is intended to reduce bycatch through several different management tools, including capacity reduction. As vessel participation is reduced in the commercial fisheries over time, vessel fuel consumption will also be reduced. None of the alternatives, including the preferred alternative, speak to capacity reduction in the recreational fisheries, which are primarily managed by the states. It is difficult to predict vessel fuel consumption in the recreational fisheries, but it is not likely to be reduced as a result of the preferred alternative.

7.5 Urban Quality, Historic Resources, and the Design of the Built Environment

The Newport Beach dory fleet, which may be indirectly affected by the proposed action, is considered a historic resource locally. Although the proposed action does not directly affect urban quality, other historic resources, or the design of the built environment, it may have indirect effects. Fishing fleets add to the character of many West Coast communities and are a determining factor in investment in port infrastructure, including the maintenance of navigation channels. Aside from any broad effects on community income, continued decline in the number of vessels, which is likely to occur under more restrictive management measures, could affect infrastructure investment and might contribute to changes in the character of waterfront areas. Significant adverse impacts are unlikely.

7.6 Possible Conflicts Between the Proposed Action and Other Plans and Policies For the Affected Area

Groundfish are caught incidentally in fisheries managed under other Council FMPs (for salmon, coastal pelagic species, and highly migratory species). Similarly, those species are caught incidentally in groundfish fisheries. The preferred alternative, which is intended to reduce all bycatch, groundfish and non-groundfish. Regulatory programs to implement the preferred alternative may make small amounts of commercial non-groundfish species available to fisheries managed under Council FMPs. Conversely, as more information becomes available on the bycatch of groundfish, particularly overfished species, in non-groundfish fisheries, harvest in those fisheries may need to be restricted to reduce groundfish bycatch. The Council may also need to coordinate with the states and tribes to reduce groundfish bycatch in state-managed non-groundfish fisheries. Ongoing use of GCAs to minimize overfished species bycatch will require continued coordination between the Council, states, and five West Coast national marine sanctuaries on areal fishing closures.

7.7 Significant and Unavoidable Adverse Impacts

The EIS must include a discussion of those adverse effects that cannot be avoided (40 CFR 1502.16). This discussion focuses on potentially significant adverse impacts of the proposed action, as implemented by the different alternatives. Council on Environmental Quality (CEQ) regulations at 40 CFR 1508.27 define "significantly" in terms of both context and intensity, and provide ten factors to consider when evaluating the intensity of an impact. NOAA provides agency guidance in determining significant impacts of fishery management actions in administrative order NOAA Administrative Order (NAO) 216-6 at §6.02, which expands on the CEQ definition. These criteria focus on the components of the human environment most likely to be affected by these types of actions.

Between these two sources, the primary area where the preferred alternative could potentially have significant effects on the human environment is under CEQ regulatory considerations at 40 CFR 1508.27(b)(6), "*the degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about future consideration.*" The preferred alternative sets guidance on future bycatch mitigation programs, which is to be included in the FMP. Under the preferred alternative, the Council will give precedence to incentives-based, rather than command-and-control bycatch mitigation programs. The preferred alternative would amend the FMP to:

- Set criteria for phasing in sector bycatch caps that would include: monitoring standards, full retention programs, and individual vessel incentives for exemption from caps
- Set standards for future development of IFQ programs to ensure that those programs are designed, in part, to reduce bycatch and bycatch mortality.
- Acknowledge the Strategic Plan's goal of reducing capacity in the commercial fisheries into the FMP: "*To have a level of harvest capacity in the fishery that is appropriate for a sustainable harvest and low discard rates, and which results in a fishery that is diverse, stable, and profitable. This reduced capacity should lead to more effective management for many other fishery problems. For the short term, adjust harvest capacity to a level consistent with the allowable harvest levels for the 2000 fishing year, under the assumption that stock rebuilding will require reduced harvests for at least the next two decades. Maintaining a year-round fishery may not be a short-term priority.*"

Given these elements of the preferred alternative, this action may be viewed as establishing precedents for future actions. Some of these future actions may have a significant effect on the human environment, most likely with positive benefits for the physical and biological environments and both negative and positive effects on the socioeconomic environment. Over the longer term, the socioeconomic environment should benefit from increased groundfish abundance and fishing opportunity, as well as more direct individual control over and responsibility for fishing behavior.

This EIS is also related to actions taken under Amendments 16-2 and 16-3, which set rebuilding plans for eight overfished species into the FMP. Under 40 CFR 1508.27(b)(7), the action must be evaluated in terms of "*whether the action is related to other actions with individually insignificant but cumulatively significant impacts.*" While a rebuilding plan for an individual species may not have a significant effect on the environment, all eight rebuilding plans together with the preferred alternative in this EIS could cumulatively have significant effects on the human environment. Both the rebuilding plans and this bycatch EIS set Council policy direction for the foreseeable future, reducing both total mortality and bycatch mortality. The rebuilding plans require the reduction in total mortality of both overfished stocks and more healthy groundfish stocks that co-occur with those overfished species. In the near-term, these reductions in total mortality level may have a significant effect on fisheries participants. Over the longer-term, however, sustainable harvest levels are expected to increase, showing a positive effect of the actions on the biological environment and a correlated positive effect on the socioeconomic environment.

The proposed action may potentially impact biodiversity and ecosystem function within the affected area (NAO 216-6 §6.02g). The 80+ groundfish species managed under the FMP are each part of intricate food web interactions between each other and non-groundfish species. The effect of reducing bycatch and bycatch mortality of groundfish on biodiversity and ecosystem function depends on many factors, including environmental conditions. Prior to 2000, Federal groundfish gear restrictions primarily focused on trawl mesh restrictions intended to reduce bycatch of juvenile groundfish.

The impacts of the preferred alternative, particularly in combination with overfished species rebuilding plans could have a variety of unpredictable effects on biodiversity and ecosystem function. For example, adult lingcod and rockfish tend to prey on juvenile rockfish. The lingcod stock has been rebuilding fairly swiftly and lingcod may well be preying on rockfish species managed under rebuilding plans. In general, the preferred alternative is intended to better account for total mortality and to ensure that those fish that are caught in the fishery are retained for use. The preferred alternative may result in an overall increase in groundfish biomass within the California Current marine ecosystem. Biodiversity and ecosystem function within that ecosystem may be more affected over the longer term by climate changes and human effects on the marine environment from activities other than fishing.

The proposed action could have significant social or economic impacts interrelated with the potential significant natural or physical environmental effects discussed above (NAO 216-6 §6.02h). In the short term, significant socioeconomic effects, resulting from lost fishing opportunity via capacity reduction programs, could occur. As discussed above, this action in combination with the rebuilding plans is expected to ultimately result in larger-sized groundfish stocks, with higher annual sustainable mortality levels. Greater longer-term fishing opportunities may have significant socioeconomic benefits. However, the persons and communities that ultimately benefit from improved groundfish stock conditions will be different from those who are enduring the negative effects of overfished species rebuilding now. Rockfish rebuilding plans are necessarily longer in time frame than for short-lived species under rebuilding plans in other parts of the country. Stocks that are more abundant 20-30 years from now will not benefit communities in the near term.

Overall, the proposed action is beneficial. This net benefit, although unquantified, will occur if long-term benefits from reducing bycatch and bycatch mortality outweigh the short-term costs to fishery participants.

7.8 Mitigation

An EIS must discuss “means to mitigate the adverse environmental impacts” stemming from the proposed action (40 CFR 1502.1(h)), even if the adverse impacts are not by themselves significant. The preferred alternative is itself a mitigative program intended to mitigate potential adverse environmental impacts that could result from taking no action on bycatch planning and minimization. Bycatch mitigation tools available to the Council and NOAA Fisheries fall into three major categories: those that reduce unintended catch, those that may reduce mortality of unintended catch, and those that reduce waste of unintended catch. A fourth category could also be considered (reduce unobserved gear-related mortalities) but very little information is available to address that category. The magnitude of effects for the first three categories is difficult to predict, and even the direction of effect may not be apparent or predictable.

Tools to mitigate unintended catch are likely to affect species abundance and ecosystem structure. Some of these tools have more selective effects and may affect relatively few species of similar size and shape. Others have broad effects on a variety of species and sizes. These effects are analyzed in Chapter 4 of this EIS for a set of species that represent various trophic levels and geographic areas within the affected environment. Potential mitigation measures are discussed here with respect to the components of the human environment potentially affected by the proposed action.

<u>Habitat and ecosystem</u>: Although adverse impacts to groundfish habitats may be caused by a range of natural events and human activities, mitigation measures within the scope of NOAA Fisheries' authority would address fishing-related impacts. The GCAs, currently used to reduce overfished species bycatch, also reduces related adverse impacts from groundfish fishing gear to benthic habitat within its boundaries, because bottom trawling is prohibited in these areas. In a separate action, NMFS is preparing an EIS to identify and describe groundfish EFH, and identify habitat areas of particular concern (HAPCs) within EFH. The alternatives in the EFH EIS will include measures to minimize adverse effects on EFH caused by fishing.

<u>Groundfish species</u>: As mentioned earlier in this chapter, the preferred alternative and all of the other alternatives to no action are themselves mitigative programs. While the preferred alternative does not affect total groundfish harvest, it would reduce groundfish bycatch and bycatch mortality. The preferred alternative is also intended to improve the quantity and quality of bycatch data. If bycatch reporting and subsequent estimates of bycatch mortality improve, the Council and NOAA Fisheries will be able to more accurately manage to total harvest levels. Improved bycatch data will better ensure that unaccounted-for mortality does not occur. Dedicated access privilege programs recommended under the preferred alternative would likely result in allocations of both target and bycatch species. In addition to limiting total mortality, these types of management programs could provide incentives for fishermen to find ways to reduce their bycatch rates, since they would more directly bear the cost of producing bycatch. Gear modifications to reduce vessel bycatch rates would also be encouraged through these programs and through sector/vessel bycatch programs. In reducing bycatch overall, the preferred alternative should also be mitigative for bycatch and bycatch-mortality of non-groundfish species.

<u>Socioeconomic sectors</u>: Adverse socioeconomic impacts are attributable to increases in fisheries participation costs associated with more aggressive monitoring programs, increases in fisheries participation costs and safety concerns associated with fishing grounds closures in MPAs, and restriction of access to fishing opportunities through capacity reduction programs. One general form of mitigation is to compensate fishermen directly through subsidies or the provision services, such as job retraining programs for displaced workers. While the alternatives, including the preferred alternative, contemplate a variety of cost-increasing fishery management programs, programs do not include fisherman compensation for those costs. Over the longer term, the preferred alternative would reduce the number of vessels participating in the fishery, ultimately making fishery participation more profitable for those who remain in the fishery. Vessels operating at more profitable levels are expected, under the preferred alternative, to bear more of the cost of managing their fishery, including for bycatch monitoring and mitigation programs.

7.9 Environmentally Preferred Alternative and Rationale for Preferred Alternative

NEPA regulations, at 40 CFR 1505.2(b), state that the ROD will identify an alternative or alternatives considered "environmentally preferable." In order to inform the public and facilitate preparation of the ROD, the rationale for identifying Alternative 6 as the environmentally preferable alternative is summarized here. Guidance, in the form of *Forty Most Asked Questions Concerning CEQ's NEPA Regulations*, states that the environmentally preferable alternative is "the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (Question 6.A).

Alternative 6 represents the environmentally preferable alternative because it would implement the largest-sized MPAs of the alternatives and because it is estimated to have the least effect on biological resources in terms of impacts to habitat and ecosystem, and in terms of harm to protected species. However, in comparison to the other alternatives, Alternative 6 could have a greater adverse impact, both in the near- and longer-term, on West Coast fishing communities substantially engaged in or dependent on groundfish fisheries. Alternative 6 takes the command-and-control approach of closing large marine areas to all groundfish fishing, thereby reducing both directed and incidental take of all species by groundfish fishing vessels. Implementing these large closed areas would also require reducing total available groundfish harvest for fishing in open areas, to ensure that stocks are not locally depleted in the open areas. Fishing communities located closest to the closed areas would suffer the greatest impacts. Their fishery participants could be expected to either leave the fishery altogether or to remain in the fishery at the increased operating costs and increased safety risks associated with traveling farther at sea to reach open fishing areas. Combined with substantial declines in allowable groundfish harvest over the past five years, bycatch mitigation measures under Alternative 6 could notably affect the character and viability of these communities. NEPA describes national policy in terms of the human environment, which includes the relationship of people with the natural and physical environment (40 CFR 1508.14). Fishing, whether commercial, recreational, or ceremonial is a direct expression of this relationship.

The Council identified a preferred alternative at its April 4-9, 2004, meeting in Sacramento, California. The Council-preferred alternative, Alternative 7, combines bycatch mitigation programs from Alternative 1 (continue existing bycatch mitigation programs,) Alternative 4 (vessel/sector bycatch cap programs,) and Alternative 5 (implement dedicated access privilege programs for appropriate sectors). This alternative is intended to acknowledge and continue the Council's ongoing bycatch mitigation strategy, plus focus future Council action on new regulatory programs to reduce bycatch through vessel accountability and capacity reduction. The Council has not discussed most of its bycatch mitigation program in its FMP, nor has it recently evaluated whether its FMP should set parameters for capacity reduction programs that require those programs to accomplish goals unrelated to capacity management. While Alternative 7 would not have the same immediate negative socioeconomic effects of Alternative 6, it will result in a longer-term restructuring of the fisheries so that each sector is managed with bycatch reduction programs appropriate to that sector. Thus, Alternative 7 takes an incentives-based approach to bycatch reduction to ensure that Magnuson-Stevens Act bycatch reduction and community involvement fishery management goals are met.

8.0 Response to Comments

The 45-day public comment period on the Programmatic Bycatch DEIS closed on April 27, 2004 (69 FR 9313). NMFS received a letter of comment from the United States Environmental Protection Agency (USEPA) Region 10 in accordance with their responsibility to review and rate EISs pursuant to NEPA and Section 309 of the Clean Air Act. Because a preferred alternative was not identified in the DEIS, USEPA rated each alternative separately. Alternatives 1-5 received a rating of EC-2 (Environmental Concerns -Insufficient Information) and Alternative 6 received a rating of LO (Lack of Objections). In addition to these ratings, EPA provided detailed comments on the DEIS. The U.S. Coast Guard also sent a letter on this DEIS, indicating that, because none of the alternatives would affect the Coast Guard's ability to perform its living marine resources statutory responsibilities, the Coast Guard would offer no comments on the document. NOAA Fisheries also received written comments in a joint letter from the Natural Resources Defense Council, the Pacific Marine Conservation Council, Oceana, and the Ocean Conservancy, and in two letters from members of the public.

The detailed USEPA comments are reproduced below in their entirety, with responses following each comment. The other written comments have been summarized to identify specific comments, with responses following each comment. They are reproduced in their entirety as Appendix E to this document.

8.1 EPA Comments

Minimizing Bycatch and Mortality of Bycatch: Magnuson-Stevens Act National Standard 9 and Section 303(a)(11) require that bycatch and bycatch mortality be minimized, and standardized reporting methodologies to assess the amount and type of bycatch occurring in the fishery be developed. In addition, the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA, require that proposed actions avoid or minimize adverse effects of actions upon the quality of the environment. While all of the alternatives propose actions that would reduce bycatch and bycatch mortality and thereby reduce adverse effects on the environment, Alternative 6 clearly proposes actions that minimize bycatch of all species.

Fish stock data demonstrates that the status quo (Alternative 1) does not adequately minimize bycatch of many species, most importantly, overfished species. Alternatives 2 and 3 would reduce only regulatory discard, that portion of bycatch that results from fishers complying with the regulations. These alternatives do not propose actions to minimize economic bycatch, which according to the EIS, could account for 66% of the discarded bycatch. While Alternatives 4 and 5 reduce all groundfish bycatch, they do not minimize bycatch of other, non-groundfish species. In particular, impacts on Pacific halibut, salmon, and seabirds would not be minimized.

Alternative 6 proposes actions that would minimize bycatch and mortality to bycatch for all species by employing large area closures, gear restrictions, bycatch caps, and increased retention requirements. The trading and consolidation of RSQs and IFQs would reduce the race for fish. Alternative 6 takes a two-pronged approach to reducing bycatch through use of both a traditional command-and-control approach and a marked-based approach. In addition, Alternative 6 forbids discarding, which produces a strong incentive to develop and apply more selective gear because the cost of sorting, storing, transporting, and disposing of fish that cannot be sold must be substantial.

Response: Alternative 7, preferred, is a combination of Alternatives 1, 4, and 5. Alternative 7 would include the continued use of large area closures to prevent incidental catch of groundfish. Other, non-groundfish species commonly found in the GCAs, such as Pacific halibut, are also subject to lower overall bycatch rates because of these area closures. Alternative 7 would also phase in sector bycatch programs and monitoring standards for full retention programs. Finally, Alternative 7 would support RSQ/IFQ programs for appropriate fishery sectors. NOAA Fisheries expects that this bycatch policy alternative will result in bycatch reduction from both the command-and-control and marked-based approaches.

Observer Coverage: Monitoring is a fundamental mechanism for accounting for and, in turn, minimizing bycatch. Requiring 100% observer coverage is the most effective means of accurately accounting for bycatch. Camera monitors onboard ships are a good mechanism for monitoring the retention of bycatch. They do not, however, provide a means of accurately accounting for species composition and weight of bycatch that is discarded. At present, electronic monitoring technology is not accurate enough to identify species and estimate the weight of discarded fish more than 63% of the time. Therefore, we support 100% observer coverage, as proposed in Alternatives 5 and 6, until such time that video and electronic monitoring of bycatch equals or exceeds that of the observer program. In addition, we support the proposed quota incentives to those fishers and vessels that accommodate observers, until such time that 100% observer coverage can be provided.

Response: NOAA Fisheries has not proposed electronic monitoring as a substitute for human observers. Electronic monitoring equipment is primarily useful in identifying where a vessel is located or what fishing activities are taking place on board that vessel. For example, NOAA Fisheries has been testing the use of camera monitors in the full-retention shorebased whiting fishery. In this fishery, participating vessels retain all of their catch and do not sort it until the vessel is at the dock. Camera monitors were tested in the summer of 2004 to determine whether they would be useful tools for verifying whether the participating vessels had retained all of their catch or dumped some catch at sea. Because the vessels do not sort their catch at sea, species-specific identification of catch is not necessary.

Depending on the goal of an observer program, 100% observer coverage may not be necessary. WCGOP is a total catch sampling program, meaning that a portion of the groundfish catch is sampled and bycatch estimates are extrapolated for the fleet from those samples. Vessels participating in the at-sea whiting fisheries are being monitored for real-time accounting of catch and bycatch, thus they carry observers around the clock. The aim of the Council's preferred alternative is to match fishery monitoring coverage levels and program goals to particular management strategies of the different sectors of the fleet. For sectors where a full retention program is possible, camera monitoring in company with current VMS requirements may be a sufficient monitoring program. For sectors where real-time data is needed to monitor RSQ and IFQ catch, 100% observer coverage may be appropriate.

High Grading and Market Limits: Observer data indicates that 66% of the bycatch was discarded for market reasons. The high grading of fish for certain attributes (size, sex, or physical condition) in some cases makes them more marketable. High grading occurs when the price differential between high- and low-valued fish is greater than the cost of discarding and replacing the catch and results in increased discarded bycatch. The incentive to high grade is enhanced if the cost to catch additional fish is very low. Related to high grading, processors impose market limits to prevent market gluts or to match their processing capacity. A fisher who catches more than his market limit may high grade if there is a price differential, or may simply dump the entire excess, regardless of size or other factors.

While the EIS proposes various actions for fishers to minimize economic bycatch, it does not propose any such actions for processors. The EIS does not discuss what provisions exist under the Magnuson-Stevens Act that relate to processors for addressing high grading and market limits. The EIS should evaluate and discuss whether sections of the Magnuson-Stevens Act such as those that address processing capacity and processor permitting, could be employed to minimize economic bycatch.

Response: There is currently no legal authority in the Magnuson-Stevens Act to prevent processors from imposing market limits, or to require them to minimize processing waste.

Environmental Justice: Section 6.2.2 of the EIS states that the alternatives under consideration could affect groundfish allocations or harvest levels that could, in turn, disproportionately impact low income and minority populations. While the EIS mentioned coastal and tribal communities, it does not discern which populations may be disproportionately impacted by the proposed actions. In particular, there is no discussion of the minority (people of color) and low income populations that may be fishers, processors, or consumers. In addition, the EIS does not discuss what actions were taken to achieve meaningful participation from those minority and low-income communities that might be disproportionately impacted. The EIS should include the following:

- A comprehensive accounting of all impacts on low income and people of color, including (but not limited to) cumulative and indirect impacts, and impacts to cultural, historic, and protected resources. In addition, the EIS needs to demonstrate that (sic.) *whether* the impacts to low income and people of color communities will be disproportionately higher than those on non-low income and non-people of color communities. For such a determination, the EIS must identify a reference community, provide a justification for utilizing this reference community, and include a discussion of the methodology for selecting the reference community.

- The EIS should demonstrate that communities bearing disproportionately high and adverse effects have had meaningful input into the decisions being made about the proposed action. The EIS needs to describe what was done to inform the communities about the proposed action (notices, mailings, fact sheets, briefings, presentations, exhibits, tours, news releases, translations, newsletters, reports, community interviews, surveys, canvassing, telephone hotlines, question and answer sessions, stakeholder meetings, and on-scene information,) the potential impacts it would have on their communities, what input was received from the communities, and how that input was utilized in the decisions regarding the proposed action.

Response: In this EIS, NOAA Fisheries focused on identifying the fishing communities and fisheries dependencies of Washington coastal treaty tribes: Hoh, Makah, Quileute, and Quinault. Treaty tribes, their fisheries and communities (including their income, poverty status, economy, labor force status, and fishery infrastructure) are described in section 3.4.4 of this EIS. Scoping for this EIS is discussed in section 1.6.

Fishery management actions promulgated by the Council and implemented by NOAA Fisheries can have environmental and socioeconomic impacts covering all West Coast waters and adjacent coastal communities involved in fishing. This makes it difficult to identify minority and low-income populations that may be disproportionately affected. Fishery participants usually make up a small component of the population, and fisheries may be a small part of the local economy in many places. Thus, even if a community has a high proportion of minority or low income residents, these people might not participate in fisheries and so may be minimally affected by the preferred alternative. Furthermore, within the affected population some segments are more likely to be low income and minority than others. For example, employees in a fish processing plant may be predominantly from a minority group, or deckhands on vessels are likely to have a lower income than the skipper or vessel owner. Unfortunately, the kind of detailed population data necessary to determine the characteristics of the population affected by the proposed action are unavailable.

In 2004, NOAA's Northwest Fisheries Science Center began a community profiling project in coordination with Alaska and Southwest Centers. The Northwest Center is developing models to rank communities in Washington, Oregon, Idaho, and California, based on their dependence upon and engagement in fisheries. From those states, 150 communities will be chosen for short profiles of their demographic data, history in marine resource extraction, and current fishing activities. These profiles will be available for future NEPA analyses of West Coast groundfish management actions.

8.2 Public Comments

Comment 1: The agency originally framed this DEIS as a programmatic EIS, intended to examine the effects of implementation for the Fishery Management Plan as a whole. In response to a court ruling that NMFS's bycatch program is illegal, *Pacific Marine Conservation Council v. Evans*, 200 Supp. 2d 1194 (N.S. Calif. 2002,) the agency converted the EIS from a programmatic one to one focused on bycatch. Unless and until NMFS completes a legally adequate assessment of the direct, indirect, combined and cumulative effects of the groundfish fisheries as a whole, the agency will not meet its legal obligations under NEPA.

Response: NOAA Fisheries undertook preparation of a comprehensive EIS on the Pacific Coast Groundfish Fishery in 1991. See, 66 Fed. Reg. 18586-87 (April 10, 2001) and 67 Fed. Reg. 5962-63 (February 8, 2002). However, it subsequently became necessary to narrow the scope of the analysis to focus on bycatch. 68 Fed. Reg. 26557-58 (May 16, 2003). This action was necessitated by several species being declared overfished, and by the court's finding that Amendment 13 to the Groundfish FMP on bycatch measures was deficient.

NOAA Fisheries has not abandoned its intent to prepare a new comprehensive EIS for the groundfish fishery. We note that considerable NEPA analysis on the fishery has already been performed in the six EISs that have recently been prepared for Amendments 16-2 and 16-3 (overfished species rebuilding plans), for the 2003, 2004, and 2005-2006 specifications and management measures, and for bycatch, and in the EIS that is currently underway on EFH. Information and analysis contained in these recent EISs can be used as the foundation for developing a future comprehensive EIS on the groundfish fishery.

In 2000, the Council adopted a Strategic Plan intended to provide future direction for West Coast groundfish fisheries management. For its November 2004 meeting, the Council is scheduled to review its Strategic Plan accomplishments to date, and to determine whether to update the plan. NOAA Fisheries believes that a Strategic Plan update, followed by an FMP amendment intended to incorporate the principles of the Strategic Plan in the FMP, would be an appropriate action for which to prepare a comprehensive EIS on the West Coast groundfish fisheries.

Comment 2: This EIS is not designed to result in prompt action via an immediate fishery management plan amendment needed to bring the FMP into compliance with Magnuson-Stevens Act bycatch related requirements.

Response: As stated in section 1.1 (Proposed Action) of this document, "...The Council is expected to immediately undertake preparation of a new groundfish fishery management plan amendment that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable." Following the publication of the Notice of Availability for this FEIS, NOAA Fisheries intends to draft amendatory language for the groundfish FMP that would revise the FMP in accordance with the program directions in Alternative 7 (preferred). NOAA Fisheries intends to bring this draft amendatory language before the Council at its November 2004 meeting in Portland, OR. The agency expects to make a draft FMP amendment available to the public via the Magnuson-Stevens Act review process in 2005. NOAA Fisheries also notes that the agency and the Council are already developing a full retention and monitoring program for the shorebased sector of the whiting fishery, which is intended to be implemented in 2005. That program has been designed to meet the policy directions given in the Council's preferred alternative for this EIS.

Comment 3: The DEIS fails to present and analyze the most fundamental information needed to assess bycatch avoidance and minimization measures – species-specific information on current bycatch and discard amounts by fishing sector.

Response: These same commenters also submitted a comment letter on the DEIS for Amendment 16-3 to the groundfish FMP. In that letter, they requested that the DEIS include updated total mortality information for the groundfish fisheries. NOAA Fisheries responded in the July 2004 FEIS on Amendment 16-3 with preliminary total mortality data for 2002 and 2003. Since the publication of that FEIS, NOAA Fisheries has held a data workshop to develop, among other things, methods for using observer data to estimate historical fisheries' discard rates and amounts. Revisions to the estimates provided in the Amendment 16-3 FEIS are provided in this document in Tables 8.1 and 7.2. Methods used to estimate the total mortality amounts provided in Tables 8.1 and 8.2 were developed to be used in stock assessments to be conducted in 2005. These discard estimation methods may again be refined prior to completion of the 2005 groundfish stock assessments. A discussion of the methodology used in making these estimates follows.

Observation of the limited-entry trawl fishery by WCGOP began in September,

2001. From that starting point, data have been analyzed through August, 2003. Discard ratios for 2002 and 2003 were calculated using only observer data from the same calendar year. Consequently, 2003 discard estimates are based on data collected only through August 2003. Trawl data were restricted to those tows: 1) which were not part of an Exempted Fishing Permit (EFP); 2) where retained groundfish tonnage exceeded non-groundfish tonnage; and 3) where retained pink shrimp was less than 100 pounds. Additionally, data collected from mid-water fishing for widow or yellowtail rockfish in November-December 2002 were partitioned and evaluated separately. Data were pooled across months, but were stratified into areas north and south of 40º10' N. lat. and into depth intervals. Depth strata used for the area north of 40°10' N. lat. in both years were: 0-50 fm, 51-75 fm, 76-100 fm, 101-150 fm, 151-200 fm, 201-300 fm, and greater than 300 fm. Depth strata used for the area south of 40°10' N. lat. in both years were: 0-60 fm, 61-75 fm, 76-100 fm, 101-150 fm, 151-225 fm, 226-300 fm, and greater than 300 fm.

For species that are targeted using bottom trawl gear (e.g. sablefish, thornyheads, flatfish), discard ratios are calculated for each stratum as [discarded pounds / retained pounds] for each individual species. For species caught primarily as bycatch–including those under rebuilding plans--discard ratios are calculated as [species discard pounds / sum of retained target species pounds]. For the area north of 40°10' N. lat., the target species included in this calculation are: sablefish, thornyheads, and all flatfish. For the area south of 40°10' N. lat., slope rockfish species are also included in the ratio denominator. For the mid-water widow-yellowtail fishery, discard ratios were calculated for all species using the combined poundage of widow and yellowtail as the denominator.

Following the same stratification used for the observer data, retained weights reported in trawl logbooks are summarized for each of the target species. The observer-based discard ratios are then multiplied by the retained poundage of the appropriate species or group. The result is an estimated discard amount for each species, for all directed groundfish trawl trips covered by logbooks. Not all landings have a corresponding entry in the logbook data base. Ratios of fish ticket-to-logbook species poundage are used to expand the estimates of discard for logbook trips up to a coastwide directed trawl total. For rebuilding species, the expansion ratios use the sum of retained target species poundage from each data set. For the target species, the retained poundage of each individual species is used to expand that species' estimated discard. Expansion ratios are calculated for each area, state, and two-month period. Discard amounts are then summed across areas and time periods.

Several trawl EFPs were conducted during 2003 and all required full retention of *Sebastes* species. Since all potential discards were landed and captured within the fishticket reporting system, application of non-EFP discard rates to all logbook tows would overstate the true amounts of discard (and total catch) for *Sebastes* species. Because an official listing of tows conducted as part of EFPs was not available at the time these estimates were made, an interim approach for categorizing EFP tows is used. During 2003, only EFP participants had the ability to legally bottom trawl for groundfish within the trawl RCA. Using this restriction, rockfish discard rates are not applied to target tonnage caught within the RCA depths off Oregon and Washington. Additionally, the principal EFP in Washington allowed large amounts of arrowtooth flounder to be landed in excess of trip limits. Accordingly, tows by Washington vessels that exceeded the 2-month allowance of arrowtooth flounder for non-EFP vessels are also categorized as EFP tows. The total target species poundage estimated for EFPs, using these criteria, was also subtracted from fish ticket landings in each state and 2-month period before expansion ratios were calculated.

WCGOP data from the primary fixed-gear sablefish fisheries during 2001-03 are used to calculate discard ratios for rebuilding species and sablefish. For 2002, these rates were calculated across all depths and multiplied by all sablefish landed north of 36^{o} with fixed gear (limited-entry and open access). For 2003, discard rates were calculated for the depths available to the fishery in that year. It is important to note that in these early years, no observer data were collected during these primary fisheries from ports south of Ft. Bragg, California. As a consequence, these data do not provide reliable estimates of discard occurring of central and southern California.

Comment 4: The EIS should contain a more concrete discussion of the magnitude of the effect of bycatch reduction that could be expected from implementing each alternative. Could bycatch reduction associated with each alternative be quantitatively analyzed? Without this specific information, it will be difficult for the Council and NMFS to determine which bycatch reduction measures are practicable.

Response: This EIS is not designed, nor was it intended, to produce a quantitative evaluation of bycatch reduction. Rather, each alternative was developed to include a combination of general management tools that are known to reduce bycatch. The alternatives reflect a range of goals and standards, and the analysis portrays a range of general costs and benefits (or effectiveness) of each alternative.

Alternative 7, the preferred alternative, uses a combination of management approaches from the other alternatives to balance the competing mandates of the Magnuson-Stevens Act. We do not currently have the information necessary to quantify precisely the bycatch reduction effects of specific management techniques. However, this information will be gathered as the preferred alternative is implemented, and will be used in adaptive management of the fishery as the relative efficacy of different bycatch reduction measures becomes more precisely known.

Comment 5: The DEIS mentions gear restrictions under Alternative 4, such as escape panels in fish traps and finfish excluder devices, but does not explain why it mentions these modifications or what the effects on the environment would be if they were or were not adopted.

Response: Each alternative includes a combination of management tools that could be applied to the fishery if that alternative were adopted. Gear restrictions and definitions are one generic management tool that can be used to reduce bycatch. There are hundreds of possible definitions and restrictions that could be applied. For example, finfish excluder devices could be narrowly defined by size, shape, or configuration, or they could be defined in terms of the objectives or standards to be achieved. The EIS lists and describes many gear modifications that could be required and describes the type of results that would be likely from those modifications. However, it was not the intent of this EIS to adopt specific gear modifications at this step in the process. Specific environmental effects will be analyzed when regulations are developed. For example, the Council has recommended trawl gear regulations for 2005 and beyond that would require the use of selective flatfish trawl gear north of 40°10' N. lat. This gear has been designed to reduce rockfish bycatch by trawlers targeting nearshore flatfish stocks. The effects on the environment of implementing this requirement have been analyzed in the Council's DEIS for the Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2005-2006 Pacific Coast Groundfish Fishery. As other new bycatch-reducing gear requirements are developed, those specific gear configurations will also be analyzed via the NEPA process.

Comment 6: Sector catch limits would provide incentives to fishing industry participants to avoid bycatch, which would have the effect of reducing regulatory bycatch. The EIS at Table 4.1.2 makes no mention of the potential socioeconomic effects of sector allocations, catch limits, and individual quotas. The EIS at Table 4.1.3 also indicates that sector allocations would have only a minor indirect effect on reducing regulatory bycatch of overfished species, which seems implausible.

Response: NOAA Fisheries agrees that Table 4.1.2 in the DEIS was incomplete. The agency has revised that table for the FEIS, now labeled as Table 4.1.5. NOAA Fisheries agrees that the DEIS 4.1.3 was confusing, so has removed that table. The current management program already uses several sector allocations, as the EIS explains. In most cases, these are retention limits that are based on anticipated catch levels and assumed (or previously observed) bycatch/discard rates. Where catches are fully monitored (for example, in the at-sea whiting sectors), real-time catch and bycatch data are available for inseason management. These sectors have relatively few participants, and thus cooperative agreements (such as data sharing) are more easily established. For larger sectors where the rates of at-sea catch/bycatch observations are less extensive (most of the non-whiting fisheries, especially the open access and recreational sectors), data would not be adequate to demonstrate real-time changes in bycatch rates or amounts.

The EIS describes the issue of "free rider" vessel operators within sectors that may take advantage of more conscientious fishers. The strength of bycatch-avoidance incentives increases as the number of participants in a sector declines. Dedicated access privilege programs provide an extreme example of this phenomenon, wherein the individual has strong incentives to hold himself directly responsible for his vessel's bycatch. Sector allocations by themselves do not resolve the free rider and monitoring problems, and thus may have little direct or indirect effect on bycatch.

Comment 7: Performance standards are a set of goals, criteria and indicators used to identify a target and measure progress toward meeting it. The analysis of the alternative should include a discussion of the role of bycatch performance standards in making sure a set of measures accomplishes its purpose. The DEIS provides no discussion or analysis that would assist the Council or NMFS in setting bycatch program goals.

Response: As discussed in the responses to Comments 4 and 5, the EIS's alternatives provide guidance for future policy directions on bycatch reduction programs. Alternatives 5, 6, and 7 include individual performance standards in the form of individual catch limits or quotas. Alternative 4 would require the setting of sector performance standards as sector catch limits. These performance goals would be set with the specific regulatory program used to implement the policy goals of the Council's preferred alternative.

Comment 8: The discussion of the economic impact of Alternative 4 contains virtually no numerical estimates of any costs of the alternative. Because Alternative 4 proposes sector bycatch caps, the DEIS should address whether the proposed sectors are too large or lack necessary safeguards so that free riders may decrease incentives to reduce bycatch. The DEIS should also specify the magnitude of the economic benefits that could result if the incentives are successful.

Response: Alternative 4, like the other alternatives, proposes a new policy direction for addressing bycatch. The sectors discussed in Alternative 4 may be too large to provide the appropriate incentives for sector participants to reduce their bycatch. As discussed in Sections 4.4.4 and 4.4.7, prescribing smaller-sized sectors in a sectors caps program may provide greater incentives for sector participants to reduce their bycatch levels. NOAA Fisheries believes that in implementing the policy direction provided by Alternative 7 (preferred), the Council will need to think creatively about where sector bycatch caps can be used, and how to define the appropriate sectors for such a program. For sectors that are already well-defined, such as one of the whiting fishery sectors, bycatch caps may be more easily implemented. For sectors that are heterogeneous, like the open access fisheries, the Council will need to define sectors and set sector allocations for targeted and non-targeted species as an initial step to a sector bycatch program.

In the short term, and perhaps the long term as well, bycatch reduction would be expected to result in greater economic costs than benefits. Effective monitoring would be costly; full observer coverage, unless the fleet is substantially reduced, is beyond anticipated government funding levels. As the Council identifies fishery sectors for sector-specific bycatch minimization programs, those sectors and programs will be analyzed for the costliness of implementation through vessel operator funding.

Comment 9: The DEIS must analyze the impacts of bycatch issues on habitat-forming species.

Response: The MSA defines “fish” to include all forms of marine animal and plant life other than marine mammals and birds, and thus bycatch includes the capture, injury and/or destruction of structure-forming species such as sponges and coral. Structure-forming species are generally immobile and slow-growing. Thus, long-term spatial management (area closures or prohibition of on-bottom fishing) is the most effective tool to protect them from incidental catch. WCGOP has been collecting sponge and coral interception data since its inception in August 2001. In January 2004, NOAA’s Office of Ocean Exploration published “Deep Sea Coral Collection Protocols” for ocean researchers. WCGOP has been using this document to revise its onboard observer protocols to improve the amount and type of information it collects on structure-forming invertebrates taken in the groundfish fisheries. NOAA Fisheries is investigating the distribution of West Coast communities of structure-forming species for its draft EFH EIS. That EIS will provide the most complete available data on structure-forming species, including an analysis of where those species’ habitats intersect with common fishing areas.

Comment 10: The DEIS must acknowledge that the status quo violates the Magnuson-Stevens Act by failing to establish a standardized reporting methodology and failing to minimize bycatch and bycatch mortality.

Response: Legal compliance with the Magnuson-Stevens Act requirements for bycatch was addressed in the case of *Pacific Marine Conservation Council, Inc. v. Evans*, 200 F. Supp.2d 1194 (N.D. Calif. 2002). The court's decision required that the observer program, which is being used in conjunction with other data sources as the standardized bycatch reporting methodology, be made mandatory. In response to the court's decision, the observer program was made mandatory by Amendment 16-1 to the Groundfish FMP. The court's decision also required a new NEPA document and FMP Amendment to address bycatch. This Bycatch FEIS, and the upcoming FMP amendment on bycatch, are intended to address those aspects of the court's decision.

Comment 11: The DEIS must evaluate the adequacy of the standardized reporting methodology for assessing the amount and type of bycatch occurring in the groundfish fishery.

Response: Chapter 3 of this EIS has been expanded to describe current monitoring programs and reporting methodologies used by NOAA Fisheries, the States of Washington, Oregon and California, and the Pacific States Marine Fisheries Commission. Costs associated with an increased at-sea observer program are also described. Appendix A provides methodology reports and analyses from the WCGOP, which is the primary federal standardized reporting program for the commercial West Coast groundfish fisheries.

NOAA Fisheries recently evaluated its standardized reporting methodologies conducted in federal waters nationwide, "Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs." (Powers et al., 2003). In this report, NOAA Fisheries provided evaluation criteria for all of its monitoring programs and rated WCGOP as a *developing* program and the at-sea whiting fisheries monitoring program as *mature*. A developing observation program is "A program in which an established stratification design has been implemented and alternative allocation schemes are being evaluated to optimize sample allocations by strata to achieve the recommended goals of precision of bycatch estimates for the major species of concern." A mature program is "A program in which some form of an optimal sampling allocation scheme has been implemented. The program is flexible enough to achieve the recommended goals of precision of bycatch estimates for the major species of concern considering changes in the fishery over time." This EIS is not intended to provide an adequacy evaluation for NOAA Fisheries' standardized reporting methodologies that supplants those provided in the 2003 Powers et al. report. WCGOP continues to consider itself a developing program, primarily because it is just now (August 2004) completing its third year of operation. WCGOP will continue to evaluate itself through its annual data report and summary analyses, with the aim of becoming a mature monitoring program for each of the groundfish fisheries it monitors. WCGOP has its longest time series of observer data on the limited entry groundfish trawl fishery. Thus, the observation program for the trawl fishery will likely be considered mature before the program as a whole is considered mature for all groundfish fisheries.

Comment 12: The DEIS does not provide information on known bycatch species and amounts, or on current reporting methodologies used to acquire this information. The EIS should note the current limitations of the WCGOP in identifying and quantifying all bycatch in the fisheries monitored by the observer program, not just those species that are overfished or commercially or recreationally valuable.

Response: In the response to Comment 3 and in Table 8.1 and 8.2, NOAA Fisheries provides bycatch estimates for major fish species discarded in the West Coast groundfish fisheries. Current bycatch reporting methodologies are described in Section 3.4.10 of this EIS. The WCGOP's data collection program is more fully described in Appendix A to this EIS, the Northwest Fisheries Science Center's "West Coast Groundfish Observer Program Initial Data Report and

Summary Analyses" for 2003 and 2004.

Comment 13: For the whiting fisheries, the EIS should describe standardized reporting methodologies.

Response: Chapter 3 (Affected Environment) has been expanded from that of the DEIS to better describe the various fishery monitoring and reporting programs, including those for the whiting fisheries, in section 3.4.10.

Comment 14: For the open access fisheries, the EIS should state whether information is available via standardized reporting methodologies. If not, discuss this information gap and describe options for filling it.

Response: Chapter 3 (Affected Environment) has been expanded from that of the DEIS to better describe the various fishery monitoring and reporting programs, including those for the open access fisheries, in section 3.4.10. The WCGOP has begun to expand its observer coverage into the directed groundfish open access fisheries and will present its initial data from that expansion in early 2005. At its September 2004 meeting, the Council will also review options for expanding VMS coverage into the various open access fisheries.

Comment 15: The DEIS should estimate the amount and type of bycatch occurring in the recreational fisheries and should assess the adequacy of recreational monitoring systems now in place as standardized bycatch reporting methodologies. Following on this analysis should be another analysis to look at the practicability of improving recreational total catch accounting. A recreational fishery accounting system should: account for total fishing mortality by species; establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding specified limits; monitor bycatch in a manner that is accurate, timely, and not excessively costly, and; gather information on unassessed and/or non-commercial species to aid in the development of ecosystem management approaches to overall fishery management.

Response: In the response to Comment 3 and in Tables 8.1 and 8.2, NOAA Fisheries provides bycatch estimates for major fish species discarded in the West Coast groundfish fisheries, including the recreational fisheries. Chapter 3 (Affected Environment) has been expanded from that of the DEIS to better describe the various fishery monitoring and reporting programs, including those for the recreational fisheries, in section 3.4.10. NOAA Fisheries, PSMFC, and the West Coast states are implementing a new recreational data collection program in 2004-2005 to address increasing needs for accurate recreational fisheries monitoring. These entities were spurred to develop this new program by uncertainty in the estimates derived from the nationally-run Marine Recreational Fisheries Statistics Survey. The states have greater data collection responsibilities in the new system, relying more on direct, at-dock observation of recreational effort and less on telephonic surveys. Telephonic surveys are being shifted from random sampling of coastal county residents to random sampling of state fishing license holders. The goal of the program is to get improved estimates of recreational catch and to provide managers with more timely estimates of catch to use for inseason management.

Comment 16: No information is provided on bycatch or bycatch reporting methodologies in the tribal fisheries.

Response: Chapter 3 (Affected Environment) has been expanded from that of the DEIS to better describe the various fishery monitoring and reporting programs, including those for the tribal fisheries, in sections 3.4.4 and 3.4.10.

Comment 17: The DEIS fails to provide adequate information to determine which measures are practicable.

Response: Chapters 3 and 4 have been augmented with information relating to costs, logistics and other factors that influence practicability. Section 4.9, "Practicability" has been added to discuss practicability under the Magnuson-Stevens Act. This section discusses factors that influence determination of whether and under which circumstances an alternative may be considered practicable. This section also discusses the practicability of the alternatives, based on the different factors that may determine practicability.

Comment 18: The EIS fails to consider completely phasing out bottom trawling.

Response: The alternatives for this EIS were developed through a public scoping process described in Section 1.6 of this document. The complete phasing out of bottom trawling was not raised as an alternative for consideration during public scoping, nor did the Council request such an alternative for inclusion in this EIS. NOAA Fisheries does not intend to revise this EIS at this stage in the process to include another alternative on the elimination of bottom trawling. However, this EIS does include alternatives intended to reduce trawl sector capacity (Alternatives 2, 5, 6, and 7). Alternative 7 is the Council's preferred alternative and includes capacity reduction in the trawl and other commercial fisheries through implementation of dedicated access privileges programs.

Comment 19: We question the need for the proposed action as it applies to the Southern California longline live fish fishery, since the current management measures already minimize bycatch and bycatch mortality to the extent practicable. The imposition of sector bycatch caps under Alternative 7, which includes Alternative 4, may necessitate the placement of full-time observers aboard our small boats, significantly increasing our operational costs and burdens. We cannot afford full-time observers, nor can we accommodate them on our small (26') vessels. Alternative 7 could be construed to eliminate our fishery altogether. Given the difference between our fishery and other fisheries along the coast, the requirements in any of the Alternatives 4-7 should not be universally applied to all fisheries. In particular, gear types with a proven record of low bycatch should be subject to fewer requirements than other gear types or fisheries, and should be reimbursed for observer coverage requirements.

Response: Alternative 7, the Council's preferred alternative, would apply sector bycatch caps to appropriate sectors of the groundfish fishing fleets. NOAA Fisheries agrees that applying sector bycatch caps may require vessels to carry full-time observers in order to verify ongoing quantities and rates of bycatch. During the summer of 2004, the agency has been investigating the use of electronic monitoring devices for catcher vessels in the shorebased Pacific whiting fishery. If these devices prove useful in monitoring whether vessels are complying with full retention requirements, they may be required for use in other fisheries in lieu of observers. These devices would not perform the same functions as observer – they would not be used to estimate species-specific bycatch levels. The devices could, however, prove useful in monitoring discard frequencies in fisheries where participants are less able to afford full-time human observation.

Table 8.1 --Estimated total mortality (mt) of major West Coast groundfish species from commercial and recreational fishing during 2002.

	2002 metric tons						
	Total commercial landings	Estimated trawl discard	Estimated non-trawl discard[1]	Comm. mortality sub-total	Recreational landed + discard	At-sea landed + discard	Estimated total mortality
Sablefish		*1,814*					
mortality [2]	3,807	907	59	4,773	7	21	4,801
Shortspine	798	355		1,153		12	1,165
Longspine	1,911	380		2,291			2,291
Dover	6,272	1,210		7,482		0.7	7,482
Petrale	1,775	185		1,960			1,960
Arrowtooth	2,071	4,128		6,199		5.7	6,205
Otr. Flatfish	3,622	1,161		4,783	160	11.8	4,955
Slope Rock.	1,219	196		1,416		1.61	1,417
Splitnose	66	21		87		11.4	98
Yellowtail	1,001	396		1,397	45	191	1,633
Lingcod		*269.1*					
mortality [2]	203	134.5	1.8	339.6	666	0.5	1,006
Canary	48	35.8	1.3	84.9	17	5.2	107
Widow	264	39.1		302.9	3	155	461
Yelloweye	4	0.9	1.6	6.4	7		13
Bocaccio	22	27.4		49.1	86	0.6	136
Cowcod	.	3.1		3.1	1		4
POP	147	36.0		183.1	0	3.8	187
Darkblotched	106	93.6	0.1	199.9		3.2	203
Chilipepper	167	141.1		307.6	13	4.9	325
Shortbelly		5.1		5.1		0.6	6
Hake	45,701	1,841		47,542		84728	179,811

[1] Non-trawl discard is estimated only for the sablefish fishery, based on observations of the primary limited-entry, fixed-gear season. Since no observations were available this fishery south of Ft. Bragg, CA, nor from any rockfish target fishing, discard estimates for southern species, such as bocaccio and cowcod should not be viewed as complete.

[2] Sablefish and lingcod have been observed to survive discard, thus discard mortality estimates are reduced from total discard for these species.

Sources:

Commercial landings were extracted from PacFIN summary-catch tables on August 10, 2004.

Recreational removals include estimates for retained and discarded dead catch (A+B1), and were extracted on August 19, 2004.

At-sea commercial estimates extracted from NPGOP data September 1, 2004.

Table 8.2 -- Estimated total mortality (mt) of major west coast groundfish species from commercial and recreational fishing during 2003 [1].

	2003 metric tons						
	Total commercial landings	Estimated trawl discard	Estimated non-trawl discard [2]	Comm. mortality sub-total	Recreational landed + discard	At-sea landed + discard	Estimated total mortality
Sablefish		*1,615*					
mortality [3]	5,430	808	92	6,330	8	17	6,355
Shortspine	815	432		1,248		16	1,264
Longspine	1,575	321		1,895			1,895
Dover	7,348	1,102		8,450		0.9	8,451
Petrale	2,003	105		2,107			2,107
Arrowtooth	2,319	587		2,907		4.3	2,911
Otr. Flatfish	3,230	753		3,983	54	6.8	4,044
Slope Rock.	1,008	191		1,200		2.2	1,202
Splitnose	157	7		165		12	177
Yellowtail	413	4		417	42	36.4	496
Lingcod		*139.4*					
mortality [3]	166	69.7	1.3	236.6	1,176	0.5	1,413
Canary	9	14.5	0.6	24.6	29	0.9	54
Widow	27	4.9		32.1	0	14.4	46
Yelloweye	3	0.2	1.3	4.4	10		14
Bocaccio	1	2.3		2.9	11	0.3	14
Cowcod	.	0.1		0.1			0
POP	130	14.2		144.6	1	6.2	152
Darkblotched	80	39.0	0.2	119.3		4.3	124
Chilipepper	18	2.3		19.9	0	1.3	21
Shortbelly		0.1		0.1		0.5	1
Hake	55,335	1,255		56,590		86610	199,789

[1] Discard estimates for 2003 are based on observer data collected from January through August, 2003.

[2] Non-trawl discard is estimated only for the sablefish fishery, based on observations of the primary limited-entry, fixed-gear season. Since no observations were available this fishery south of Ft. Bragg, CA, nor from any rockfish target fishing, discard estimates for southern species, such as bocaccio and cowcod should not be viewed as complete.

[3] Sablefish and lingcod have been observed to survive discard, thus discard mortality estimates are reduced from total discard for these species.

Commercial landings were extracted from PacFIN summary-catch tables on August 10, 2004.

Recreational removals include estimates for retained and discarded dead catch (A+B1), and were extracted on August 19, 2004.

At-sea commercial estimates extracted from NPGOP data September 1, 2004.

9.0 Preparers and Contributors

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Executive Summary:	Glock
Chapter 1:	Glock; de Reynier
(past management, scoping)	Goen; Dahl
Chapter 2:	Glock; PFMC ad hoc Groundfish EIS Oversight Committee; Golden
Chapter 3:	Glock
(Groundfish):	Golden; Lenarz; Glock
(Non-groundfish):	Schmitt
(Marine mammals, turtles):	Hanan
(Sea birds):	Nordeen
(Social and Economic):	Hartley, Schug, Wellman, Kirac, Porteen
Chapter 4 (Environmental Impacts)	
(Gear descriptions, impacts)	Recht; Glock; Golden
(Groundfish):	Golden; Lenarz; Glock
(Non-groundfish):	Schmitt

(Marine mammals, turtles):	Hanan
(Sea birds):	Nordeen
(Social and Economic):	Hartley, Schug, Wellman, Kirac, Porteen, Hill
Chapter 5 (Consistency):	Glock
Chapter 6 (Other federal law):	Glock
Appendix A:	NWFSC Groundfish Observer Program
Appendix B:	Schmitt, Lenarz, Golden
Appendix C:	Glock
Appendix D:	McElderry, Schraeder, Illingworth

Contributor Bios

Mr. Jim Glock served as the project manager for this PEIS. From 1987-2000, he was the Groundfish Staff Officer for the Pacific Fishery Management Council and also dealt with the Northern Anchovy FMP (replaced by the Coastal Pelagic Species FMP) and Pacific halibut management. From 1980-1987, Mr. Glock served as a Fishery Management Plan Coordinator for the North Pacific Fishery Management Council FMPs for salmon, king crab, and Bering Sea/Aleutian Islands groundfish. He also helped prepare a draft FMP for Bering Sea herring.

Dr. Doyle Hanan retired from the California Department of Fish and Game where he served as a senior supervising biologist over nearshore sport fisheries, pelagic fisheries, and marine mammals. He serves on two standing committees to advise the Secretary of Commerce on marine mammals in the Pacific Ocean and reduction of marine mammal, seabird, and turtle/ fisheries interactions. He served as co-chair of the PFMC's Coastal Pelagic Species (CPS) FMP development team and chair of the CPS management team. He has worked extensively on marine mammal, seabird and turtle populations, as well as many California recreational and commercial fisheries.

Mr. Jim Golden retired from the Oregon Department of Fish and Wildlife (ODFW) as Acting Director of the ODFW Marine Resources Program after 25 years of service. His experience with ODFW included all technical aspects of groundfish research in support of stock assessments, including age determination of rockfish and flatfish, at-sea research and surveys, submersible and scuba diving investigations, computer programming, analysis, and modeling. He has contributed to formal stock assessments using a variety of contemporary fisheries models (VPA, catch-at-age-analysis, and stock synthesis). He has served as chair of a Council Stock Assessment Review (STAR) panel and also participated on the PFMC's Strategic Plan Implementation Committee.

Ms. Cyreis Schmitt is a marine fish biologist who currently works for the Oregon Deptartment of Fish and Wildlife in Newport, Oregon. Ms. Schmitt has worked for the International Pacific Halibut Commission, the Washington Department of Fish and Wildlife, and NMFS Northwest Fisheries Science Center (NWFSC). At the NWFSC, she spearheaded preparation of the Council's first groundfish EFH plan amendment, including preparation of the extensive EFH appendix. Also while at NWFSC, she managed the FRAM Division in Newport, Oregon and oversaw the groundfish stock assessment preparation and review process.

Mr. Marcus Hartley was the lead economist for NOAA Fisheries' Draft PSEIS for the Groundfish Fisheries of Alaska (2003) and EIS for the Pelagic Fisheries of the Western Pacific Region (2001). As Vice President of Northern Economics, Inc (Anchorage, AK), he has managed and contributed to many other fisheries projects, including sector and regional profiles of the groundfish fisheries of Alaska, an assessment of processing limits and excessive shares under the American Fisheries Act, license limitation programs for crab and groundfish, and other fishery management issues. As (former) senior economist at the North Pacific Fishery Management Council, Mr. Hartley was deeply involved with high profile allocation issues confronting North Pacific fisheries. These issues included individual fishing quotas for sablefish and halibut, a vessel moratorium and license limitation programs for crab and groundfish, inshore and offshore pollock processing allocations, allocation of Pacific cod among gear groups, and commercial and recreational allocation of halibut.

Dr. Donald Schug is a social scientist who has written reports and peer-reviewed publications covering a broad range of fisheries-related topics in the United States and abroad. He has worked extensively in the Pacific islands, including Polynesia (Hawaii and American Samoa), Micronesia (Kiribati) and Melanesia (Papua New Guinea). He has conducted analyses of the economic and social aspects of fisheries and fisheries management at the community, national, and international levels. As staff social scientist for the Western Pacific Fishery Management Council, Dr. Schug prepared assessments of the social and economic impacts of federal management regimes for pelagic, bottomfish, crustacean, and precious coral fisheries in the U.S.-affiliated Pacific islands. In his current position as a Socioeconomic Analyst with Northern Economics, Inc., Dr. Schug has been closely involved in the development of the economic assessment for the Alaska Groundfish Fisheries Draft Programmatic Supplemental EIS.

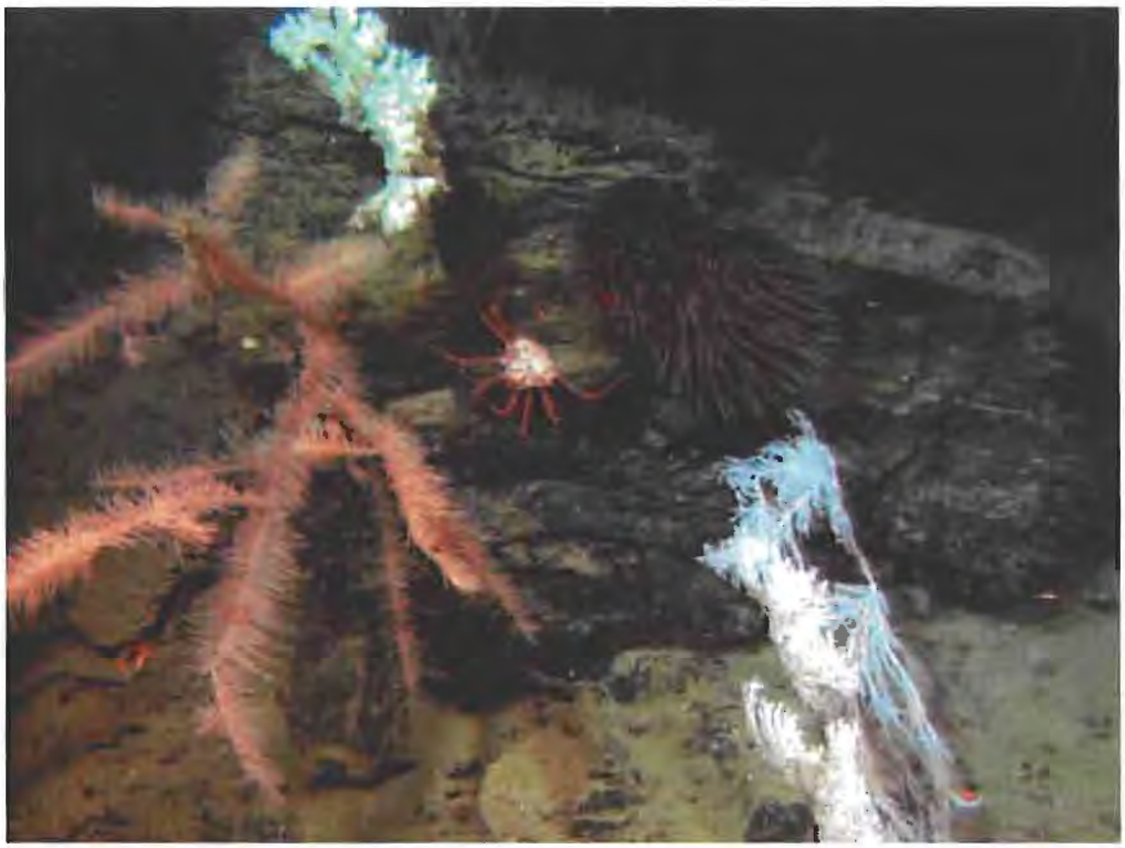
Mr. Tamer Kirac is an economist with 20 years of experience in regional socio-economic analysis and project management. He has worked as technical staff and as a project manager preparing regional economic plans and natural resource development and investment impacts studies. He has assisted numerous small and large communities to conduct economic base analysis and to develop strategic plans, incorporating primary and secondary sources of information derived from public meetings, surveys, and public and proprietary information sources.

Ms. Kelly Porteen is a recent graduate of the University of Wyoming with a Masters of Science in Economics, with an emphasis in natural resource economics.

Dr. Katharine (Trina) Wellman specializes in environmental and natural resource economics as applied to marine resource management (including commercial and recreational fisheries) and public policy development and implementation. She has conducted research in the areas of fisheries and wetland restoration, water quality management and enhancement, habitat protection and conservation, and coastal hazards mitigation. Dr. Wellman's dissertation research looked at consumer choices of seafood products taking into account quality as a choice variable. She has been involved in the conceptual design of individual transferable quota schemes for the U.S. fishing industry and analyzed the cost structure of the early Northwest Pacific factory trawler fleet.

Appendix B

Preliminary Report on Occurrences of Structure-Forming Megafaunal Invertebrates off the West Coasts of Washington, Oregon and California



August 2004
Fishery Resource Analysis & Monitoring Division
Northwest Fisheries Science Center

Cover page: Video frame grab image taken at a depth of 1004 meters in Astoria Canyon off the mouth of the Columbia River with the ROPOS ROV's broadcast quality camera showing an antipatharian or black coral (pinkish orange branched structure on left), gorgonians (two white branched corals), a sea anemone, and crab (probably a "scarlet king crab" *(Lithodes cousei)*

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I. INTRODUCTION AND BACKGROUND

In comparison to their tropical counterparts, the knowledge on cold water/deep-sea corals is limited. Scientists still know little about their distribution, biology, and their function as essential fish and invertebrate habitat. Recently, interest has been building among the scientific community and the public to determine the role of these coral and other biogenic species in the ecosystem and their relation to commercial fisheries.

Cold water/deep-sea corals are found in temperate waters worldwide and at various depths from the continental shelf down to the abyssal plain. They consist of cnidarian families of octocorals (e.g., gorgonians like red tree corals and bamboo corals, and sea pens and whips), hexacorals (e.g., stony corals and black corals), and hydrocorals (e.g., lace corals). They are long-lived, and slow growing, and probably vulnerable to physical disturbance. In addition to corals, other structure-forming megafaunal invertebrates such as sponges and anemones are also a critical component of the habitat of continental shelf and slope ecosystems. Structure-forming megafaunal invertebrates refer to any epibenthic organism that grows to sufficient size to provide potential habitat structure for other benthic organisms and fishes.

If we are to appropriately manage and protect the ecosystems in which cold water/deep-sea corals and other structure-forming invertebrates reside, there is clearly a need to build an information base about these organisms. The ecosystem function of these species, especially as it relates to fish habitat needs to be defined. In addition, their habitat preferences and vulnerability to disturbance need to be determined. In order to do so, initially a quantitative description of their distribution and local environment must be completed. Other information such as the rate of dispersal, recolonization, and growth, as well as such things as their systematics, larval ecology and genetics must be collected.

As a first step in developing the requisite information base, we located, charted, and described the distribution of known collections of structure-forming megafaunal invertebrates. This initial mapping effort was produced to inform the EFH/EIS process and is a first step in synthesizing the available information.

Unfortunately, targeted studies on these species are very limited. The existing data were primarily collected during surveys of fish populations and therefore only represent occurrences. In many cases the taxonomic information from these data are poor or are not available. Therefore there are limitations on the interpretation of the data.

There have been few high resolution mapping studies of these organisms on the west coast. However, these high-resolution studies have the best taxonomic and most precise location information. Thus, we have included information from two unpublished studies in this summary. Additional data from academic institutions and museums were compiled by Entnoyer and Morgan (2003) and those data are also included in this summary.

The objectives of this report are to:

1. Identify the occurrences of cold water/deep-sea corals and other biogenic species from all previous collections
2. Place these observations on the existing hydrographic and geological framework
3. Evaluate if obvious patterns in distribution are apparent.

We hope that this will form the beginning of a comprehensive information base on these important organisms.

II. METHODS

For this study, we gathered data on observations of structure-forming megafaunal invertebrates collected primarily within federal waters of the exclusive economic zone (EEZ) of the United States off the coasts of Washington, Oregon, and California. Two exceptions are: 1) Southern California Coastal Water Resource Project (SCCWRP); which includes bottom trawl observations within California state waters, and 2) Monterey Bay Aquarium Research Institute (MBARI) submersible/ROV observations; which include dives also within California state waters (i.e. Monterey Bay). Some studies include data collected outside the EEZ, but those are not included in this report.

Many of the data used represent aggregated catch from trawls towed over kilometers of seabed, and often times were collected during regional surveys. On the other hand, some high-resolution studies were conducted at specific sites off Oregon and California. These studies include observations interpreted from submersible video recordings of organisms in situ; and are represented either as point locations or observed densities along habitat patches that extend over meters and tens of meters of seabed. When possible, catch or observational data are normalized by trawl net swept area or submersible transect area, respectively.

Observations of megafaunal invertebrates from numerous sources were catalogued according to species codes listed in the RACE survey database (RACEBASE). RACEBASE does not include an exhaustive listing of all invertebrates but includes many of the structure-forming megafaunal species of concern for this study. These codes encompass species from nine orders (Actiniaria, Antipatharia, Corallimorpharia, Gorgonacea, Pennatulacea, Scleractinia, Filifera, Zoanthidea, and various pooled orders of Phylum Porifera) and twenty-eight families (Acanthogorgidae, Actinernidae, Actinidae, Actinostolidae, Alcyonidae, Anthoptilidae, Antipathidae, Aphrocallistidae, Caryophyllidae, Corallimorphidae, Halichondridae, Haloclavidae, Hormathidae, Hyalonematidae, Isididae, Leuconidae, Liponematidae, Metrididae, Nephtheidae, Paragorgidae, Pennatulidae, Plexauridae, Primnoidae, Rossellidae, Suberitidae, Tethyidae, Umbellulidae, Virgularidae). For mapping purposes, some orders and families were not plotted because they were either unknown, not benthic, or too small. Due to the complex taxonomy of sponges, all orders of Phylum Porifera were pooled into one group. Structure-forming invertebrate species not included in RACEBASE but in other studies were appended and categorized taxonomically.

Data Sources

West Coast Groundfish Bottom Trawl Survey

In summer 1998, the West Coast Slope Groundfish Survey was begun by the NWFSC. Conducted annually, the geographic extent of the survey has evolved over the years. From 1998-2001, survey trawls were made from the Canadian border southward to Pt. Conception at depths ranging from 100 to 700 fathoms. In 2002, the survey was expanded southward to the Mexican border and in 2003 the shoreward depth boundary was expanded inshore to 30 fathoms. From 1998-2002, an east west transect design with 10º intervals was utilized; and in 2003 a grid design was implemented to provide stratified, random selection of 2.0x1.5 nmi grid cells. Prior to 2001, invertebrate identification was not a priority so this study focuses on observations recorded from 2001-2003. Catch records of structure-forming megafaunal invertebrates from 1,406 bottom trawls include 1,941 occurrences from seven orders (Actiniaria, Antipatharia, Corallimorpharia, Gorgonacea, Pennatulacea, Scleractinia, and various pooled orders of Phylum Porifera) and thirteen families (Actinernidae, Actinidae, Alcyonidae, Anthoptilidae, Antipathidae, Caryophyllidae, Hormathidae, Isididae, Liponematidae, Metrididae, Paragorgidae, Plexauridae, Virgularidae). Ancillary data on depth and bottom temperature were also recorded.

West Coast Groundfish Observer Program (WCGOP)

WCGOP began in September 2001. The goal of the program is to monitor and record commercial bycatch data, including species composition of retained and discarded catch, and to collect critical biological data such as fish length, sex, and weight. The program observes vessels permitted for the limited-entry groundfish trawl and fixed gear fisheries, as well as some vessels that are part of the open-access groundfish fleet. Primary animals of interest are marine mammals, endangered salmon species, and overfished groundfish species, however information on coral, anemones, and sponge bycatch is recorded. Detailed taxonomic classification of these species is very limited at this time.

Records from 12,411 observed hauls or sets from trips made between September 2001 and February 2004 were queried to identify catches of structure-forming invertebrates. Since specific identification of invertebrates for the most part was not included in observer collection protocols until recently, the data currently available were categorized into four general groups (corals, sea pens, sponges, and anemones). Furthermore, observers were not trained to evaluate the disposition (live vs. dead) of coral samples, so catches of corals do not necessarily represent areas of known live coral aggregations.

Heceta Bank Fisheries Investigations – Submersible and ROV observations

Heceta Bank, off the central Oregon coast is the site of ongoing investigations of demersal fish habitats by the NWFSC and collaborators. Major goals of these investigations are to utilize in situ survey technologies to enumerate demersal fishes and megafaunal invertebrates and characterize fish habitat. In 2000 and 2001, twenty-seven ROV and submersible dives were made at five of six stations used in historical studies and at thirteen new sites. In 2002, eighteen submersible dives were made at six historical stations. Submersible dives occurred at 68-342 meters water depth with a mean depth of 113 meters (Tissot et al., in prep.). Observations of megafaunal invertebrates were recorded via video and normalized by transect area.

Alaska Fisheries Science Center (AFSC) – Resource Assessment and Conservation Engineering Division (RACE) West Coast regional trawl surveys

A total of 10,218 survey trawls from research cruises off Washington, Oregon, and California occurred from 1977 through 2001. Catch records include 7,560 occurrences of structure-forming invertebrates, including organisms from seven orders (Actiniaria, Antipatharia, Corallimorpharia, Gorgonacea, Pennatulacea, Scleractinia, and various pooled orders of Phylum Porifera) and twenty families (Acanthogorgidae, Actinernidae, Actinidae, Actinostolidae, Alcyonidae, Anthoptilidae, Antipathidae, Caryophyllidae, Haloclavidae, Hormathidae, Isididae, Liponematidae, Metrididae, Nephtheidae, Paragorgidae, Pennatulidae, Plexauridae, Primnoidae, Umbellulidae, Virgularidae).

Southern California Coastal Water Resource Project (SCCWRP) Survey bottom trawls
During 1994 and 1998 SCCWRP conducted bottom trawls during surveys in the Southern California Bight (http://www.sccwrp.org/). During these years 915 trawl catches were sampled. Catch records from SCCWRP trawls include 48 observations of structure-forming megafaunal invertebrates from Orders Actiniaria, Pennatulacea, Scleractinia, Phylum Porifera and Families Caryophyllidae, Metrididae, Pennatulidae.

Occurrences of Habitat-forming Deep Sea Corals in the Northeast Pacific Ocean – A Report to NOAA's Office of Habitat Conservation- Peter Etnoyer and Lance Morgan, Marine Conservation Biology Institute
Much of the cold and deep-sea coral records on the West Coast were summarized by Etnoyer and Morgan (2003). A total of ten institutions provided geo-referenced data to authors on the distribution of deep-sea corals. These institutions included:

- California Academy of Sciences (CAS)
- Canadian Museum of Nature and Department of Fisheries and Oceans (CMN-DFO)
- Monterey Bay Aquarium Research Institute (MBARI)
- National Museum of Natural History at the Smithsonian Institution (NMNH)
- National Oceanic and Atmospheric Administration (NOAA) – Office of Ocean Exploration (NOAA-OE)
- National Marine Fisheries Service – RACEBASE (RACE)
- Santa Barbara Museum of Natural History (SBMNH)
- REEF Foundation (REEF)

- Scripps Institution of Oceanography (SIO)
- A study performed by the late Dr. Robert Cimberg for VTN Oregon (Cimberg).

These data were categorized into eight coral families, including: Antipathidae, Oculinidae, Caryophylliidae, Corallidae, Isididae, Paragorgiidae, Primnoidae and Stylasteridae

Common attributes of all data points were latitude, longitude, family, species name, and depth in meters. Data were also ranked by two factors: 1) whether a physical sample is associated with the record and 2) the identifiers level of expertise.

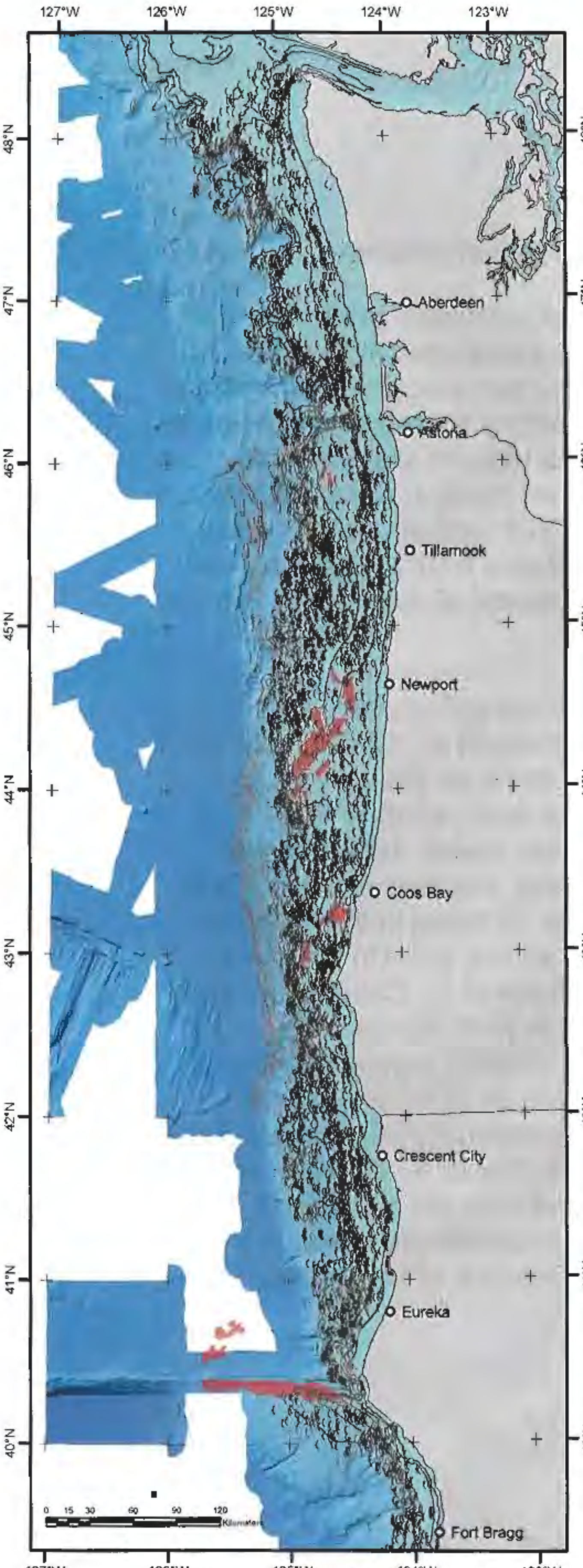
Unpublished data; M. Yoklavich, Southwest Fisheries Science Center and M. Love, University of California at Santa Barbara
Yoklavich and Love (unpublished) have conducted submersible dives in the Cowcod conservation area in 2003. Included in this report are their observations of occurrences of black corals (Order Antipatharia) in that area. For more information regarding their research, please contact Mary Yoklavich at the Southwest Fisheries Science Center.

III. RESULTS

General Distribution of Observations

A general reference map depicting the occurrences of all structure-forming megafaunal invertebrate observations used in this study is shown in Figure 1. This map gives a general indication of the spatial extent of the observations. The observations extend over the entire EEZ off the U.S. West Coast and 13,939 records are displayed. Due to the large scale of the reference map in Figure 1, observations from high-resolution surveys at Heceta Bank (off central Oregon) and in the Cowcod Conservation Area are excluded from Figure 1 but are described in a later section. Data sources for all records are listed in Table 1.

Most of the data presented in this report come from trawl survey observations. Figure 2 depicts the locations of all NWFSC and AFSC survey trawls. These surveys primarily focus on the collection of information on the abundance and distribution of fish. The surveys cover both the shelf and slope of the West Coast. However, until 2002 there was very limited of trawl survey activities south of Point Conception. The relatively small number of trawls in the Southern California Bight is a reflection of limited survey effort in that area. AFSC surveys focused effort primarily north of Pt. Conception; and NWFSC extended survey coverage south of Pt. Conception beginning in 2002. The total number of NWFSC survey trawls examined was 1,406 and the total number of AFSC trawls was 12,411 (Table 1). Structure-forming megafaunal invertebrates occur widely in both NWFSC and AFSC trawls (Figure 3). The invertebrate catches in survey tows is fairly ubiquitous over the entire EEZ, with the exception of a few clusters of tows near offshore banks in the Southern California Bight that show no records of invertebrate catches.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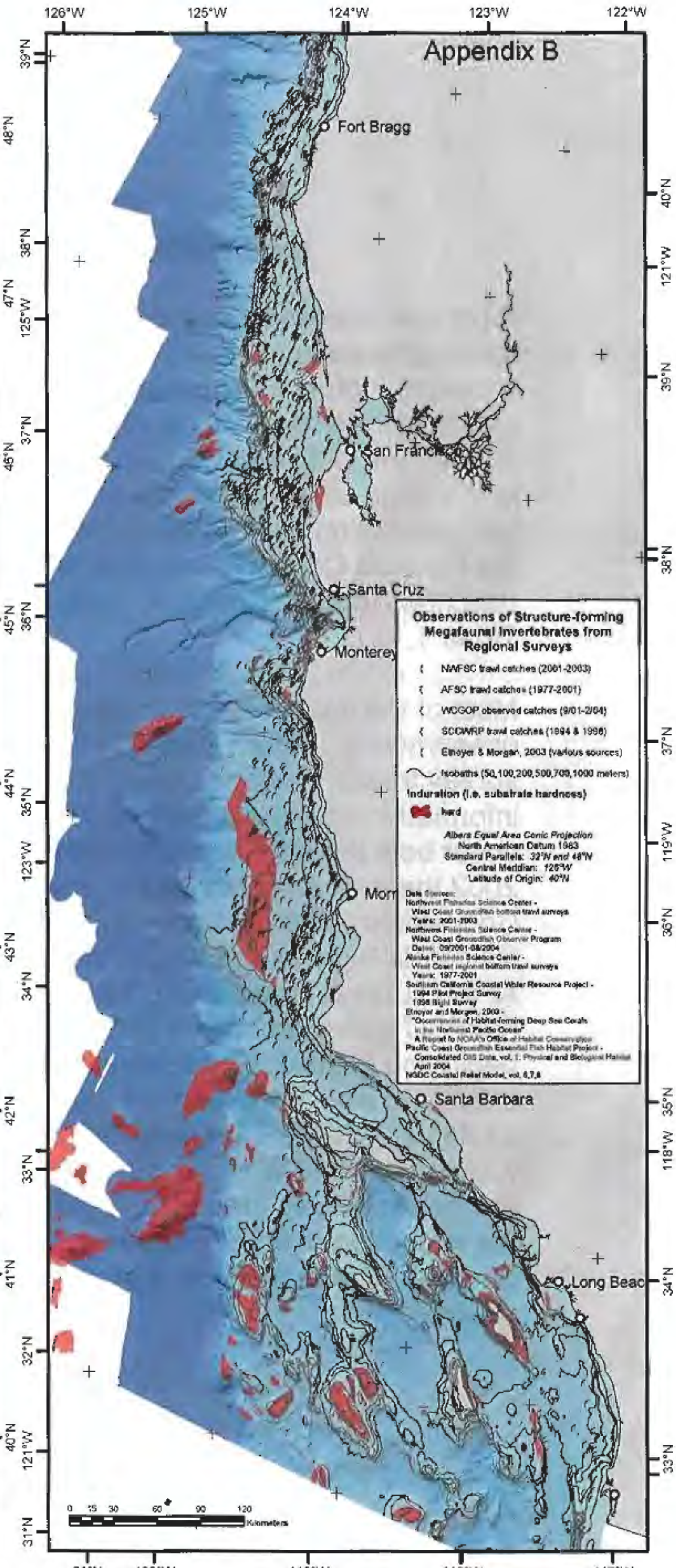
Appendix B
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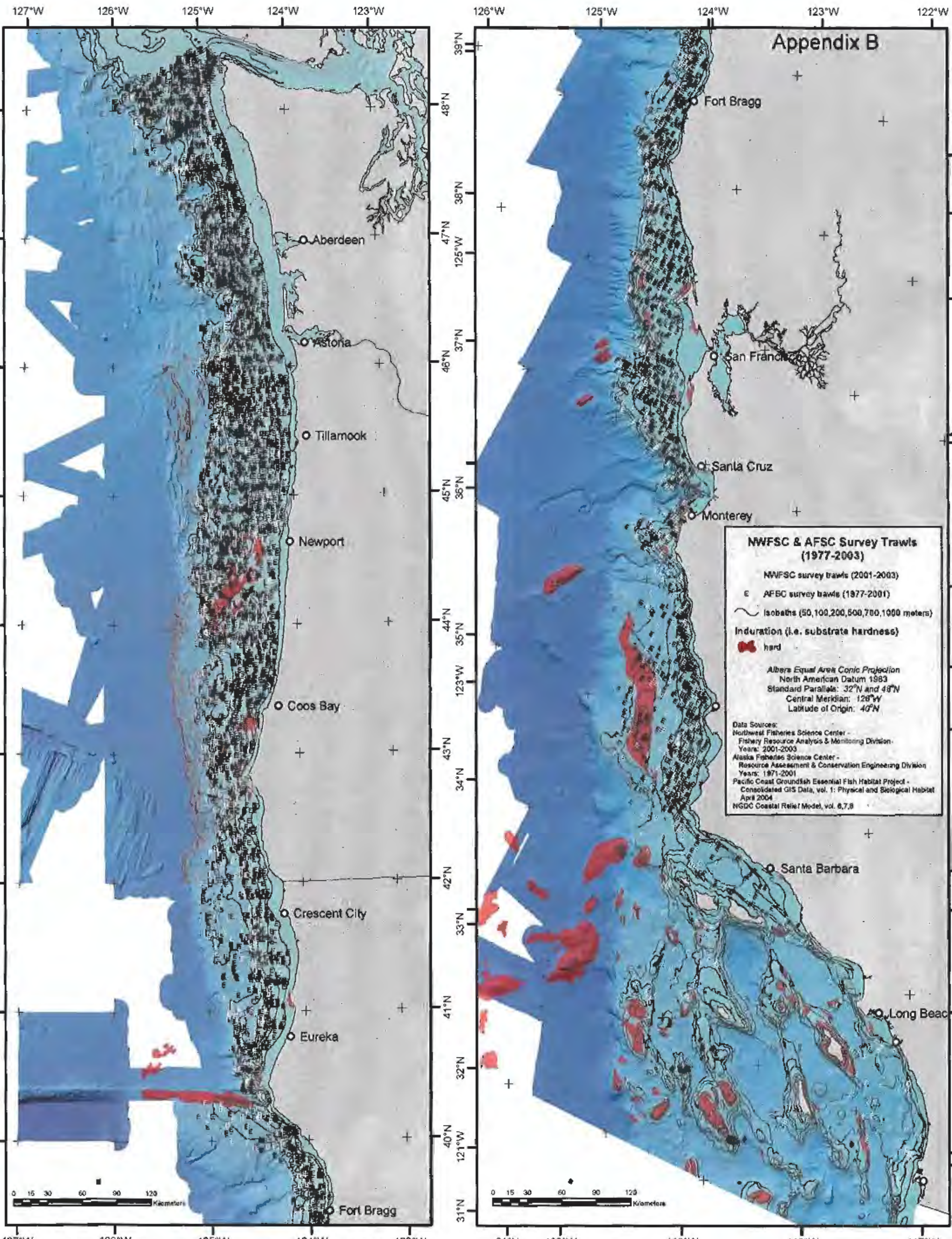
Long Beac
Observations of Structure-forming Megafaunal Invertebrates from Regional Surveys
NWFSC trawl catches (2001-2003)
AFSC trawl catches (1977-2001)
WCGOP observed catches (9/01-2/04)
SCCWRP trawl catches (1994 & 1998)
Etnoyer & Morgan, 2003 (various sources)
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Albers Equal Area Conic Projection
North American Datum 1983
Standard Parallels: 32°N and 48°N
Central Meridian: 126°W
Latitude of Origin: 40°N
Kilometers



Appendix B
NWFSC & AFSC Survey Trawls (1977-2003)
NWFSC survey trawls (2001-2003)
AFSC survey bawls (1977-2001)
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Albers Equal Area Conic Projection
North American Datum 1983
Standard Parallels: 32°N and 48°N
Central Meridian: 126°W
Latitude of Origin: 40°N
Data Sources:
Northwest Fisheries Science Center -
Fishery Resource Analysis & Monitoring Division
Years: 2001-2003
Alaska Fisheries Science Center -
Resource Assessment & Conservation Engineering Division
Years: 1971-2001
Pacific Coast Groundfish Essential Fish Habitat Project -
Consolidated GIS Data, vol. 1: Physical and Biological Habitat
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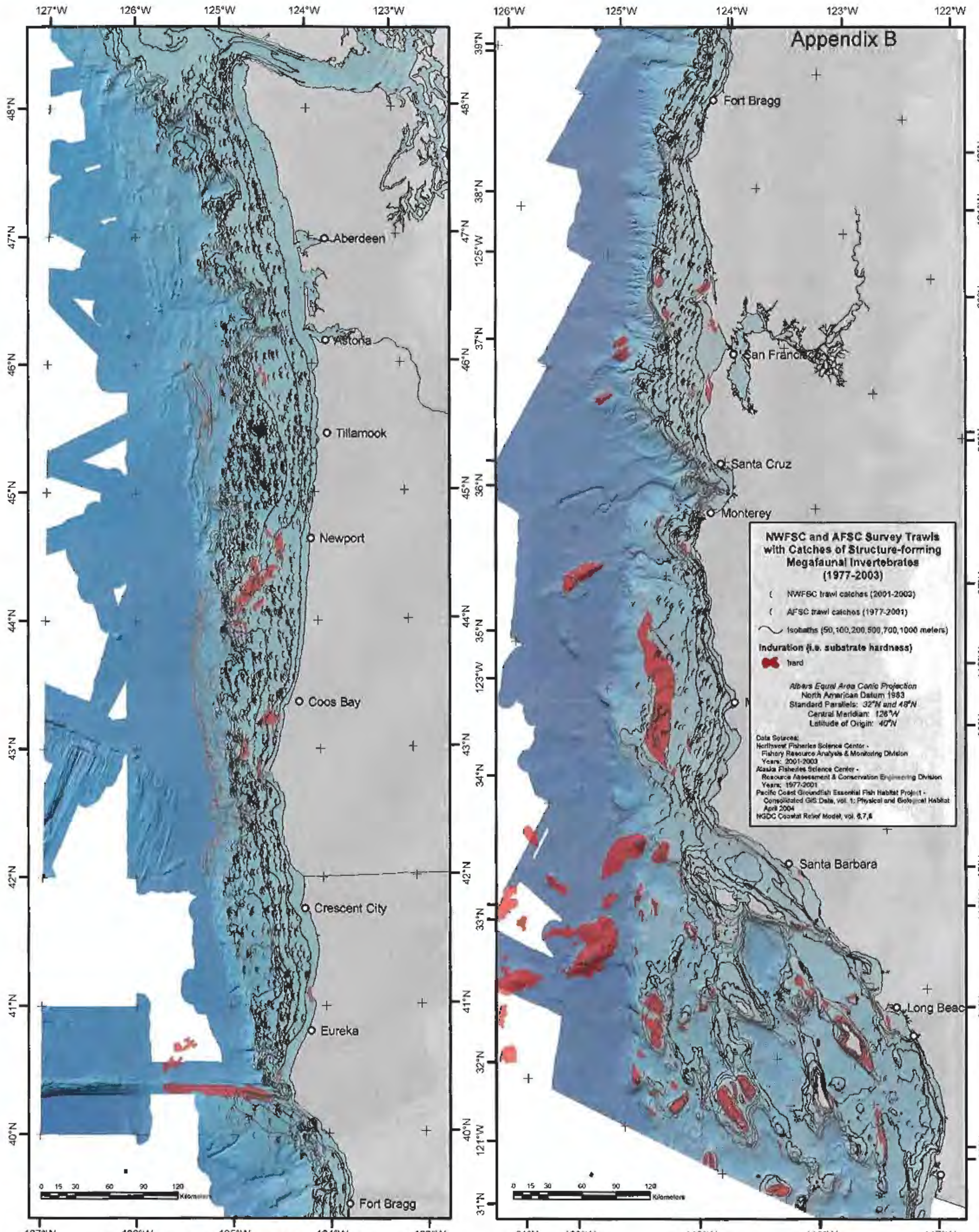
Appendix B
NWFSC and AFSC Survey Trawls with Catches of Structure-forming Megafaunal Invertebrates (1977-2003)
NWFSC trawl catches (2001-2003)
AFSC trawl catches (1977-2001)
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
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Fort Bragg
San Francisco
Santa Cruz
Monterey
Santa Barbara
Long Beach
Kilometers

Table 1. Summary of Medium Scale Mapping Data sources

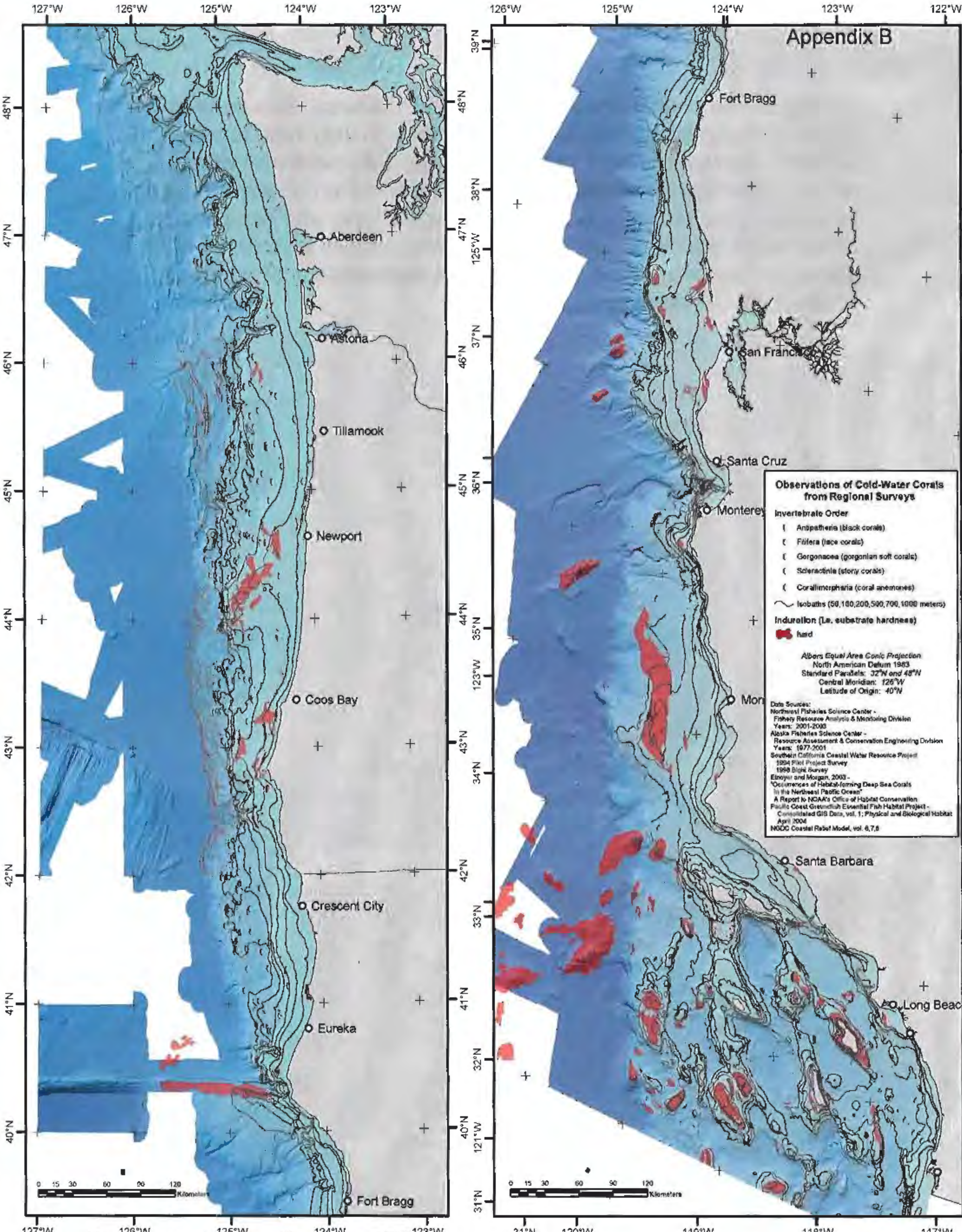
SOURCE	TYPE	TOTAL RECORDS REVIEWED	CORALS (BLACK AND STONY) (GORGONIANS) (CORAL ANEMOMES) (LACE CORALS)	SEA PENS AND WHIPS	SPONGES	ANENOMES
NWFSC-FRAM Division	West Coast Groundfish Slope Trawl Survey – 2001-2002	832	64 (20) (44) (0) (0)	114	150	737
NWFSC-FRAM Division	West Coast Groundfish Combined Shelf/Slope Trawl Survey – 2003	574	65 (35) (29) (1) (0)	84	182	544
NWFSC-FRAM Division	West Coast Groundfish Observer Program (WCGOP) – Sept. 2001-Feb 2004	12411	239 (NA) (NA) (NA) (0)	80	145	3548
AFSC RACE Division	All West Coast regional trawl surveys – 1977-2001	10218	340 (125) (184) (31) (0)	1361	962	4897
Southern California Coastal Water Resource Project	1994 Pilot Project Survey bottom trawls	261	1 (1) (0) (0) (0)	7	1	13
Southern California Coastal Water Resource Project	Bight '98 Survey bottom trawls	654	6 (3) (3) (0) (0)	14	3	0
Etnoyer, P. and L. Morgan – Marine Conservation Biology Institute	Occurrences of Habitat-forming Deep Sea Corals in the Northeast Pacific Ocean – A Report to NOAA's Office of Habitat Conservation (all information excluding AFSC trawl surveys)	NA	381 (38) (315) (0) (28)	NA	NA	NA

Distributions of Structure-forming Megafaunal Invertebrates Organized by Order

Observations of cold water/deep sea corals from five invertebrate orders are portrayed in Figure 4. They include black corals (Order Antipatharia), lace corals (Order Filifera), gorgonian soft corals (Order Gorgonacea), stony corals (Order Scleractinia), and coral anemones (Order Corralimorpharia). Antipatharian observations appear concentrated north of Cape Mendocino with a few exceptions near Monterey Canyon, on Davidson Seamount (area of hard induration west-southwest of Monterey), and in the Southern California Bight. Gorgonians range from Cape Flattery, Washington southward into the Southern California Bight, but there distribution is fairly patchy south of Monterey, California. North of Monterey, gorgonians appear concentrated on the continental slope. Six gorgonian observations also occur on or near a large patch of hard induration (close to Santa Lucia Escarpment) off Morro Bay, California. Filiferan, Scleractinian, and Corallimorpharian observations were fairly scarce throughout the EEZ; and discerning any spatial patterns proved problematic due to their low sample numbers.

Etnoyer and Morgan (2003) compiled records from AFSC surveys and as well as from other institutions. Information from the AFSC surveys is included in Figure 4. The additional observations of black corals (Order Antipatharia), lace corals (Order Filifera), gorgonian soft corals (Order Gorgonacea), and stony corals (Order Scleractinia) summarized by these authors are presented in Figure 5. Again, Antipatharian observations appear concentrated north of Cape Mendocino and on the continental slope. The low sample numbers of Filiferan, Gorgonian, and Scleractinian observations off the West Coast preclude any determination of geographic distributions.

Figure 6 depicts the observations of other structure-forming megafaunal invertebrates from NWFSC, AFSC, and SCCWRP research trawls. Catch records are organized into three categories, including sea anemones (Order Actiniaria), sea pens and sea whips (Order Pennatulacea), and various pooled orders of sponges (Phylum Porifera). The distribution of anemones appears fairly ubiquitous throughout the survey area. Sponge observations are conspicuously absent between Cape Mendocino and Santa Cruz, California with the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Long Beach
Observations of Cold-Water Corals from Regional Surveys
Invertebrate Order
Antipatheria (black corals)
Filifera (lace corals)
Gorgonacea (gorgonian soft corals)
Scleractinia (stony corals)
Corallimorpharia (coral anemones)
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Albers Equal Area Conic Projection
North American Datum 1983
Standard Parallels: 32°N and 48°N
Central Meridian: 126°W
Latitude of Origin: 40°N
Data Sources:
Northwest Fisheries Science Center -
Fishery Resource Analysis & Monitoring Division
Years: 2001-2003
Alaska Fisheries Science Center -
Resource Assessment & Conservation Engineering Division
Years: 1977-2001
Southern California Coastal Water Resource Project
1994 Pilot Project Survey
1998 Bight Survey
Etnoyer and Morgan, 2003 -
"Occurrences of Habitat-forming Deep Sea Corals in the Northeast Pacific Ocean"
A Report to NOAA's Office of Habitat Conservation
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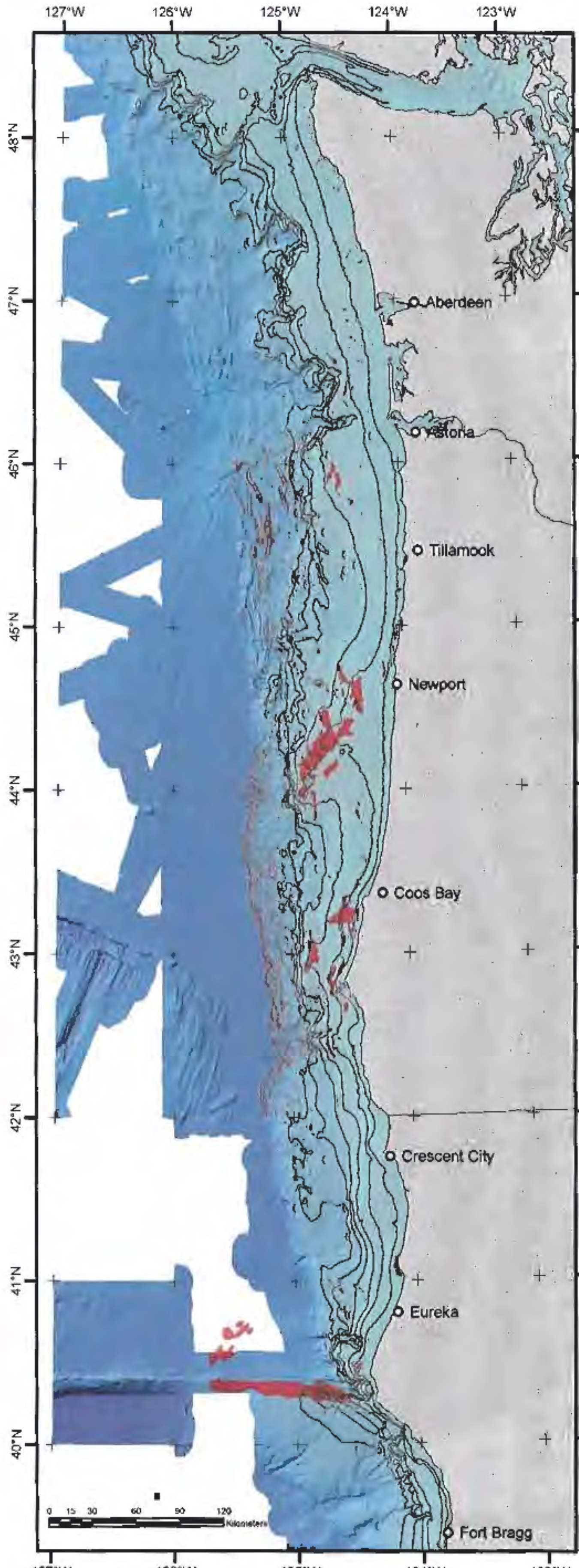
exception of a cluster of observations off Pt. Arena. Sea pens and whips also exhibit a wide distribution, although they tend to taper off between Eureka and Monterey, California. Sea pens and whips appear to exhibit a narrower depth distribution than anemones and sponges. The low sample numbers of anemones and sea pens and whips in the Southern California Bight may be due to reduced effort in that area; however, there are numerous observations of sponges south of Pt. Conception.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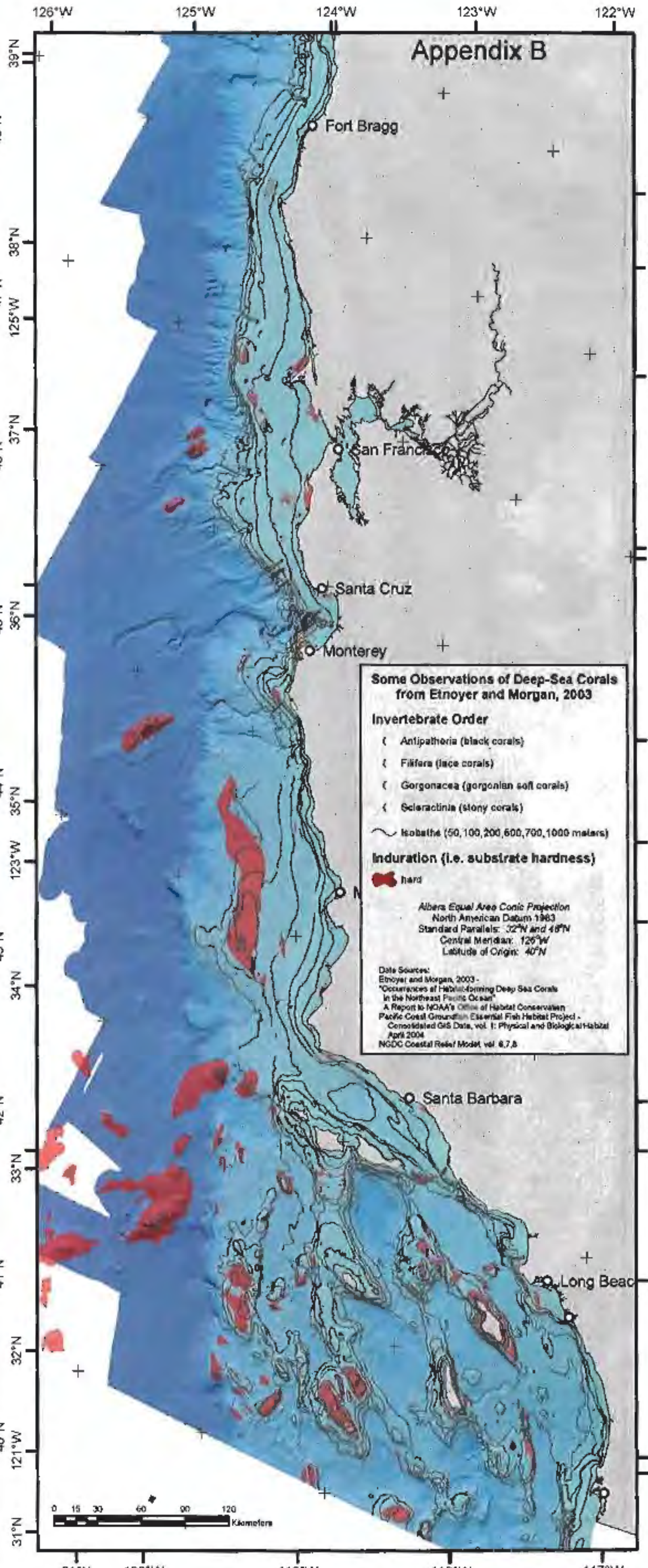
Newport
Coos Bay
Crescent City
Eureka
Fort Bragg
Kilometers


Appendix B
Fort Bragg
San Francisco
Santa Cruz
Monterey
Santa Barbara
Long Beach
Some Observations of Deep-Sea Corals from Etnoyer and Morgan, 2003
Invertebrate Order
Antipatharia (black corals)
Filifera (lace corals)
Gorgonacea (gorgonian soft corals)
Scleractinia (stony corals)
Isobaths (50,100,200,600,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Albers Equal Area Conic Projection
North American Datum 1983
Standard Parallels: 32°N and 48°N
Central Meridian: 126°W
Latitude of Origin: 40°N
Data Sources:
Etnoyer and Morgan, 2003 -
"Occurrences of Habitat-forming Deep Sea Corals in the Northeast Pacific Ocean"
A Report to NOAA's Office of Habitat Conservation
Pacific Coast Groundfish Essential Fish Habitat Project - Consolidated GIS Data, vol. 1: Physical and Biological Habitat April 2004
NGDC Coastal Relief Model, vol. 6,7,8
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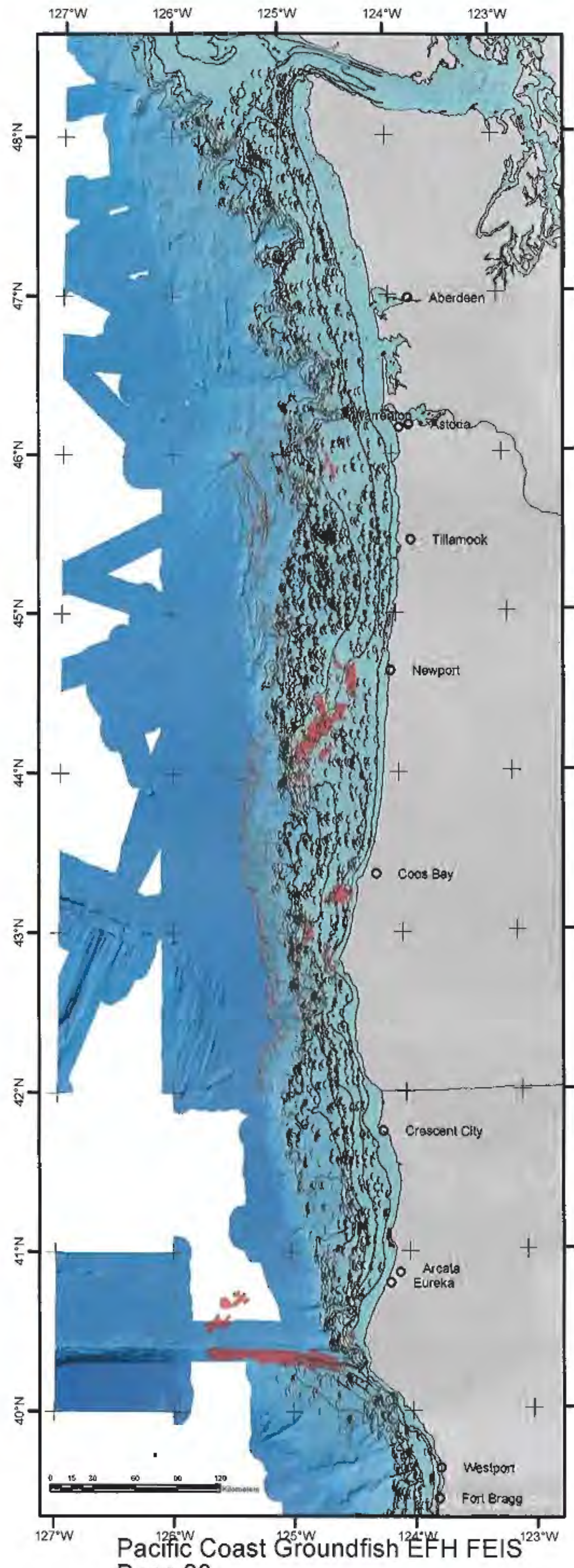
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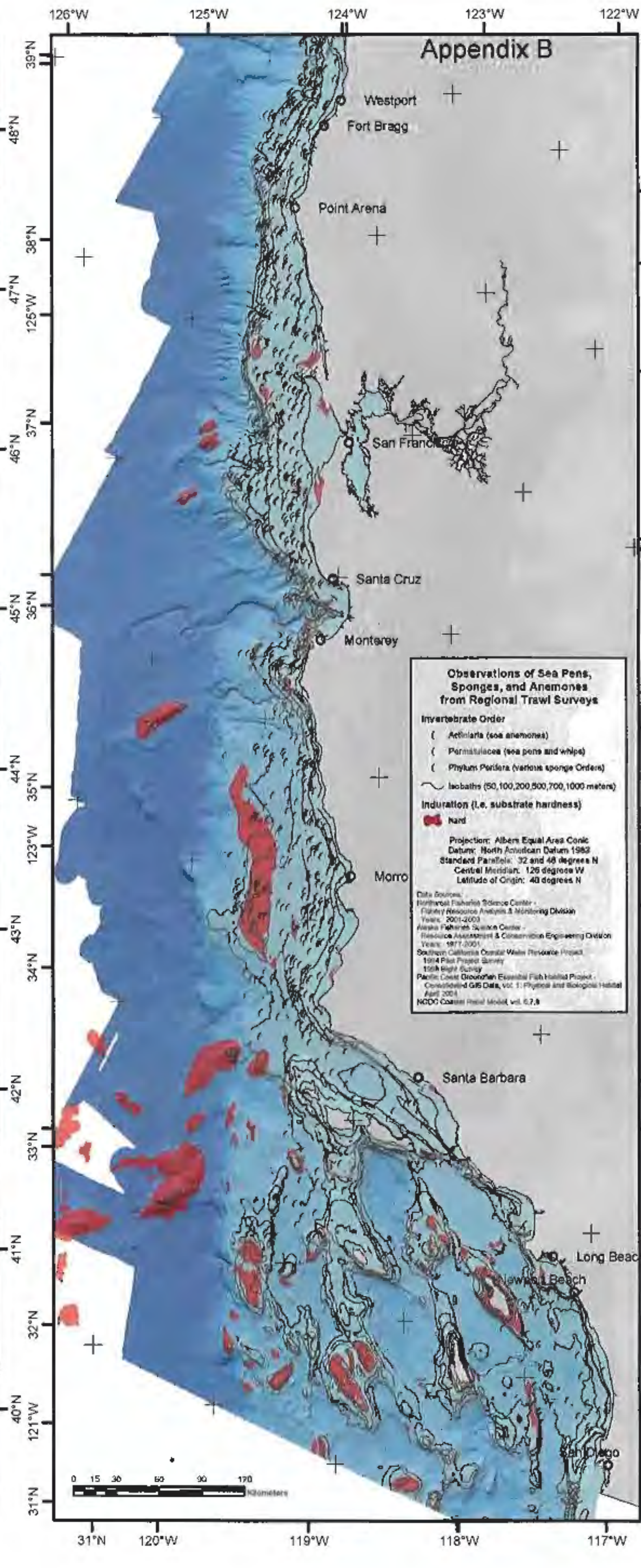
Westport
Astoria
Tillamook
Newport
Coos Bay
Crescent City
Arcata
Eureka
Westport
Fort Bragg
Kilometers


Westport
Fort Bragg
Point Arena
San Francisco
Santa Cruz
Monterey
Morro
Santa Barbara
Long Beach
Newport Beach
San Diego
Observations of Sea Pens, Sponges, and Anemones from Regional Trawl Surveys
Invertebrate Order
Actiniaria (sea anemones)
Pennatulacea (sea pens and whips)
Phylum Porifera (various sponge Orders)
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
Hard
Projection: Albers Equal Area Conic
Datum: North American Datum 1983
Standard Parallels: 32 and 48 degrees N
Central Meridian: 126 degrees W
Latitude of Origin: 40 degrees N
Data Sources:
Fishery Resource Analysis & Monitoring Division
Years: 2001-2003
Years: 1977-2001
1994 Pilot Project Survey
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Distributions of Structure-forming Megafaunal Invertebrates Organized by Family

Observations of seven families of sea anemones (Order Actiniaria) from NWFSC and AFSC survey trawls are shown in Figure 7. They include:

- Actinostolidae
- Actinernidae
- Actinidae
- Haloclavidae
- Hormathidae
- Liponematidae
- Metrididae

Metrididae (n=564) observations appear concentrated at shallower water depths, while Actinostolidae (n=1337), Hormathidae (n=400), and Liponematidae (n=764) observations are more prevalent at deeper water depths. The number of records of Actinernidae (n=19), Actinidae (n=21), and Haloclavidae (n=2) are too small to discern any meaningful spatial patterns. Additional observations of sea anemones are included in Figures 4 and 5, but not all samples were identified to the family level.

Figure 8 portrays the observations of one family (Antipathidae) of black corals (Order Antipatharia) from NWFSC and AFSC survey trawls and Etnoyer and Morgan, 2003. The distribution of Antipathidae (n=197) observations falls off markedly south of Cape Mendocino, with numerous catches concentrated off Oregon. Thirty-five samples described by Etnoyer and Morgan, 2003 occur in Monterey Bay and on Davidson Seamount (west-southwest of Monterey, California). Additional observations of black corals are included in Figures 4 and 5, but not all samples were identified to the family level.

Figure 9 portrays the observations of seven families of gorgonians (Order Gorgonacea) from NWFSC and AFSC survey trawls. They are:

- Acanthogorgidae
- Alcyonidae

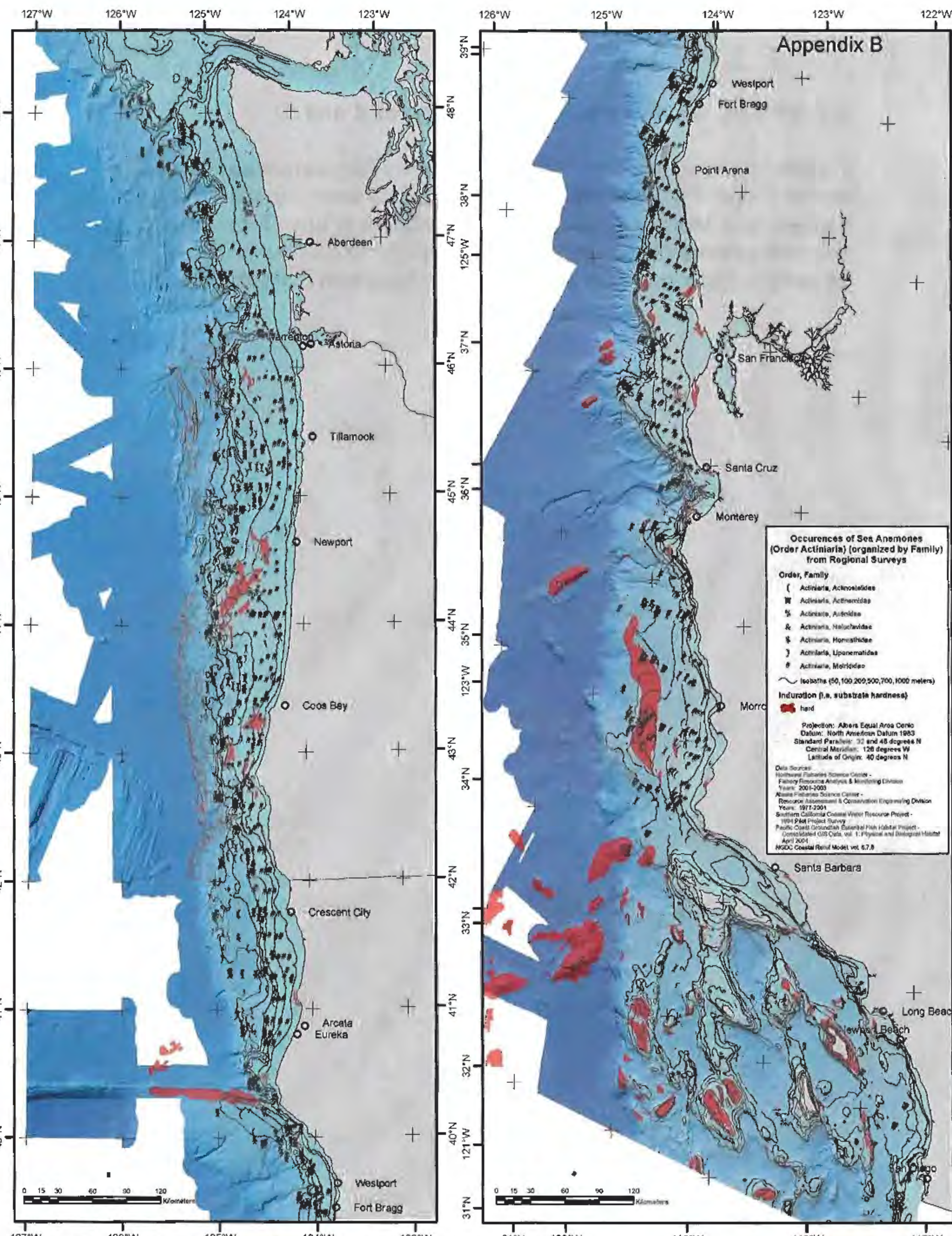
- Isididae
- Neptheidae
- Paragorgidae
- Plexauridae
- Primnoidae

Gorgonian observations in general appear concentrated on the continental slope. Alcyonidae (n=72) and Plexauridae (n=42) observations dominate survey catch records of gorgonians. Etnoyer and Morgan, 2003 included 240 sample records of Family Isididae that were observed in Monterey Bay. All but five sample records of Family Paragorgidae (n=68) were also included in Etnoyer and Morgan, 2003. All but one sample was collected in Monterey Bay. The number of records of Acanthogorgidae (n=5), Neptheidae (n=2), and Primnoidae (n=16) are too small to discern any meaningful spatial patterns. Additional observations of gorgonians are included in Figures 4 and 5, but not all samples were identified to the family level.

Figure 10 shows the observations of four families of sea pens (Order Pennatulacea) from NWFSC, AFSC, and SCCWRP survey trawls. Virgularidae (n=572) are ubiquitous throughout the survey area. Sea pens in families Anthoptilidae (n=172) and Umbellulidae (n=122) are prevalent at deeper water depths with the Umbelluliae most prevalent north of Eureka, California. Numbers of records of Pennatulidae (n=48) are too small to discern any meaningful spatial patterns. Additional observations of sea pens are included in Figures 4 and 5, but not all samples were identified to the family level.

Figure 11 portrays observations of two families (Caryophyllidae and Oculinidae) of stony corals (Order Scleractinia) from NWFSC, AFSC, and SCCWRP survey trawls. Stony corals were caught only 18 times in NWFSC and AFSC survey trawls and only one of those eighteen samples was identified to family. Stony corals in Family Caryophyllidae were caught only four times in SCCWRP research trawls. Two observations in Family Caryophyllidae and one in Family Oculinidae from Etnoyer and Morgan (2003) are shown. Due to the low sample numbers we cannot identify any meaningful spatial patterns. Seventeen additional records of stony corals from NWFSC and SWFSC surveys are included in Figures 4 and 5.

Figure 12 shows observations of one family (Stylasteridae) of lace corals (Order Filifera). Records of this family were reported only in Etnoyer and Morgan (2003) and did not occur in any of the other data sources summarized in this report. Most of the 28 observations occur off central California with a few from the Southern California Bight.


Appendix B
Westport
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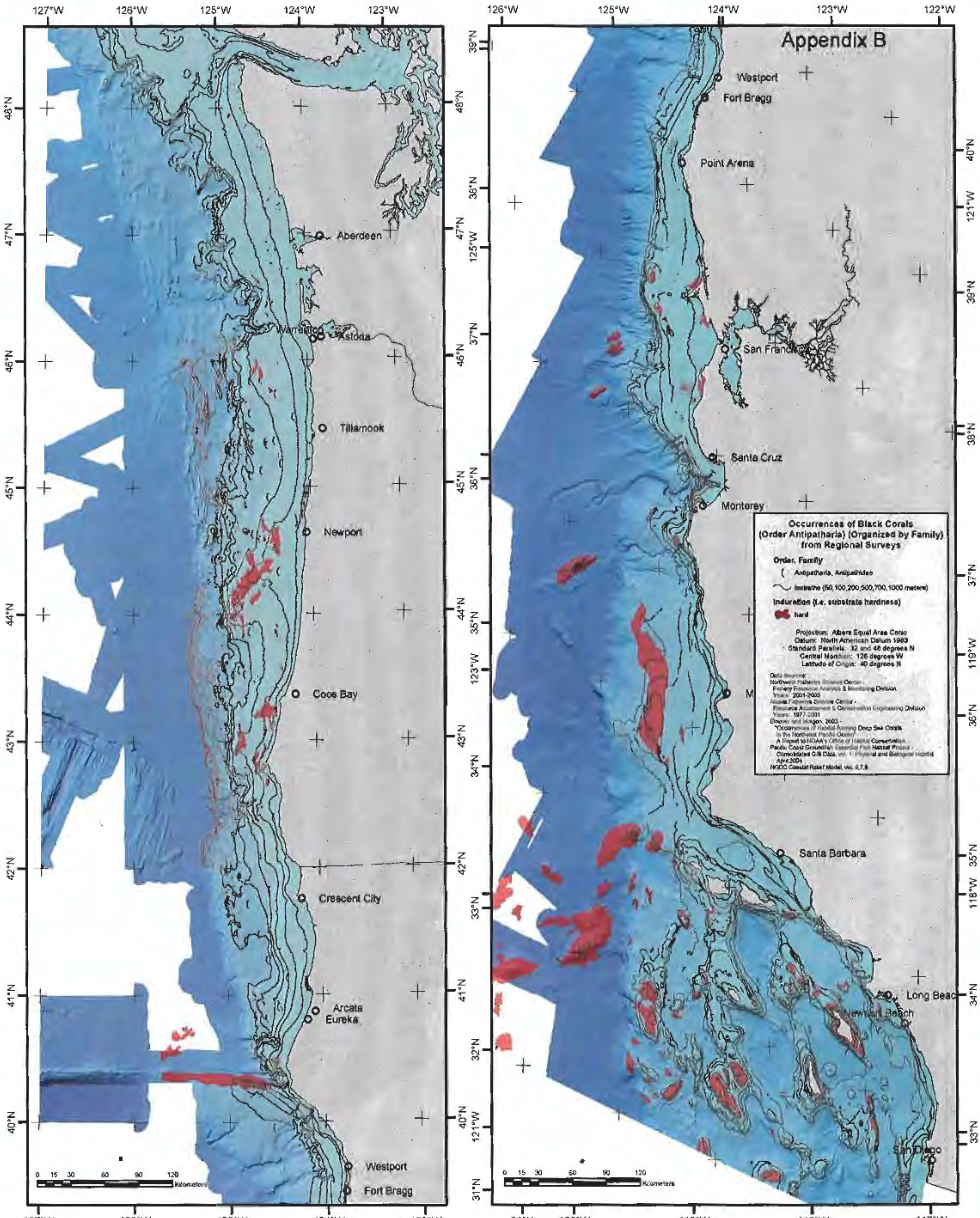
Point Arena
San Francisco
Santa Cruz
Monterey
Santa Barbara
Long Beach
Newport Beach
Aberdeen
Astoria
Tillamook
Newport
Coos Bay
Crescent City
Arcata
Eureka
Occurences of Sea Anemones
(Order Actiniaria) (organized by Family)
from Regional Surveys
Order, Family
Actiniaria, Hormathiidae
Actiniaria, Liponematidae
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Projection: Albers Equal Area Conic
Datum: North American Datum 1983
Central Meridian: 126 degrees W
Latitude of Origin: 40 degrees N
Kilometers


Appendix B
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Tillamook
Newport
Coos Bay
Crescent City
Arcata
Eureka
Westport
Fort Bragg
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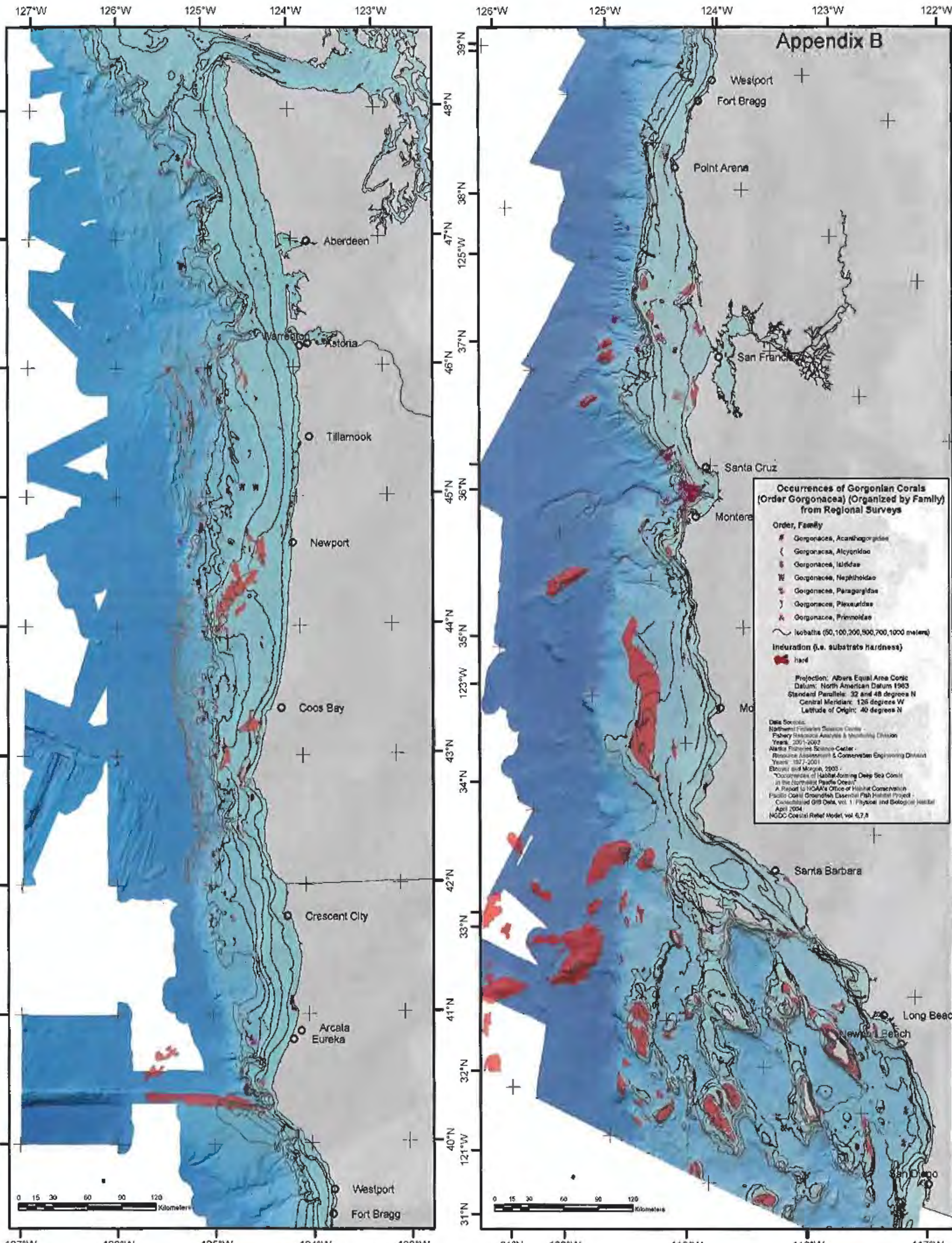
Santa Cruz
Monterey
Santa Barbara
Long Beach
San Diego
Occurrences of Black Corals
(Order Antipatharia) (Organized by Family)
from Regional Surveys
Order, Family
Antipatharia, Antipathidae
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Projection: Albers Equal Area Conic
Datum: North American Datum 1983
Standard Parallels: 32 and 48 degrees N
Central Meridian: 126 degrees W
Latitude of Origin: 40 degrees N
Kilometers


Appendix B
Occurrences of Gorgonian Corals
(Order Gorgonacea) (Organized by Family)
from Regional Surveys
Order, Family
Gorgonacea, Alcyoniidae
Gorgonacea, Isididae
Gorgonacea, Nephtheidae
Gorgonacea, Paragorgiidae
Gorgonacea, Plexauridae
Gorgonacea, Primnoidae
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Projection: Albers Equal Area Conic
Datum: North American Datum 1983
Standard Parallels: 32 and 48 degrees N
Central Meridian: 126 degrees W
Latitude of Origin: 40 degrees N
Data Sources:
Alaska Fisheries Science Center -
Years: 1977-2001
A Report to NOAA's Office of Habitat Conservation
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Aberdeen
Warrenton
Astoria
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Coos Bay
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Fort Bragg
Point Arena
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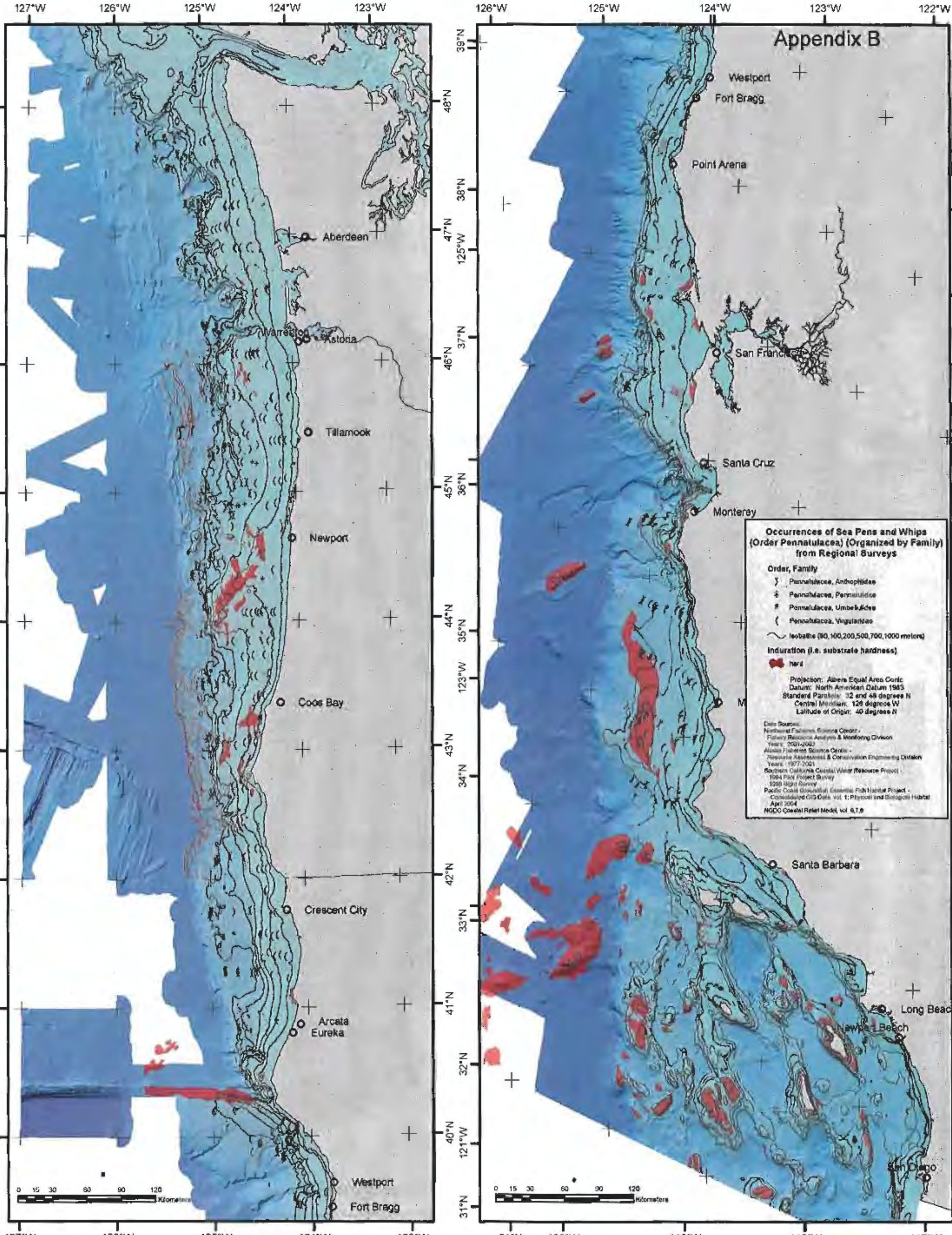
Santa Cruz
Monterey
Santa Barbara
Long Beach
Newport Beach
San Diego
Kilometers


Appendix B
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Crescent City
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Eureka
Westport
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Point Arena
San Francisco
Santa Cruz
Monterey
Santa Barbara
Long Beach
Newport Beach
San Diego
Occurrences of Sea Pens and Whips (Order Pennatulacea) (Organized by Family) from Regional Surveys
Order, Family
Pennatulacea, Anthoptilidae
Pennatulacea, Pennatulidae
Pennatulacea, Umbellulidae
Pennatulacea, Virgulariidae
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Projection: Albers Equal Area Conic
Datum: North American Datum 1983
Standard Parallels: 32 and 48 degrees N
Central Meridian: 126 degrees W
Latitude of Origin: 40 degrees N
Data Sources:
Northwest Fisheries Science Center -
Fishery Resource Analysis & Monitoring Division
Years: 2001-2003
Alaska Fisheries Science Center -
Resource Assessment & Conservation Engineering Division
Years: 1977-2001
Southern California Coastal Water Resource Project -
1994 Pilot Project Survey
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Pacific Coast Groundfish Essential Fish Habitat Project -
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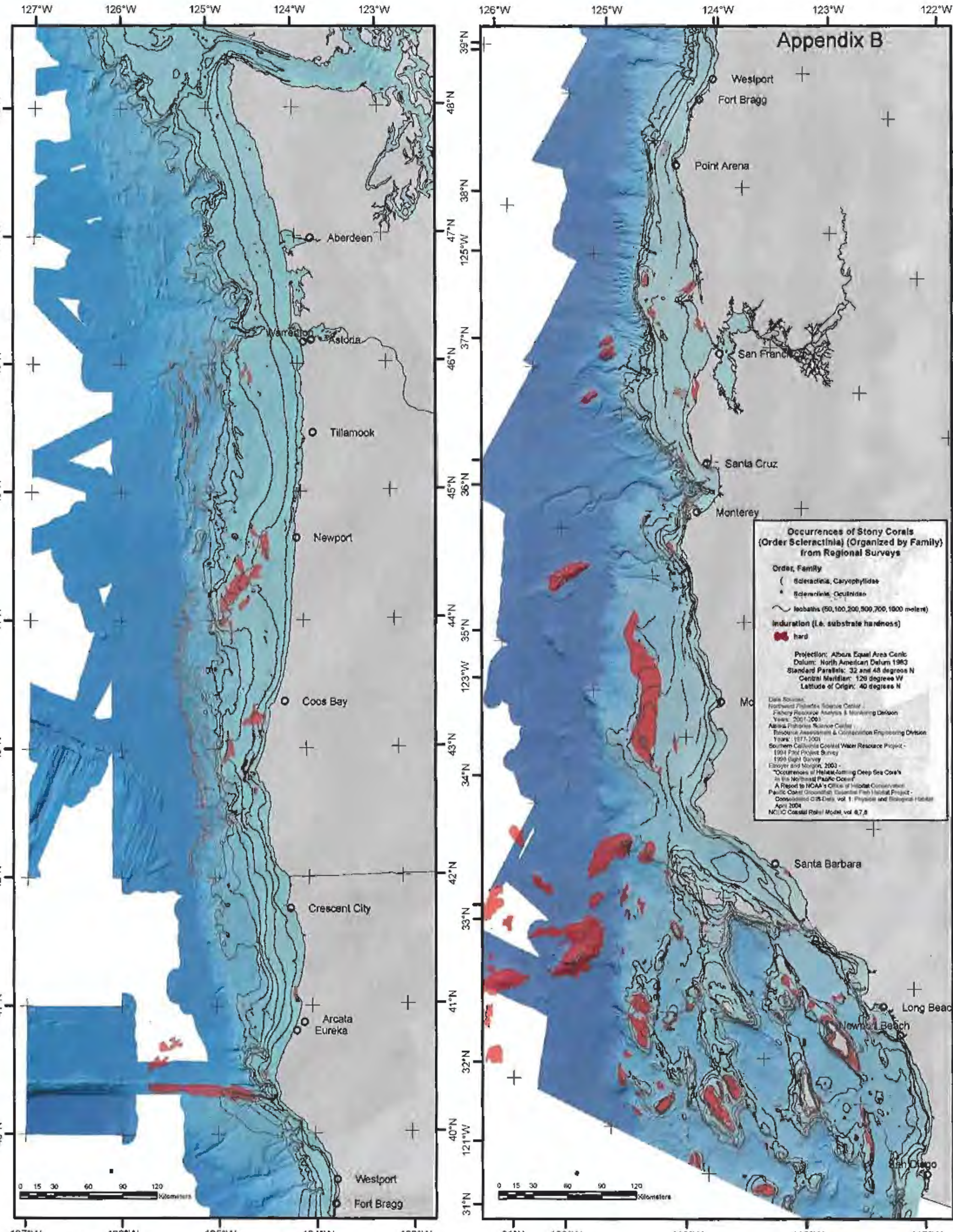
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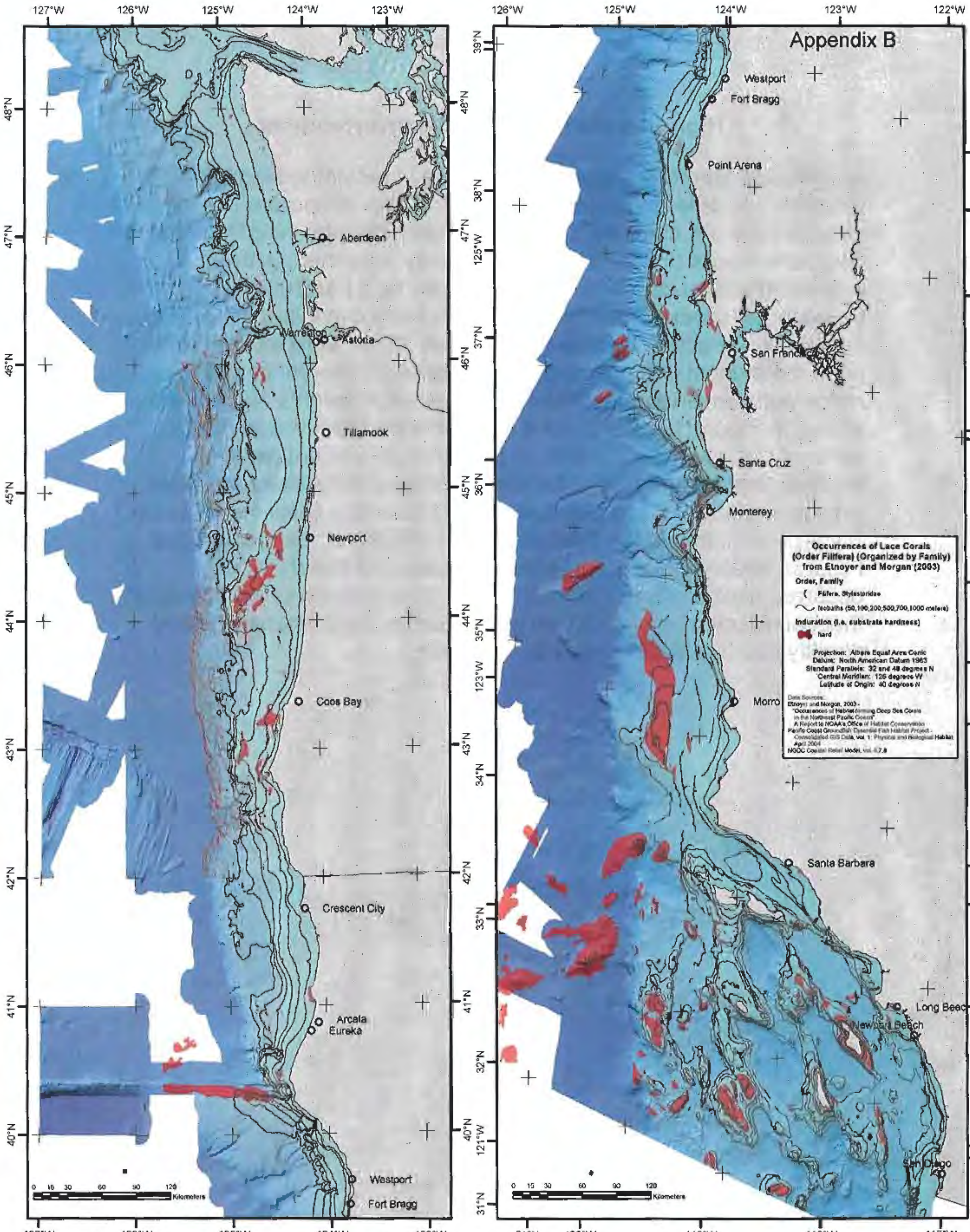
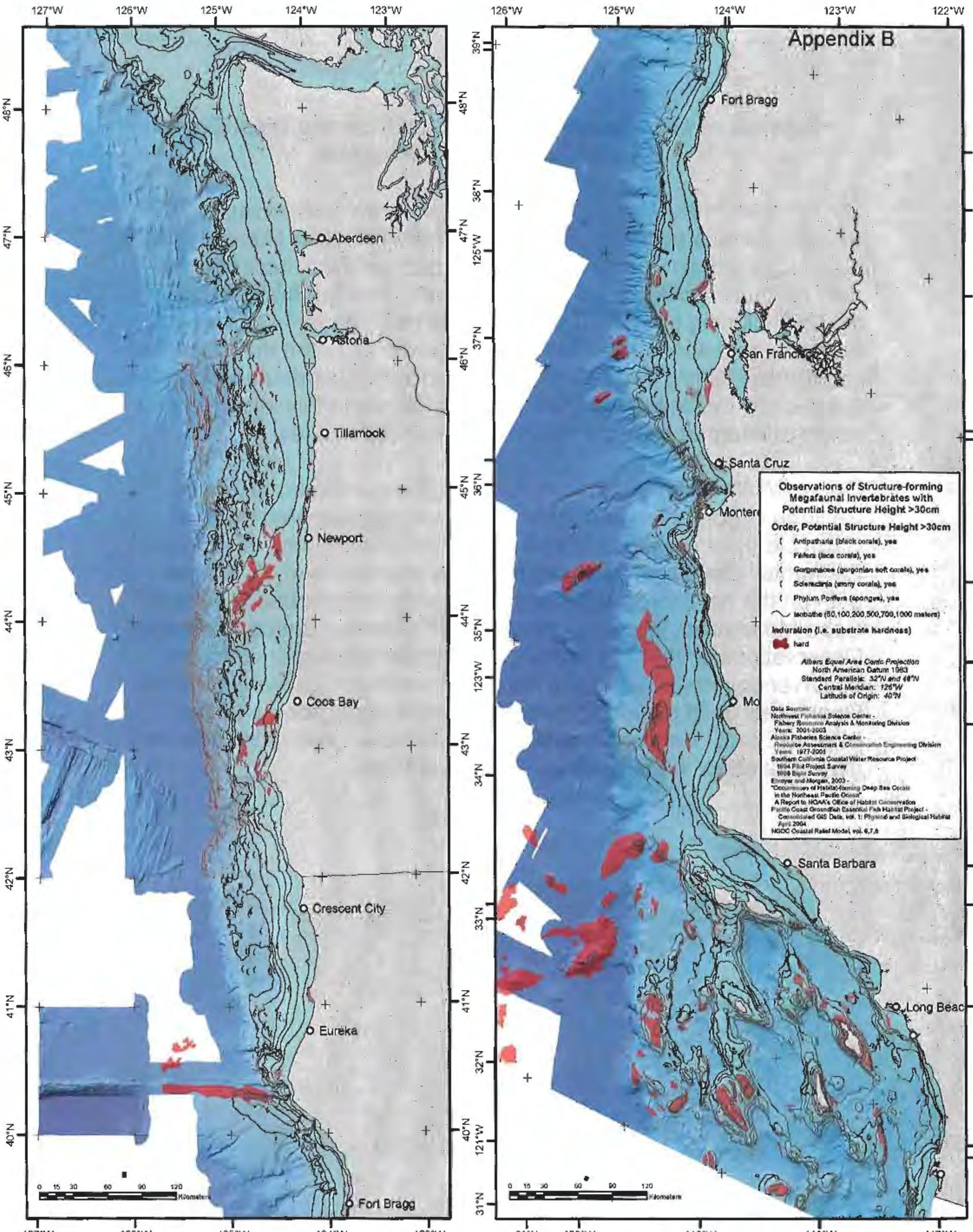
Santa Cruz
Monterey
Santa Barbara
Long Beac
Newport Beach
San Diego
Kilometers
Occurrences of Stony Corals
(Order Scleractinia) (Organized by Family)
from Regional Surveys
Order, Family
Scleractinia, Caryophyllidae
Scleractinia, Oculinidae
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Projection: Albers Equal Area Conic
Datum: North American Datum 1983
Standard Parallels: 32 and 48 degrees N
Central Meridian: 126 degrees W
Latitude of Origin: 40 degrees N
Southern California Coastal Water Resource Project -
"Occurrences of Habitat-forming Deep Sea Corals
A Report to NOAA's Office of Habitat Conservation
NGDC Coastal Relief Model, vol 6,7,8



Appendix B
Occurrences of Lace Corals
(Order Filifera) (Organized by Family)
from Etnoyer and Morgan (2003)
Order, Family
Filifera, Stylasteridae
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Projection: Albers Equal Area Conic
Datum: North American Datum 1983
Standard Parallels: 32 and 48 degrees N
Central Meridian: 126 degrees W
Latitude of Origin: 40 degrees N
Westport
Fort Bragg
Point Arena
San Francisco
Santa Cruz
Monterey
Morro
Santa Barbara
Long Beach
Newport Beach
San Diego
Aberdeen
Warrenton
Astoria
Tillamook
Newport
Coos Bay
Crescent City
Arcata
Eureka
Kilometers

High Structure Megafaunal Invertebrates

Megafaunal invertebrates may play a role in providing biogenic structure. In order to determine the distribution of species like to provide such structure we have categorized them by their Potential Structure Height (PSH). PSH for this study is defined as the maximum known structure height obtained by a particular invertebrate species. Numerous experts were consulted to develop this index. Structure heights greater than 30 cm were thought to have the highest potential to provide habitat. Observations of megafaunal invertebrates that potentially reach heights >30 cm are shown in Figure 13. Black coral species were observed primarily north of Cape Mendocino and on Davidson Seamount (west-southwest of Monterey, California). Sponge observations are most prevalent north of Cape Mendocino, off Morro Bay (near Santa Lucia Escarpment), and in the Southern California Bight. Gorgonian and Filiferan observations are sparse but clusters of observations occurred near Monterey Bay. Only one observations of a stony coral that can reach a height >30 cm was recorded near Anacapa Island directly south of Santa Barbara, California.



Appendix B
Observations of Structure-forming Megafaunal Invertebrates with Potential Structure Height >30cm
Order, Potential Structure Height >30cm
Antipatharia (black corals), yes
Gorgonacea (gorgonian soft corals), yes
Scleractinia (stony corals), yes
Phylum Porifera (sponges), yes
Isobathe (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Albers Equal Area Conic Projection
North American Datum 1983
Standard Parallels: 32°N and 48°N
Central Meridian: 126°W
Latitude of Origin: 40°N
Data Sources:
Northwest Fisheries Science Center -
Fishery Resource Analysis & Monitoring Division
Years: 2001-2003
Alaska Fisheries Science Center -
Years: 1977-2001
Southern California Coastal Water Resource Project
1994 Pilot Project Survey
1998 Bight Survey
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Monterey
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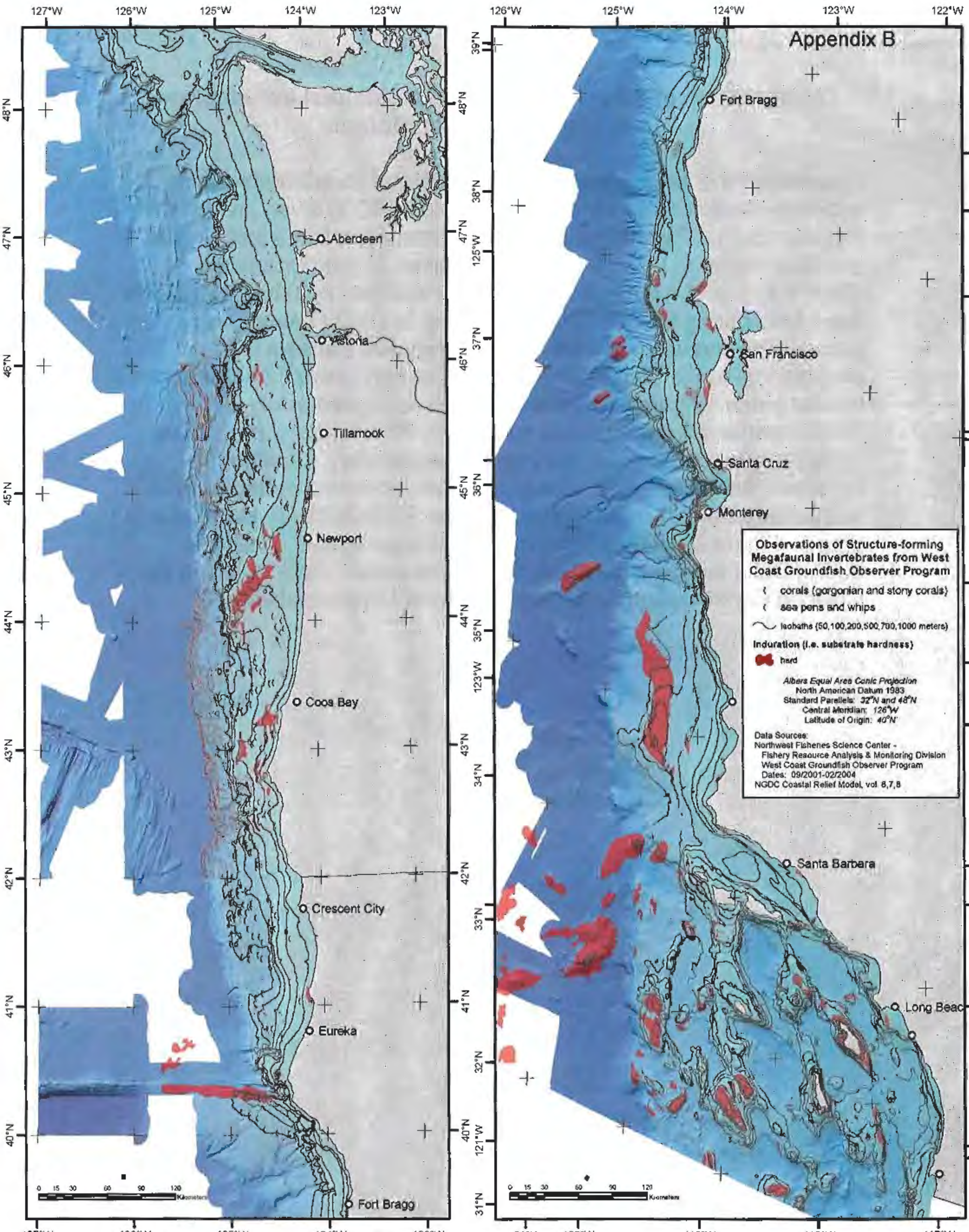
Long Beach
Kilometers

Catches of Megafaunal Invertebrates from the West Coast Groundfish Observer Program

Out of 12,411 observed hauls or sets, corals were observed in 239 and sea pens in 80 hauls. Since specific identification of invertebrates was not included in observer collection protocols until recently, the data currently available are categorized into four general groups: corals (including gorgonian and stony corals), sea pens and whips, sponges, and anemones (Table 1). It should be noted that observed commercial fishing effort has not been uniformly distributed along the coast since the beginning of WCGOP in 2001 and this affects our ability to interpret the data on invertebrate occurrences.

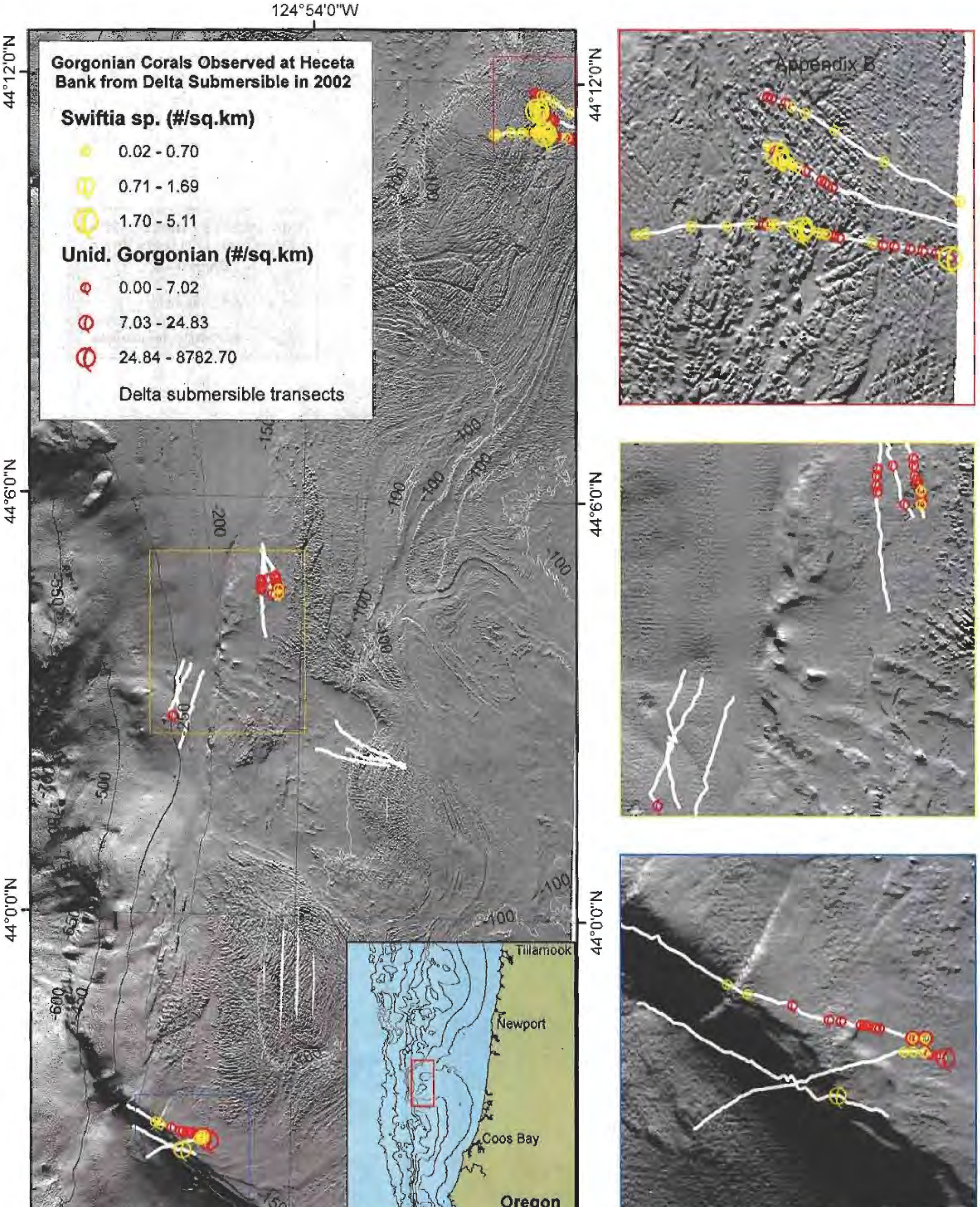
Figure 14 shows distribution of corals and sea pens occurrences. Records of gorgonian and stony corals are concentrated north of Cape Mendocino, with only about a dozen observations off central California. Occurrences of sea pens are concentrated off Oregon both on the continental shelf and slope, with limited observations off Cape Mendocino, Morro Bay, and one off Newport Beach, California. Observations south of Pt. Conception appear quite sparse, where observer coverage is focused primarily on the open access fisheries. Gear types used by open access fisheries include hook-and-line, pots, etc. that rarely catch sessile invertebrates, producing a visible gear bias effect in the Southern California Bight.

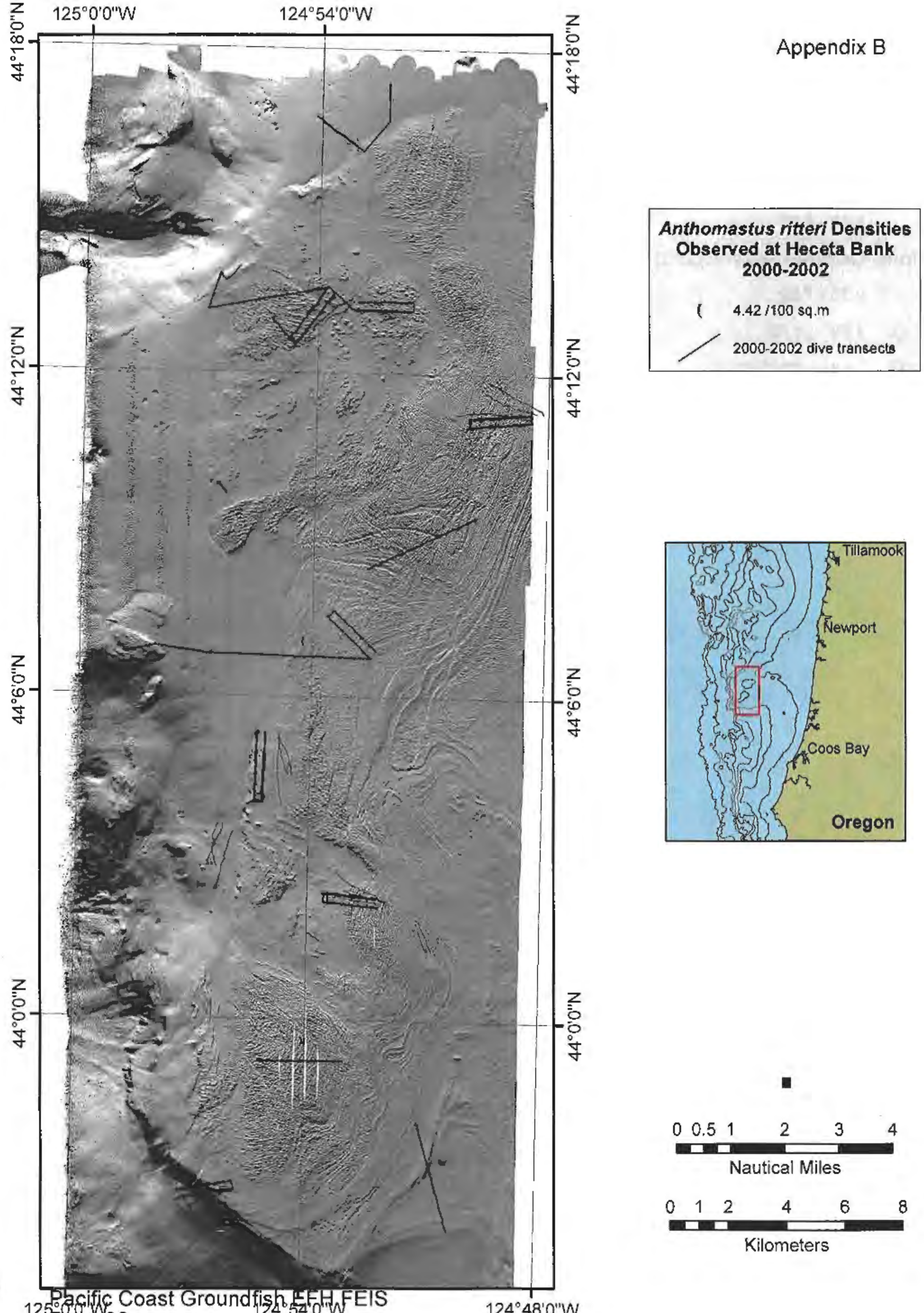


Appendix B
Aberdeen
Astoria
Tillamook
Newport
Coos Bay
Crescent City
Eureka
Fort Bragg
San Francisco
Santa Cruz
Monterey
Santa Barbara
Long Beach
Observations of Structure-forming Megafaunal Invertebrates from West Coast Groundfish Observer Program
corals (gorgonian and stony corals)
sea pens and whips
isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Albers Equal Area Conic Projection
North American Datum 1983
Standard Parallels: 32°N and 48°N
Central Meridian: 126°W
Latitude of Origin: 40°N
Data Sources:
Northwest Fisheries Science Center -
Fishery Resource Analysis & Monitoring Division
West Coast Groundfish Observer Program
Dates: 09/2001-02/2004
NGDC Coastal Relief Model, vol. 6,7,8
Kilometers

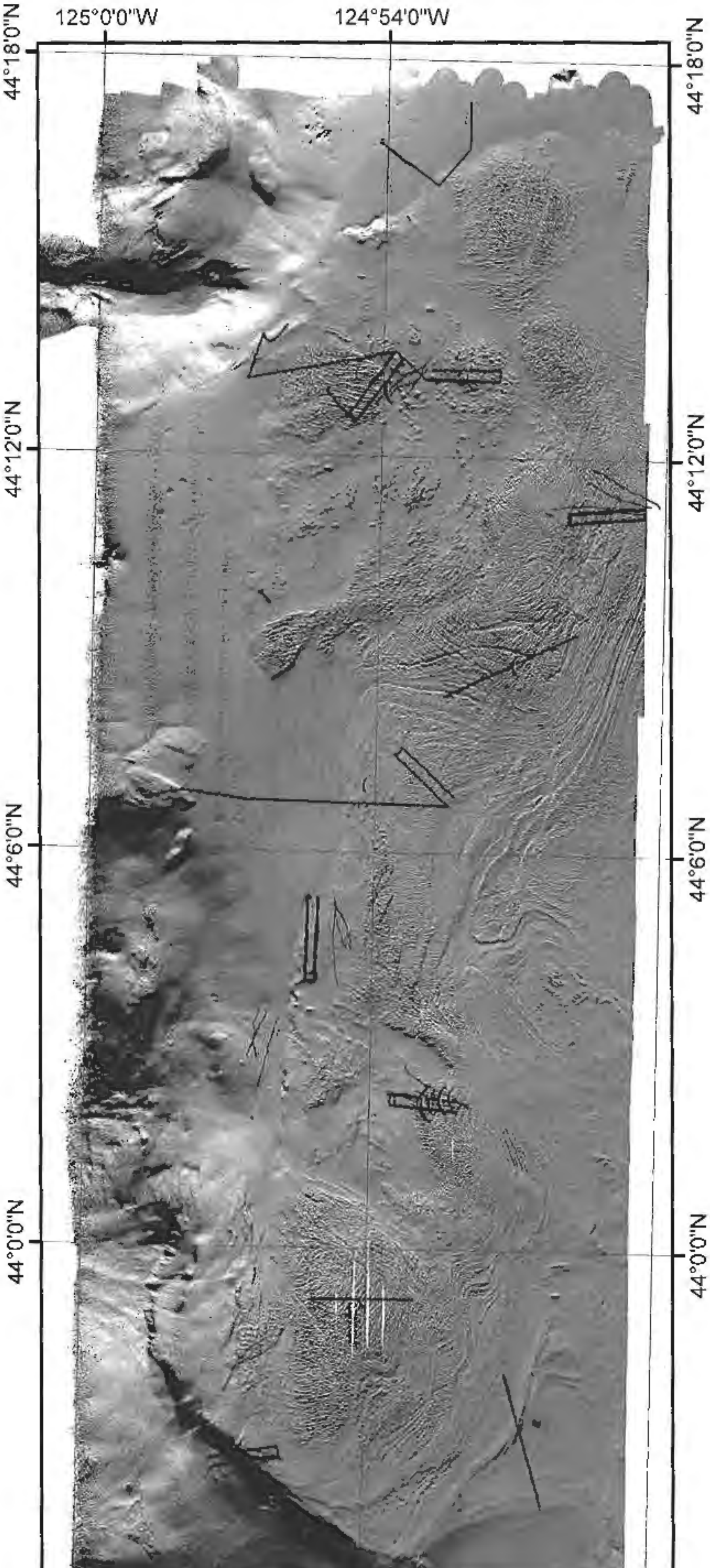
Observations of Structure-forming Megafaunal Invertebrates from High-Resolution Studies

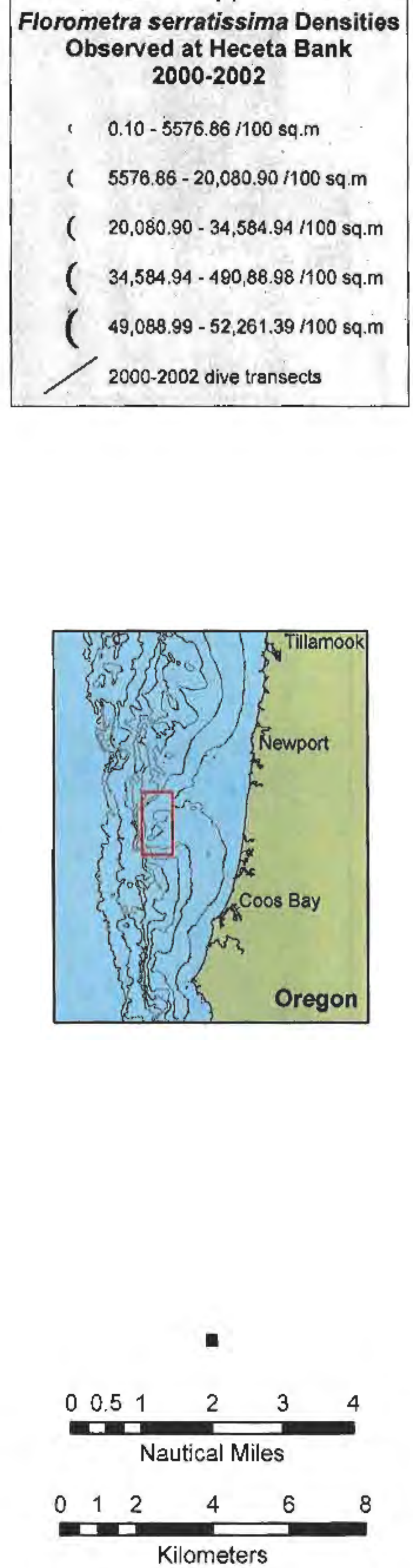
Observations of structure-forming megafaunal invertebrates from submersible and remotely operated vehicle (ROV) dives are shown in Figures 15-21. This higher resolution information is not included in previous maps. Figure 15 portrays densities of two gorgonians (*Swiftia* spp. and a currently unidentified species) observed at Heceta Bank only during Delta submersible dives in 2002 (Tissot et al in prep.). The line width of each represented dive transect is proportional to the density of species observed over a homogeneous habitat patch. Figures 16-20 show observed densities of *Anthomastus ritteri* (gorgonian soft coral), *Florometra serratissima* (crinoid), *Gorgoncephalus eucinemis* (basket star), *Metridium farcimen* (anemone), and various sponges observed during all ROV and submersible dives at Heceta Bank in 2000-2002 (Tissot et al in prep.). Figure 21 shows 180 locations of black corals observed during Delta submersible dives on shallow water, rocky banks in the Cowcod Conservation Area (Yoklavich and Love unpublished).

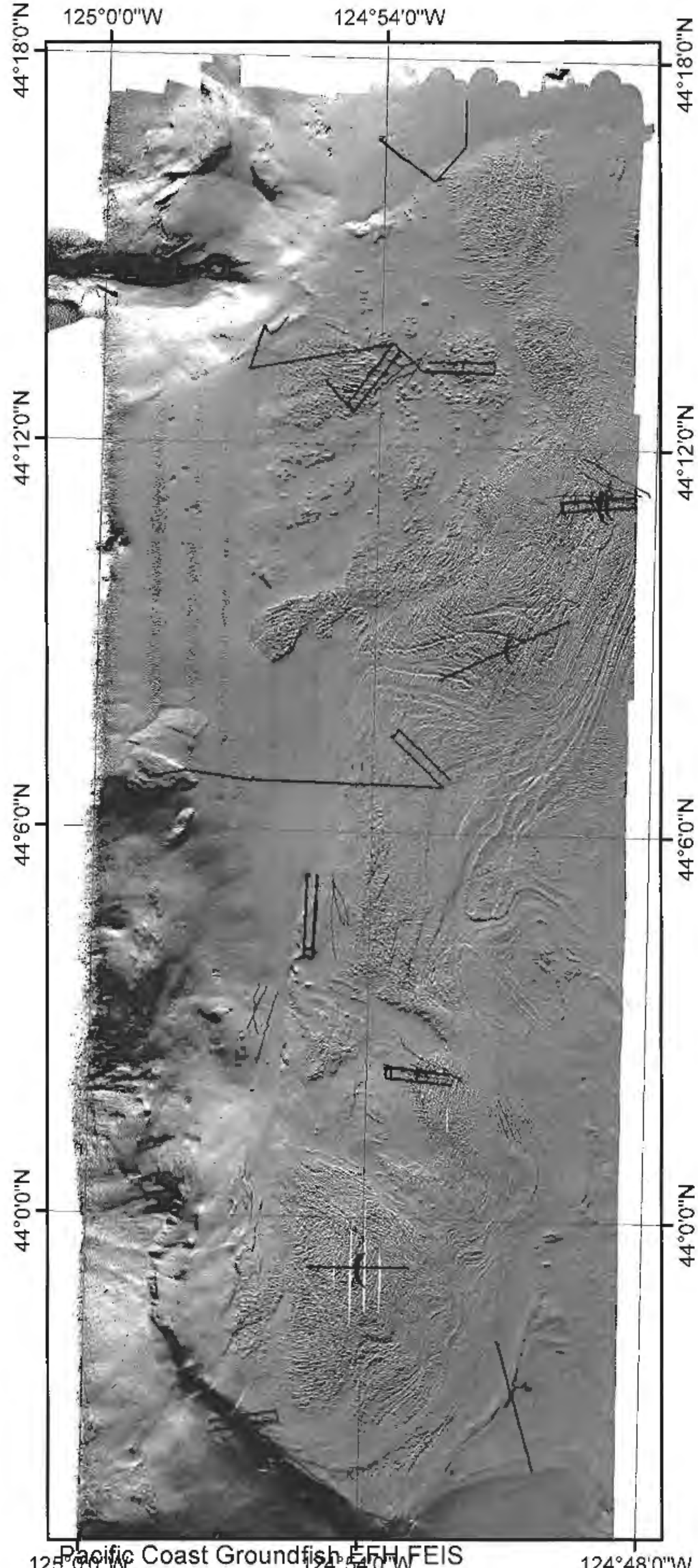

Gorgonian Corals Observed at Heceta Bank from Delta Submersible in 2002
Swiftia sp. (#/sq.km)
0.02 - 0.70
0.71 - 1.69
1.70 - 5.11
Unid. Gorgonian (#/sq.km)
0.00 - 7.02
7.03 - 24.83
24.84 - 8782.70
Delta submersible transects
124°54'0"W
44°12'0"N
44°6'0"N
44°0'0"N
Tillamook
Newport
Coos Bay
Oregon

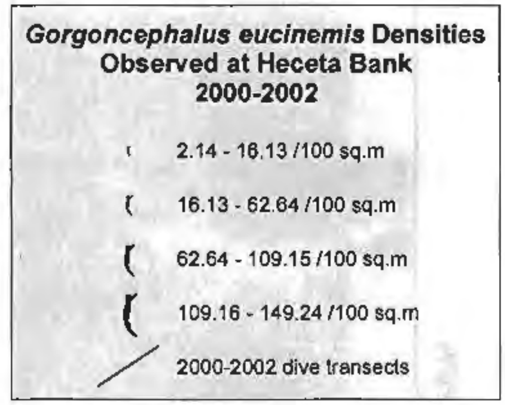

125°0'0"W
124°54'0"W
124°48'0"W
44°18'0"N
44°12'0"N
44°6'0"N
44°0'0"N
Anthomastus ritteri Densities Observed at Heceta Bank 2000-2002
4.42 /100 sq.m
2000-2002 dive transects
Tillamook
Newport
Coos Bay
Oregon
0 0.5 1 2 3 4
Nautical Miles
0 1 2 4 6 8
Kilometers

Appendix B

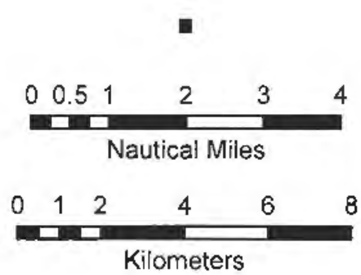

125°0'0"W
124°54'0"W
124°48'0"W
44°18'0"N
44°12'0"N
44°6'0"N
44°0'0"N


Florometra serratissima Densities Observed at Heceta Bank 2000-2002
0.10 - 5576.86 /100 sq.m
5576.86 - 20,080.90 /100 sq.m
20,080.90 - 34,584.94 /100 sq.m
34,584.94 - 490,88.98 /100 sq.m
49,088.99 - 52,261.39 /100 sq.m
2000-2002 dive transects
Tillamook
Newport
Coos Bay
Oregon
0 0.5 1 2 3 4
Nautical Miles
0 1 2 4 6 8
Kilometers

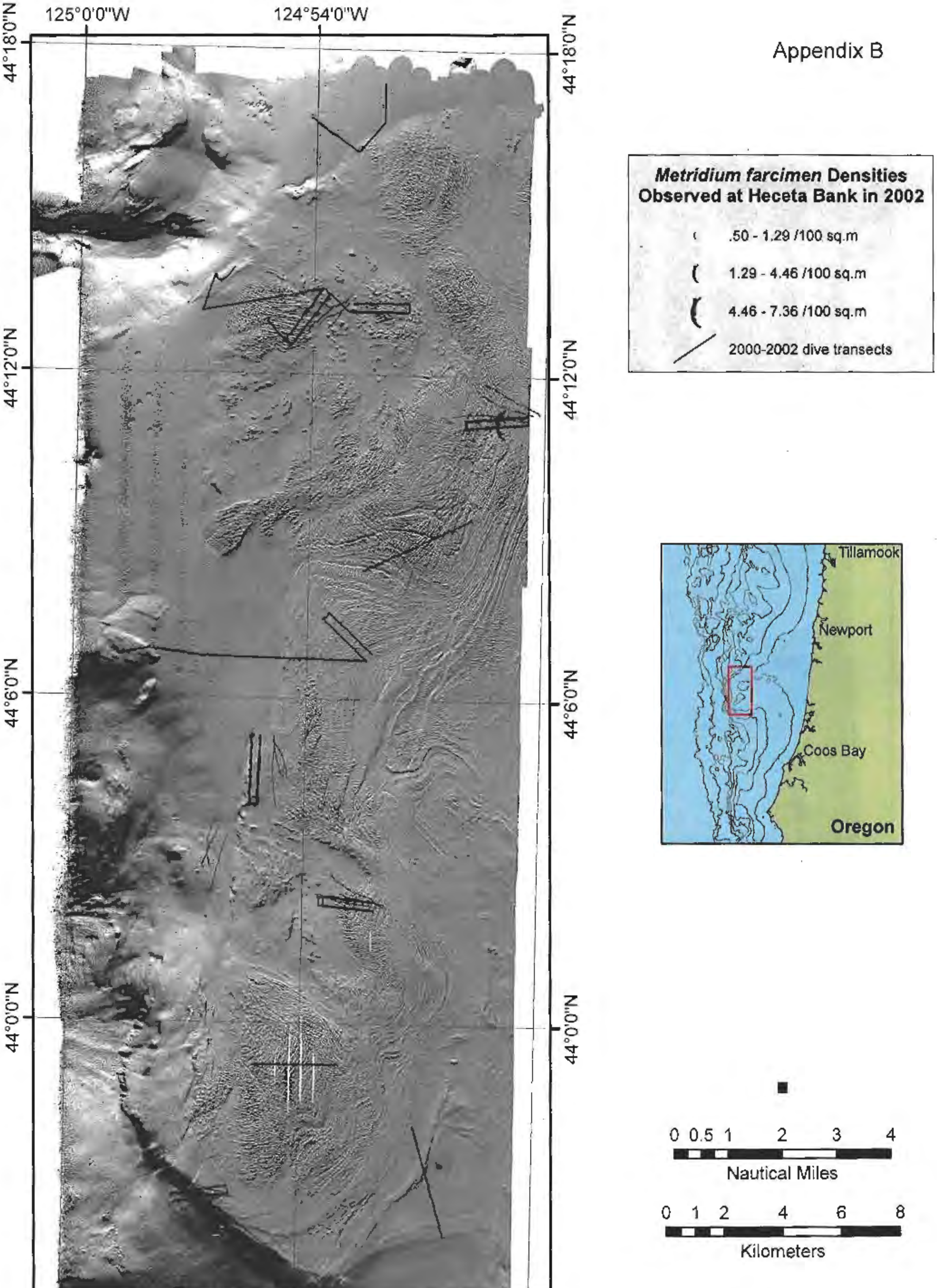

125°0'0"W
124°54'0"W
44°18'0"N
44°12'0"N
44°6'0"N
44°0'0"N
124°48'0"W

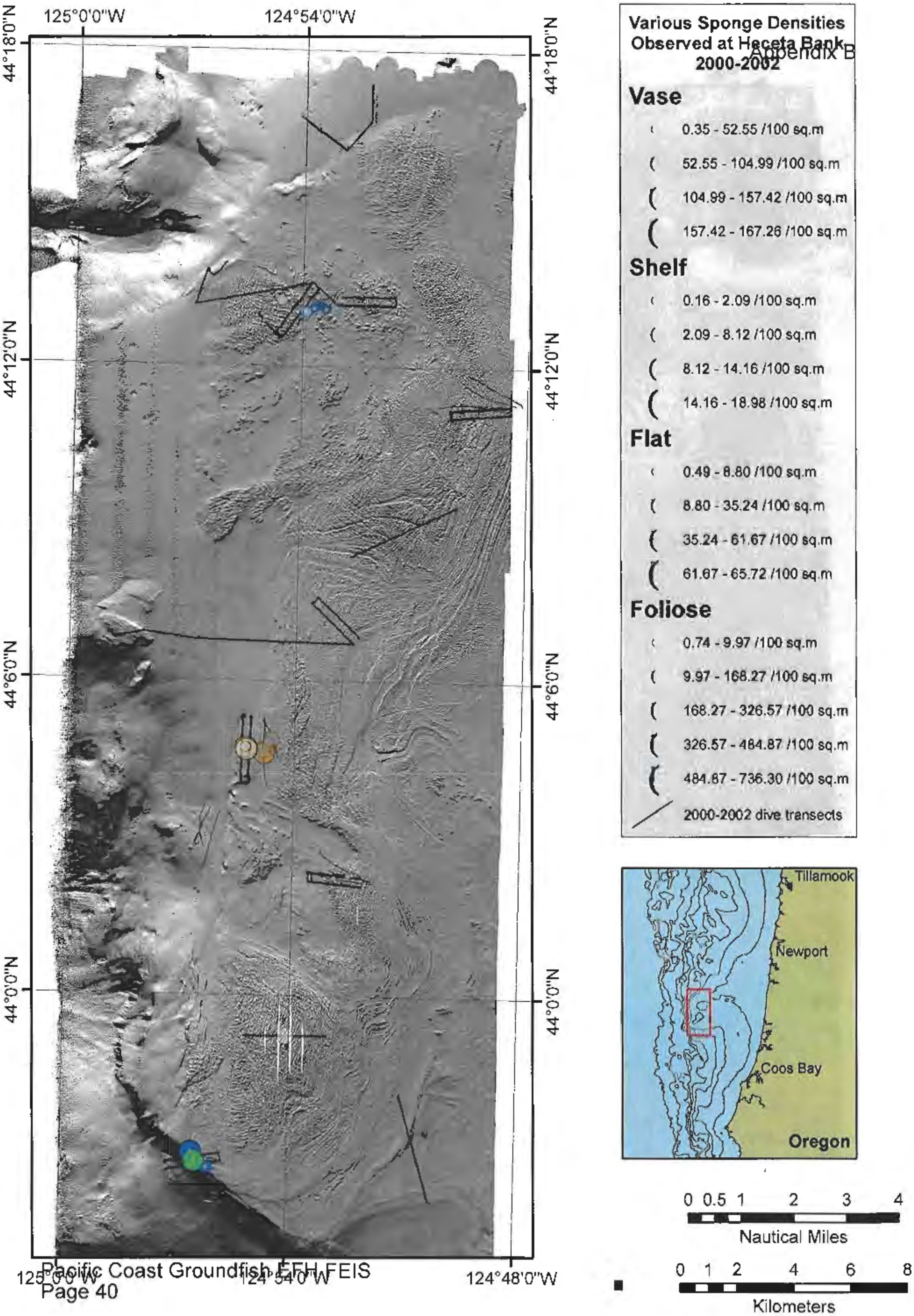

Gorgoncephalus eucinemis Densities
Observed at Heceta Bank
2000-2002
2.14 - 16.13 /100 sq.m
16.13 - 62.64 /100 sq.m
62.64 - 109.15 /100 sq.m
109.16 - 149.24 /100 sq.m
2000-2002 dive transects

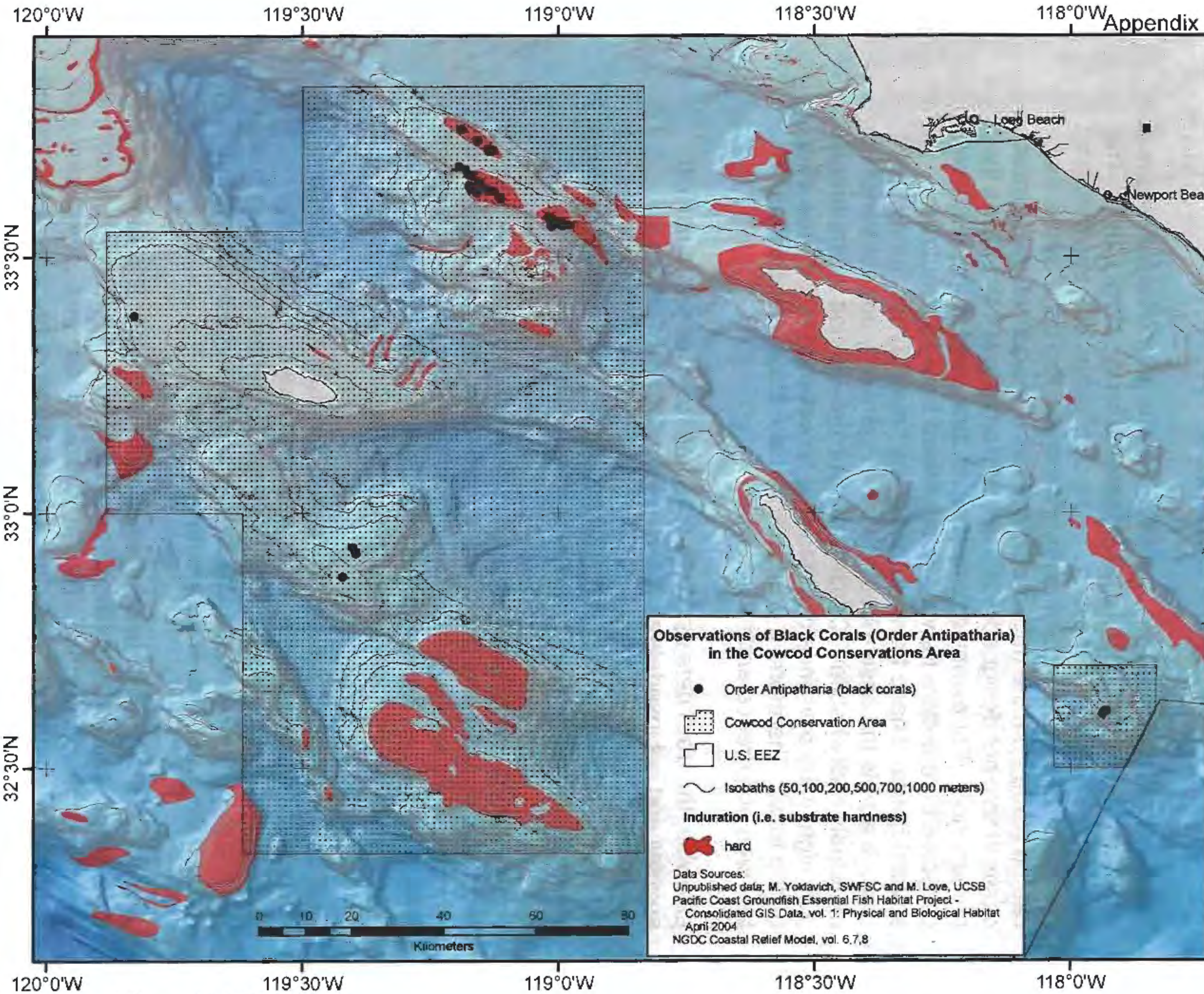

Tillamook
Newport
Coos Bay
Oregon


0 0.5 1 2 3 4
Nautical Miles
0 1 2 4 6 8
Kilometers

Appendix B


125°0'0"W
124°54'0"W
124°48'0"W
44°18'0"N
44°12'0"N
44°6'0"N
44°0'0"N
Metridium farcimen Densities Observed at Heceta Bank in 2002
.50 - 1.29 /100 sq.m
1.29 - 4.46 /100 sq.m
4.46 - 7.36 /100 sq.m
2000-2002 dive transects
Tillamook
Newport
Coos Bay
Oregon
0 0.5 1 2 3 4
Nautical Miles
0 1 2 4 6 8
Kilometers


125°0'0"W
124°54'0"W
44°18'0"N
44°12'0"N
44°6'0"N
44°0'0"N
125°0'0"W
124°54'0"W
124°48'0"W
Various Sponge Densities Observed at Heceta Bank 2000-2002
Vase
0.35 - 52.55 /100 sq.m
52.55 - 104.99 /100 sq.m
104.99 - 157.42 /100 sq.m
157.42 - 167.26 /100 sq.m
Shelf
0.16 - 2.09 /100 sq.m
2.09 - 8.12 /100 sq.m
8.12 - 14.16 /100 sq.m
14.16 - 18.98 /100 sq.m
Flat
0.49 - 8.80 /100 sq.m
8.80 - 35.24 /100 sq.m
35.24 - 61.67 /100 sq.m
61.67 - 65.72 /100 sq.m
Foliose
0.74 - 9.97 /100 sq.m
9.97 - 168.27 /100 sq.m
168.27 - 326.57 /100 sq.m
326.57 - 484.87 /100 sq.m
484.87 - 736.30 /100 sq.m
2000-2002 dive transects
Tillamook
Newport
Coos Bay
Oregon
0 0.5 1 2 3 4
Nautical Miles
0 1 2 4 6 8
Kilometers


120°0'W
119°30'W
119°0'W
118°30'W
118°0'W
33°30'N
33°0'N
32°30'N
Long Beach
Newport Beac
Observations of Black Corals (Order Antipatharia) in the Cowcod Conservations Area
Order Antipatharia (black corals)
Cowcod Conservation Area
U.S. EEZ
Isobaths (50,100,200,500,700,1000 meters)
Induration (i.e. substrate hardness)
hard
Data Sources:
Unpublished data; M. Yoklavich, SWFSC and M. Love, UCSB
Pacific Coast Groundfish Essential Fish Habitat Project - Consolidated GIS Data, vol. 1: Physical and Biological Habitat April 2004
NGDC Coastal Relief Model, vol. 6,7,8
0 10 20 40 60 80
Kilometers

Discussion

The report summarized much of the available data on occurrences of structure-forming megafaunal invertebrates on the West Coast. The data provide a general overview of the distribution of these species and are based on a large number of records. The conclusions that can be made from the data are limited since the collections in most cases where not designed with the mapping of invertebrates as their primary goal. For example, a majority of data used in this study was collected from bottom trawls with are towed from 15 minutes to several hours. These trawls transit many habitat types during that time. It also is the case that these trawls generally are not transiting extremely rocky habitat. Catches of structure-forming invertebrates only signify the presence of organisms somewhere in the area swept by the trawl. Therefore, it is difficult to make clear associations between occurrence and habitat type.

Likewise, the trawl nets used are designed to target demersal fish species and not invertebrates. Since the gear is not designed specifically to collect invertebrates the fact that an organism was not recorded in the catch of a particular trawl does not necessarily mean the organism did not reside within the area swept.

Finally, the specific identifications are generally not available from most data sources and the dispositions (live vs. dead) of invertebrate samples were not recorded. Therefore there is uncertainty to specific identifications and if the samples represent live organisms and therefore those that are currently living in the area.

Fine scale surveys are the best method to obtain specific habitat associations and to develop high resolution maps. Such high-resolution data are very limited. We have presented some fine scale information here, but these studies represent a large portion of the data on this scale that are currently available.

Given the limitations of existing information it is clear that more targeted data collections and mapping efforts are needed. In order to accurately describe the occurrence, habitat associations and other biological information about these species, specific surveys must be implemented to provide both high resolution and medium resolution maps in representative habitat areas. The NWFSC is currently making plans for such surveys.

List of Figures

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M. Yoklavich, SWFSC and M. Love, UCSB. Unpublished data.

Appendix C: Treaty Indian Fishing Rights

Legal Background

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).

The National Marine Fisheries Service (NMFS) recognizes four tribes as having u & a grounds in the marine areas managed by the 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).

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 percent 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)"]

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 C.F.R. 660.324(c) (u & a grounds for groundfish); 50 C.F.R. 300.64(i) (u & a grounds for halibut). The u & a grounds recognized by NMFS may be revised as ordered by a federal court.

Current Regulations

In 1994, the United States formally recognized that the four Washington coastal treaty Indian tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish in the Pacific Ocean, and concluded that, in general terms, the quantification of those rights is 50 percent of the harvestable surplus of groundfish that pass through the tribes' usual and accustomed ocean fishing areas (described at 60 CFR 660.324). A federal regulation that specifically pertains to treaty Indian fisheries for groundfish was promulgated at 50 C.F.R. 660.324. This regulation acknowledges treaty Indian fishing rights, lists the tribes with fishing rights in the EEZ, describes the boundaries of the relevant tribes' u & a grounds in the Pacific Ocean, and establishes procedures for implementation of tribal rights.

Under the current groundfish regulations, a tribal allocation is subtracted from the species' OY before limited entry and open access allocations are derived. The tribal fisheries for sablefish, black rockfish, and whiting are separate fisheries, and are not governed by the limited entry or open access regulations or allocations. The tribes regulate these fisheries so as not to exceed their allocations.

In 2004, the tribal allocation for black rockfish taken for commercial purposes is 20,000 lb (9,072 kg) north of Cape Alava, WA (48 degrees 09'30" N. lat.) and 10,000 lb (4,536 kg) between Destruction Island, WA (47 degrees 40'00" N. lat.) and Leadbetter Point, WA (46degrees 38'10" N. lat.). The tribal sablefish allocation is 10 percent of the total catch OY north of Point Conception, CA (751 mt), less 3 percent for estimated discard mortality, or 728.5 mt.

In 1999 through 2004, the tribal whiting allocation 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 percent tribal harvest ceiling at OY levels below 145,000 mt. To date, only the Makah Tribe has conducted a whiting fishery.

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 sliding scale allocation 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), and again in April 2003, id., Order Granting Federal Defendants' and Makah's Motions for Summary Judgment and Denying Plaintiffs' Motions for Summary Judgment, April 15, 2003. The latter ruling has been appealed to the Ninth Circuit, but no decision has been rendered as yet. As of 2004, NMFS remains under a court order in Subproceeding 96-2 to continue use of the sliding scale methodology unless the Secretary of Commerce 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.

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 has established trip limits recommended by the tribes and the Council to accommodate modest tribal fisheries. In 2004, tribal harvest limits are as follows. For lingcod, all tribal fisheries are restricted to 450 lb (204 kg) per day and 1,350 lb (612 kg) per week cumulative limits. Tribal fisheries will be managed with a 25-mt lingcod harvest guideline. For rockfish species, the 2004 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 3.6 mt in 2004. A 300-lb (136-kg) thornyheads trip limit is expected to result in landings of 4.8 mt in 2004. Other rockfish limits are expected to result in the following landings levels: widow rockfish, 40 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.

Appendix E. Letters of Comment Received on the DEIS.

Comments on PROGRAMATIC ENVIRONMENTAL IMPACT STATEMENT for Pacific Coast Groundfish Bycatch Management

Submitted March 26, 2004

Introduction

This EIS has two important shortcomings. The first shortcoming is a failure to consider an important alternative. The second relates to the complete lack of quantitative rigor in evaluating alternatives.

Shortcoming One: Failure to consider all reasonable alternatives.

NEPA Regulations, 40 CRF 1502.14(a) states:

> Agencies shall rigorously evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

There is one alternative that is conspicuously absent from this EIS and no reasons are offered as to why. That is, the option of completely phasing out bottom trawling throughout the entire region --- not just in reserves or protected areas.

The benefits of this alternative are clear. According to a recent report sponsored by the Pew Charitable Trusts [1], bottom trawling is clearly the worst widely practiced fishing method in terms of finfish bycatch, impacts on the physical structure of the seafloor, and impact on seafloor organisms. It is arguably the least "specific" of the fishing gear types.

Quoting the Pew-sponsored report, "fishing gears that contact the seafloor disturb geologic and biological structures. These gears plane off structures on soft areas of the ocean bottom, displace boulders, and harm bottom-dwelling organisms by crushing them, burying them, or exposing them to predators. .... The benthic animals most sensitive to fishing gears [that contact the bottom] are those that are erect and fragile, long-lived and slow-growing, or living in waters where severe natural disturbances are less common, particularly below a depth of 350 feet."

NOAA should use the best available bycatch model to estimate how much eliminating bottom trawling would reduce total bycatch and compare it to the other alternatives. The fact that bycatch estimates are uncertain is no excuse for not using quantitative models to compare options. The uncertainties can be expressed as ranges and/or probability distributions.

Eliminating bottom trawling would have costs. It would temporarily reduce the profit earned by bottom trawling fishers. It would reduce the supply of certain commercial fish species. Over time these costs will be reduced as new, less harmful fishing methods are deployed and alternative fish supplies are substituted. Economic impacts could be mitigated by phasing out bottom trawling over a 5 or 10 year time frame.

The market impacts of curtailing bottom trawling may be relatively modest if they are examined carefully. According to the Pew-sponsored report, bottom trawling accounts for only about 10 percent of the revenue from fish landings in the Pacific Region. The highest value class of the species caught in bottom trawling is ocean shrimp. It is hard to believe that the consumer would be seriously hurt by one less shrimp option available at the market.

NOAA should also examine explicitly the profit associated with bottom trawling. Fishing revenues are indicators but they are not the ultimate measure of economic benefit. Economic benefits for fishers and for society in general should be evaluated based on profit, where profit equals revenue minus costs. Measuring impacts in terms of revenue alone is misleading. Businesses exist to maximize profit, not revenue. If NOAA examined profit, we might see that bottom trawl fishing this a very destructive but only marginally profitable enterprise.

Along with evaluating the elimination of bottom trawling, NOAA should evaluate the productivity of simultaneous investments in research and development on alternative, less harmful, bottom fishing technology. Development of traps should be high on NOAA's priority. Program costs and likely outcomes of the research should be a part of this EIS.

So why is NOAA condoning or overlooking this destructive fishery? The answer isn't apparent in the EIS.

Shortcoming Two: Lack of quantitative support offered to compare and evaluate alternatives

NEPA Regulations 40 CFR 1502.14(b) states that

> "agencies shall devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits."

This objective is echoed on page 1-21 of the EIS where it says, "The Council and NMFS will consider how each alternative addresses the purpose and need for action. They will weigh the expected or potential benefits and costs of each alternative and decide which, if any, alternative, provides the optimal balance." It is hard to believe that this EIS document, as long as it is, will be much help in meeting this goal. Generally speaking, the evaluation is wordy and lacks analytical rigor.

The differences among the alternatives in this EIS would be much clearer if a more quantitative cost-benefit approach were taken. A quantitative approach would also have the benefit of helping the preparers of the EIS to be more clear and concise in their thinking and communication.

Many of the important outcomes of the alternatives are easily expressed in numbers, e.g., numbers and pounds of fish caught, fraction of bycatch, percent of bycatch mortality, area of bottom habitat disrupted, consumer prices, fishing revenues and costs, and implementation costs. For example, it would be useful to see a table of bycatch broken down by gear type. Granted, many of the impacts are uncertain. Non-the-less, uncertainties can effectively be quantified and communicated using ranges and probability distributions.

Without quantification, much of the ranking of alternatives and summaries of alternative effects creates more heat than light. Rankings like those in Tables 4.3.1-6, 4.5.2,4.6.1 and 4.6.2 give us no idea of the magnitude of differences and are of little help in finding the "optimal balance." Likewise, "Significance Ratings" like those used in Tables 2.3.2, 2.3.3, 2.3.5 and 4.7.2 are needlessly abstract and lack objectivity. And, in general, the "Verbal Summaries" like Tables 2.3.4, 4.7.1 and 4.8 do little to highlight the significant differences between options. Decisions should be based on clear differences and concise insights. These tables offer completeness but little insight regarding the differences that are a basis for decision making.

Commercial fishing is a business. Universally accepted quantitative tools from management science should be used to support the bycatch mitigation decisions. Computer-based mathematical models and decision analysis are examples. They are used routinely to support decision making throughout the world in business and government [2,3]. They are grossly underutilized in this EIS.

Summary

Firstly, the EIS should explicitly consider and evaluate elimination of bottom trawling as an alternative. And secondly, the evaluation should have been much more quantitative.

In the words of Lord Kelvin (1824-1907), "When you can measure what you are speaking about and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the state of science, whatever the matter may be." He also said, "If you cannot measure it, you can not improve it."

Your thoughtful consideration of my comments is appreciated. Thank you.

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References:

[1] Morgan, L.E., Ratana Chuenpagdee, Shifting Gears: Addressing the Collateral Impacts of Fishing Methods in U.S. Waters. 2003, Pew Science Series on Conservation and the Environment.

[2] North, R.W., et al, The Decision to Seed Huricanes, Science, Vol. 176, p.1191 -1202, 1972

[3] For a list of books on Decision Analysis, see www.informs.org/Bookstore/das

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April 26, 2004

BY FAX AND MAIL

Mr. D. Robert Lohn
Regional Administration
Northwest Region, NMFS, NOAA
7600 Sand Point Way N. E., Bldg. 1
Seattle, WA 98115-0070

Comments on the Pacific Coast Groundfish Bycatch
Draft Progammatic Environmental Impact Statement (DPEIS)

Dear Mr. Lohn:

On behalf of D'Amato Commercial Fishing and Kingfisher Trading Co., Inc., this is to offer comments on the DPEIS.

Background of D'Amato Commercial Fishing and Kingfisher Trading Co., Inc.

D'Amato Commercial Fishing ("D'Amato")is composed of four individuals who are members of the D'Amato family living in Orange County, California. Because of the economics of the live-fish fishery, these four individuals operate 18 permitted fishing vessels on a rotation arrangement. Only one person is aboard one permitted vessel at the time of fishing. Two members of the Family each operate 5 vessels, and the two remaining members each operate 4 vessels. [1] The maximum number of vessels fishing on any fishing day is 4 vessels. Economics of the fishery do not justify the operation of more than 4 vessels on any fishing day. The vessels are registered by the California Department of Motor Vehicles (DMV) because none are large enough to be documented by the U.S. Coast Guard. None of the vessels exceed 26 feet in length. They are taken to public operated shoreside ramps by trailers. The vessels and trailers are located at the homes of the individuals. These vessels are engaged in the live-fish fishery with limited entry fixed longline gear and without Sablefish endorsements. [2] The fishing vessels are operated in compliance with the newly established VMS rules. All four fishermen have been on fishing trips with NMFS Observers recording their fishing activity.

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[1] Over a period of time, particularly in the last three years, D'Amato purchased permitted vessels as their live-fish fishery for Sablefish and Shortspine thornyhead developed. This was the only means available to them in the Groundfish FMP to attain their current efficient and profitable live-fish fishing operation.

[2] The DEIS notes that in recent years, the growth of the live-fish fishery but does not identify the number of vessels participating in such fishery or how many of these vessels operated south of 34° 27' N. Lat.; the DEIS states that during any given year that of 230 permits issued, only about 180 vessels coastwise are active. On the basis of this information, D'Amato operates 10% of this active fleet."Holders of permits that are not sablefish-endorsed are not permitted to land amounts of sablefish in excess of daily/weekly trip limit provisions." See: Dr. James Hastie, PFMC Exhibit C.4.a. Attachment 2, April 2004, "Modeling Sablefish Discard and Bycatch of Overfished Species in the 2004 Limited-Entry Fixed Gear Sablefish Fishery." page 1.

Kingfisher Trading Co., Inc. ("Kingfisher"), buys live fish from D'Amato and then sells the live fish to restaurants located in the counties of Los Angeles and Orange County. D'Amato is a significant and very reliable supplier to Kingfisher of live Sablefish and Shortspine thornyhead. This proven reliability throughout the calendar that is characteristic of D'Amato is extremely important to Kingfisher in servicing and maintaining his customers, particularly with Asian operated restaurants.

Pursuant to federal Groundfish regulations, and in particular **Table 4 (South) , 2004 Trip Limits for Limited Entry Fixed Gear South of 40° 10' N. Latitude**, the D'Amato fishing vessels fish for Sablefish and Shortspine thorneyhead. These are species of groundfish that permit their live retention after reaching the deck of the D'Amato vessels largely because of their unique biology. [3]

D'Amato describes its fishery as follows: "Limited Entry, fixed gear" used in depths beyond 250 fathoms, in waters off Southern California, south of 34° 12' N. Latitude and within the Rockfish Conservation Area (RCA). D'Amato lands live Sablefish and/or Shortspine thornyhead by using baited hooks attached to an longline stretched about the ocean floor that is secured with two anchors and two buoys. Herein, the term "D'Amato Fishery" refers to this description.

D'Amato Fishing Activity and Bycatch Reduction

NMFS Observers have fished with D'Amato, and it is the present recollection of D'Amato that the Observers recorded no bycatch-repeat-no bycatch-of the following eight overfished groundfish species: Bocaccio rockfish, Canary rockfish, Cowcod, Darkblotched rockfish, Lingcod, Pacific Ocean Perch, and Yelloweye rockfish, and Widow rockfish. D'Amato does recall the rare event of their gear incidentally catching a few individual Pacific Whiting. [4] In making this claim concerning Pacific Whiting, D'Amato is confident of support from the records of the NMFS Observers.

D'Amato contends that a very negligible portion of their ***"total catch"*** of Sablefish and/or Shortspine thornyhead is thrown away at sea and that the entire live catch or **"landed catch"** is retained and brought ashore. [5] The only reason for the very few discards of a targeted species is the discovery on the deck that the interior of fish was being "eaten away," giving rise to a description by the fishermen of "skeleton-like". [6]

We note the DEIS defines the term bycatch very broadly to "mean discarded catch of any living marine resource, plus any unobserved mortality resulting from a direct encounter with fishing gear. " [7] D'Amato fishes for Sablefish and Shortspine thornyhead in waters of 250 fathoms and greater; therefore, D'Amato believes that the only record of any other living marine resource reaching the decks of their vessels and referred to as an "incidental catch" would be a variety of sharks, such as "dogfish (pin-back sharks)", "sleeper" sharks" and an occasional

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[3] On rare occasions, D'Amato will land a live catch of Longspine thornyhead, but their choice targets are Sablefish and Shortspine thornyhead.

[4] The paper of Dr. James Hastie, cited above, notes on p.5 a limit on Observer data collected from non-tier fishing for sablefish, that is, "the fishery conducted under daily/weekly options".

[5] The terms "total catch", "incidental catch", and "landed catch" are defined in p.1-8, DEIS 2/15/04

[6] See: p. 1-3, DEIS 2/15/04.

[7] See: p. 1-6, DEIS 2/15/04

Dover sole. [8] These sharks and the Dover sole are thrown back into the ocean alive. Again, in making this claim of a very low incidental catch, D'Amato is confident of support from the records of the NMFS Observers.

D'Amato contends that the fixed longline gear they use to catch Sablefish and Shortspine thornyhead does not produce a bycatch resulting from "GHOST FISHING" as that term is used in the DEIS. D'Amato does not believe that the use of this fixed or anchored longline gear should be identified with trawl gear causing a bycatch resulting from "the stress of capture and physiological injuries" .as reported by the studies referred to in the DEIS concerning trawl gear. Should the D'Amato fail- none has occurred to date- to raise their longline gear which has its ends attached with buoys and anchors: the hooks used by D'Amato's are degradable and it is also reasonable to assume that hooks without bait do not catch fish on the ocean floor in depths greater than 250 fathoms. For these reasons, D'Amato contends that the possibility of "GHOST FISHING" in their fishery is very remote and unrealistic.

The DEIS notes that the term "fish" has a broader meaning for "most fishery managers" than commercial fishermen like D'Amato. [9] Even using the sometime use of the "broader meaning", D'Amato contends that the reports of the NMFS Observers will support their contention that no marine mammals, and seabirds are caught incidentally in the D'Amato Fishery. Further, that in the D'Amato Fishery, the sharks, Pacific Whiting, and Dover sole were returned by D'Amato are returned to the ocean alive and well, and that the number of these incidents and the quantities involved are statistically insignificant.

For the above reasons, D'Amato questions the need for the proposed action as it applies to the D'Amato Fishery.

D'Amato and Kingfisher have accommodated to the current conservation and management measures as they apply to the D'Amato Fishery. The record shows that they accomplish "to the extent practicable (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." [10] The incidental bycatch experienced by D'Amato Fishery is already zero as it relates to eight of the nine overfished species. The incidental catch in the D'Amato Fishery of the overfished Pacific Whiting is statistically inconsequential as well as extremely rare; therefore, such bycatch mortality has been minimized "to the extent practicable. The reported unavoidable bycatch of sharks and dover sole in the D'Amato Fishery do not involve mortality. Therefore, the existing groundfish fishery management plan , and regulations promulgated to implement such plan is "consistent" with national standard 9 as applied to the D'Amato fishery.

If the D'Amato Fishery becomes subject to a combination of measures proposed in Alternatives 4, 5, and 6 as substitutes to the current conservation and management measures on the ground that they significantly reduce bycatch in other fisheries if not in the D'Amato fishery, then D'Amato will unfairly experience new operating costs and burdens that will not be offset by an increase in the quantity and value of Sablefish and Shortspine thornyhead landings, thereby causing D'Amato to seek other fisheries that are economically sustainable or terminate their fishing operation completely. Should D'Amato take either of these options, then Kingfisher

[8] "Unlike most rockfish, sablefish do not have swim bladders that explode when the fish are retrieved rapidly from great depth. Consequently, if handled properly, discarded sablefish can experience high rates of survival (Olla, et al., 1998)." *Supra*, Dr. James Hastie, p.1.

[9] See: p. 1-5, DEIS 2/15/04

[10] Section 301(a) (9). Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1851(a)(9). See Also: p.1-1, DEIS 2/15/04

would most probably be forced to seek more foreign producers of live Sablefish and Shortspine thornyhead to offset his loss of domestic supply from D'Amato.

Comments: Council Preferred Alternative 7:

D'Amato and Kingfisher note that the Council has adopted a new alternative as their preferred alternative, labeled Alternative 7. The Council reports that "Alternative 7 incorporates elements from Alternative 1 (current measures), Alternative 4 (bycatch caps), and Alternative 5 (individual fishing quotas)."

D'Amato and Kingfisher are concerned that Alternative 7, in making efforts to comply with National Standard 9 of the Magnuson-Stevens Act and with the rulings in the PMCC case may result in the allocation of the OYs for Sablefish and Shortspine thornyhead that will be substantially harmful to the economic viability of the D'Amato Fishery.

D'Amato is concerned that the imposition of bycatch caps and Individual fishing quotas will necessitate the placement of full-time Observers aboard their small vessels as a condition of economic survival. [11] This means a significant increase in their operational costs and operating burdens.

> We note the coverage on this Full-time Observer issue in discussing Alternative 4, at pages 4-197-198, and in discussing Alternative 5, at pages 4-208-209. This coverage is primarily concerned about the substantial bycatch issues related to trawl gear. The DEIS does not provide the decision makers and the interested public with an adequate information or even discussion on what should be done with fisheries like that of the D'Amato Fishery wherein the existing FMP and implementing regulations have resulted in bycatch reduction "to the extent practicable".

On the bycatch caps issue: Currently, nine fishery sectors are identified by the DEIS. For the purpose of reducing bycatch, the DEIS suggests that additional sectors could be established by subdividing any of the existing nine sectors. [12] This would permit partial observer coverage for the D'Amato Fishery. However, the DEIS suggests that if vessels arrange full-time observers, they should be rewarded with larger trip limits or other forms of catch advantages. [13] This could mean larger allocations of Sablefish and Shortspine thornyhead as consideration for such full-time Observer vessels and smaller allocations to the D'Amato Fishery types. D'Amato cannot afford full-time Observers on their vessels. Continuous Observers on vessels of less than 26 feet in length create accommodation problems for both Observer and Operator. The live-fish trade in Sablefish and Shortspine thornyheads is based on a low volume and high value fishery product, using vessels with low operating and maintenance costs and no crew cost. Further, the trade needs the timely landing of the catch to coincide with demand throughout the calendar year, thereby enhancing revenue opportunities. Therefore, the concern that the imposition of rules that reward vessel operators who arrange full-time Observers means the high probability of no annual allocations or reduced annual allocations of the O Ys for Sablefish and Shortspine thornyheads for the D'Amato Fishery. This uncertainty of access to the live-fish resource would result in making the D'Amato Fishery an unreliable supply source for Kingfisher.

To further illustrate the concerns of D'Amato and Kingfisher: Under a proposal requiring bycatch caps and individual fishing quotas, we see the probability of a rule that the

[11] See: IFQs, p.2-13, DEIS 2/15/04; Bycatch caps, p. 2-11, DEIS 2/15/04
[12] See: p. 2-9, DEIS 2/15/04
[13] See: pp. 2-9, 2-10, 2-11, and in particular p. 2-12, DEIS 2/15/04

allocates the Sablefish OY under conditions that would eliminate the live-fish fishery conducted for Sablefish under daily/weekly trip limit provisions by holders of permits that are not Sablefish-endorsed. There are about 225 permits limited-entry fixed gear permits, of which 164 are "Sablefish -endorsed" Sablefish-endorsed permits provide the permit holder with an annual share of the Sablefish allocated to the primary fishery for fixed gear permits. Sablefish-endorsed permits are assigned to one of three tiers . . . Each year, these shares are translated into amounts of poundage, or "tier limits", which may be caught during the primary fishery. For the 2003 season, these shares translated into tier limits of 53,000 for Tier 1, 24,000 for Tier 2, and 14,000 for Tier 3." [14] Under Alternative 7, the establishment of individual catch quotas require the elimination of trip limits as a tool to reduce bycatch. [15] This would result in establishing quotas only for individuals who had permits Sablefish-endorsed. This is probable because holders who do not have Sablefish-endorsed permits do not "share" the Sablefish allocated to fixed-gear permits. Thus, in a live-fish fishery that has no significant discards of overfished species, Alternative 7 could be constructed to eliminate the current live-fish fishery for Sablefish for the D'Amato Fishery. We note that the DEIS does not comment on this probable impact.

D'Amato and Kingfisher contend that the D'Amato Fishery does use a fishery method that is "rarely selective enough to catch only the most desirable species." [16] The value of the live-fish fishery is noted by the DEIS: "While non-trawl vessels took only 2% of the coastwide groundfish harvest by weight, their harvest accounted for about 25% of the exvessel value **due to the prevalence of relatively high value sablefish and live fish landed in this fishery."** (emphasis added) [17]

D'Amato and Kingfisher questions the completeness of the DEIS. The DEIS does not provide information on those fisheries, who by their compliance with the Groundfish FMP and implementing federal regulations, make the FMP and implementing regulations consistent with National Standard 9. [18] For reasons stated above, the D'Amato and Kingfisher contend that the D'Amato Fishery is such a fishery. The DEIS fails to declare that if such fisheries do exist, then a universal application of new conservation and measures based on Alternatives 4 and 5 to all fisheries should nor should not be required. The DEIS makes no provision for providing that fisheries such as D'Amato need a different arrangement than proposed in the Alternatives.

D'Amato and Kingfisher do not understand why the DEIS assumes that their very selective fishing gear activity is identical to or the equivalent of non-selective fishing gear, i.e. trawl. The DEIS does not inform the decision makers on how gear types vary in their design and application in selective fishing grounds so as "to catch only the most desirable species." Such a failure in identification by the DEIS in Chapter 2 does not permit the decision-makers to make a reasoned and informed decision on the issue of whether the new tools of bycatch caps and individual fishing quotas proposed in Alternative 7 should be imposed on all groundfish fisheries regardless of their bycatch reduction record under the existing FMP and regulations.

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14 **Supra**, Dr. James Hastie, p.1

15 See: p. E. S.-9, DEIS 2/15/04 : "Alternative 5 would establish a "rights -based program of individual fishing quotas. . . Reaching any quota would require the vessel to stop fishing until it obtained additional quota . . .Administration costs . . . would increase substantially. This would be partially offset by a reduced preseason process for developing trip limits and other management measures; the process of inseason trip limit adjustments would no longer be needed. . . .Social and economic conditions would be significantly affected; some changes would be beneficial, some would be adverse, depending on the individual and the quota program design.

16 See: p. 1-9, DEIS 2/15/04

17 See: p. 3-65, DEIS 2/15/04

18 See: Section 301(a), Magnuson-Stevens Fishery Conservation and Management Act.

D'Amato and Kingfisher propose that if a groundfish fishery subject to the existing FMP and implementing regulations has a bycatch record equal to better than the D'Amato Fishery, then they should be afforded with exemptions from the costs and burdens required by Alternatives 4, 5, and 7 on fisheries that do not have such a bycatch record, e.g. exemption from full-time or expanded observer coverage and reimbursement of costs for random Observer coverage. Further, that these fisheries should be benefited by the Council for this bycatch record if and when the Council considers an initial distribution of quota shares required by Alternative 5 or Alternative 7, that the formula take into consideration this bycatch record as part of the catch history. By having this "to the extent practicable" bycatch reduction record, these D'Amato Fishery types allow the Council to claim that the existing Groundfish FMP and implementing regulations, as they apply to these fisheries, are consistent with National Standard 9 of the Magnuson-Stevens Act.

Thank you for the opportunity to submit these comments and for the cooperation of your Sstaff Members located in Portland.

Sincerely,

August Felando

cc: D'Amato and Kingfisher

PACIFIC FISHERY MANAGEMENT COUNCIL
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April 27, 2004

Mr. Robert Lohn, Regional Administrator
National Marine Fisheries Service, Northwest Region
Building 1, BIN C15700
7600 Sand Point Way NE
Seattle, WA 98115-0070

RE: The Pacific Coast Fishery Management Plan Bycatch Mitigation Draft Programmatic Environmental Impact Statement

Dear Mr. Lohn:

At its April 5-9, 2004, meeting in Sacramento, California, the Pacific Fishery Management Council (Council) reviewed the Pacific Coast Fishery Management Plan (FMP) Bycatch Mitigation Draft Programmatic Environmental Impact Statement (DPEIS) released on February 20, 2004, and identified its preferred alternative for NMFS to incorporate into the EIS. This would be identified as Alternative 7 in the Final Programmatic EIS (FPEIS) and would contain elements of several alternatives described in the DPEIS. The Council approved the following motion describing the recommended preferred alternative:

> Create a new Alternative 7 that includes elements of Alternatives 1, 4, and 5. Elements from Alternative 1 that would be included in Alternative 7 would be all current programs for bycatch minimization and management, including but not limited to: setting optimum yield specifications, gear restrictions, area closures, variable trip and bag limits, season closures, establishing landings limits for target species based on co-occurrence ratios with overfished stocks, etc. The FMP would be amended to more fully describe our standardized reporting methodology program and to require the use of bycatch management measures indicated under Alternative1 for the protection of overfished and depleted groundfish stocks and to reduce bycatch and bycatch mortality to the extent practicable. These would be used until replaced by better tools as they are developed.
>
> Elements from Alternative 4 that would be included in Alternative 7 would be the development and adoption of sector-specific caps for overfished and depleted groundfish species where practicable. We anticipate phasing in sector bycatch caps that would include: monitoring standards, full retention programs, and individual vessel incentives for exemption from caps.

Elements of Alternative 5 that would be included in Alternative 7 would be the support of future use of Individual Fishing Quota programs for appropriate sectors of the fishery. The FMP would incorporate the Strategic Plan's goal of reducing overcapacity in all commercial fisheries.

Additionally, baseline accounting of bycatch by sector shall be established for the purpose of establishing future bycatch program goals.

Consistent with our recommendation, we ask the EIS project team to further describe Alternative 7 as necessary for the purpose of making it consonant with the descriptions of the other alternatives and to support sufficient analysis of its impacts on the human environment, but to not change matters of intent substance.

After this action is finalized, the Council will consider undertaking preparation of a new groundfish FMP amendment consistent with the findings in the FPEIS. We look forward to working with NMFS after the release of the FPEIS to implement the policies and program direction described by the preferred alternative.

Sincerely,

D. O. McIsaac, Ph.D.
Executive Director

KRD:rdd

Subject: **Comments of the Pacific Coast Groundfish Draft Programmatic EIS]**
Date: Tue, 27 Apr 2004 16:04:31 -0700
From: "Bycatch.nwr" <Bycatch.nwr@noaa.gov> Internal
To: Yvonne deReynier <Yvonne.deReynier@noaa.gov>, Elizabeth Mitchell <Elizabeth.Mitchell@noaa.gov>
CC: Eileen Cooney <Eileen.Cooney@noaa.gov>

Comments from Peter Huhtala

Subject: **Comments of the Pacific Coast Groundfish Draft Programmatic EIS**
Date: Mon, 26 Apr 2004 11:34:44 -0700
From: "Peter Huhtala" <peter@pmcc.org>
To: <bycatch.nwr@noaa.gov>

Dear Jim,

I know that you've been working to find a way to quantify bycatch in the recreational groundfish fisheries, at least in order to attempt to develop a baseline of current discard levels. An important adjunct to this effort, in my view, is to assess the **adequacy** of recreational monitoring systems now in place as standardized bycatch reporting methodologies. The follow-up analysis to this examination of adequacy would be to look at the practicability of various means of improving recreational accounting. Such an analysis could prove very useful in informing the debate over the recreational data collected and provided to management by the state of California, for example.

While analyzing the adequacy of current systems, and the practicability of improvements, I believe that it is also important to address how recreational accounting systems meet, or could meet, objectives established for the Bycatch Program EIS, including:

- account for total fishing mortality by species
- establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits
- monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly
- gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches.

Thank you for considering this very important aspect of improving this EIS.

Sincerely,

Peter Huhtala
Senior Policy Director
Pacific Marine Conservation Council
PO Box 59
Astoria, Oregon 97103
(503) 325-8188

Pacific Marine Conservation Council | NRDC The Earth's Best Defense | The Ocean Conservancy | OCEANA

April 27, 2004

Mr. D. Robert Lohn
Regional Administrator
NMFS Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115-0070

RE: Comments on the Pacific Coast Groundfish Bycatch Draft Programmatic EIS

Dear ~~Administrator Lohn~~ Bob:

This letter transmits our comments and attachments on the above-referenced document. Thank you for the opportunity to comment. Do not hesitate to contact us if you have any questions.

Sincerely,

Karen Garrison

Karen Garrison NRDC	Peter Huhtala PMCC
Jim Ayres Oceana	Chris Dorsett Ocean Conservancy

cc: Susan Kennedy
Dr. Don McIsaac
Jim Glock

Comments of the
Natural Resources Defense Council
Pacific Marine Conservation Council
Oceana
The Ocean Conservancy

on the
Pacific Coast Groundfish Bycatch Management
Draft Programmatic Environmental Impact Statement

The organizations above submit these comments concerning the Draft Programmatic Environmental Impact Statement for Pacific Coast Groundfish Bycatch Mitigation Program ("DEIS") for consideration by the National Marine Fisheries Service ("NMFS").

While this DEIS is an improvement when compared to previous National Environmental Policy Act analyses for the groundfish fishery, several key flaws remain. In particular, the conversion of this EIS from one intended to take a programmatic look at the groundfish Fishery Management Plan as a whole, to one intended to remedy NMFS's bycatch failures in particular, has resulted in a document that accomplishes neither purpose adequately. The first two sections of these comments provide examples of the National Environmental Policy Act and Magnuson-Stevens Act violations. The last section discusses the preferred alternative.

National Environmental Policy Act

The National Environmental Policy Act ("NEPA") requires that federal agencies prepare environmental impact statements ("EISs") for major federal actions significantly affecting the quality of the human environment. Fishery Management Plans and the ongoing fisheries that they regulate are major federal actions requiring the preparation of Plan-level EISs. The agency originally framed the DEIS as a programmatic EIS, intended to examine the effects of implementation for the Fishery Management Plan as a whole.

In response to a court ruling that the Pacific Region's bycatch program is illegal, *Pacific Marine Conservation Council v. Evans*, 200 F. Supp. 2d 1194 (N.D. Calif. 2002), the agency converted the EIS from a programmatic one to one focused on bycatch. The focus on bycatch was intended to bring the Pacific bycatch program into compliance with the Magnuson-Stevens Fishery Conservation and Management Act ("MSA"). Accordingly, this DEIS is no longer intended to be a Plan-level EIS. Unless and until NMFS completes a legally adequate assessment of the direct, indirect, combined and cumulative effects of the groundfish fisheries as a whole, the agency will not meet its legal obligations under NEPA.

Notwithstanding the lack of an overarching FMP-level analysis, this DEIS also fails to meet NEPA's requirements as a bycatch-focused EIS. In particular, it is unduly vague, omits disclosure and analysis of relevant information, and is not designed to result in prompt action via the immediate fishery management plan amendment necessary to cure the ongoing violation of the MSA. While we have substantial additional comments, the extremely general nature of the DEIS is our overriding concern and must be remedied.

NEPA Background

NEPA is the "basic national charter for protection of the environment." 40 C.F.R. § 1500.1(a). Its goal is "to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment." Id. § 1500.1(c). To meet this purpose, NEPA requires that agencies prepare an environmental impact statement (EIS) for all "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C). An EIS "is more than a disclosure document" and is to "be used by Federal officials in conjunction with other relevant material to plan actions and make decisions." 40 C.F.R. § 1502.1. It is, therefore, "an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal Government." Id.

NMFS Must Prepare a Programmatic EIS

NEPA requires that an EIS be prepared for major federal actions, including the "[a]doption of formal plans, such as official documents prepared or approved by federal agencies which guide or prescribe alternative uses of Federal resources, upon which future agency actions will be based." Id. § 1508.18(b)(2); see also § 1502.4(b) ("Environmental impact statements may be prepared, and are sometimes required, for broad Federal actions such as the adoption of new agency programs or regulations."). For those types of federal actions, the agency is required to produce a "programmatic environmental impact statement" evaluating the broad implications of the proposed policy or program changes. The continued management of the Pacific groundfish fishery is such a broad agency action, and must be evaluated in a fishery management plan-level EIS. This EIS is no longer intended to accomplish this purpose, and at present, NMFS has no apparent plans to prepare a plan-level EIS. This NEPA defect must be remedied as quickly as possible.

The Bycatch DEIS is Missing Basic Information, Including Analysis of Current Bycatch Levels

Notwithstanding whether it evaluates a broad federal program or more discrete action, an EIS must fully and fairly evaluate the direct, indirect and cumulative effects of the proposed action and its alternatives. 40 C.F.R. § 1502.16. At the foundation of this analysis is the disclosure and discussion of all relevant information. Consideration of all relevant information is so important to successful EISs that federal agencies are required to go through a specific process when information is incomplete or unavailable. 40 C.F.R. § 1502.22. This DEIS fails to provide the public and the decisionmaker with the information necessary to make an informed and rational decision about bycatch minimization in the Pacific.

The most fundamental information necessary to assess bycatch avoidance and minimization measures is species-specific information on current bycatch and discard amounts by fishing sector. Some of this information is available or could be assembled from available sources (see *Modeling Bycatch and Discard in the Limited-entry Trawl Fishery* prepared by Dr. James Hastie (March 2004), and Appendix B, the Report of the 2002 West Coast Groundfish Observer Program (WCGOP) (January 2003)), but the DEIS fails to present and analyze the relevant information in a form that makes it accessible to decision makers. The Pacific Fishery Management Council's Scientific and Statistical Committee echoed this concern in its April 2004 statement: "...the PEIS does not currently contain information on current bycatch and discard amounts, though such information is available. The SSC recommends that future work estimate ranges of bycatch reduction, relative to the status quo, for each of the alternatives to better inform decision-making." This flaw alone is fatal to the DEIS and must be remedied prior to the Final EIS.

The Bycatch DEIS Analysis is Deficient

In addition to omitting fundamental information, the analysis in the DEIS is too vague to result in rational, informed decision-making. For example, in the discussion of the data reporting effects of Alternative 4, the DEIS notes that controls imposed under the alternative:

> would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Discard may also be reduced in the commercial fishery compared to the first three alternatives as fishers are more likely to retain catches of all usable fish, including overfished species.

DEIS at 4-118. While the DEIS assigns Alternative 4 a rank of 2-3 (out of 5, with 1 being the highest ranking) under this section, the document should contain a more concrete discussion of the magnitude of the effect of the bycatch reduction (see SSC comments above). Can the effect be modeled to produce a quantitative estimate, or at least a range of anticipated effects? Without more specific information, it will be difficult for the Council and NMFS to determine which bycatch reduction measures are practicable and, thus, legally required.

Similarly, in the discussion of the effects of gear restrictions under Alternative 4, the DEIS outlines various gear issues such as escape panels in fish traps and fish excluder devices, DEIS at 4-116, but does not explain why it mentions these modifications or what the effects would be if they were or were not adopted.

The DEIS systematically downplays the potentially beneficial effects of Alternative 4. For example, in Table ES.6(b), the DEIS states that there is no direct, indirect, or cumulative effect of Alternative 4 on ecosystem or biodiversity. Yet Alternative 4 would be expected to reduce bycatch, thereby increasing abundance of particular species and improving rebuilding outlooks, clearly with resulting positive impacts on the ecosystem and biodiversity.

Similarly, sector catch limits would provide incentives to fishing industry participants to avoid bycatch, which would have the effect of reducing regulatory bycatch. DEIS Table 4.1.1. In Table 4.1.2, the DEIS suggests that sector allocations or catch limits would have no effect on abundance (presumably of fish species in the Pacific), even though, again, reducing bycatch should improve abundance, particularly in cases where excess bycatch has led to overharvests of overfished species like bocaccio. (Table 4.1.2 also makes no mention of the potential socioeconomic impacts of sector allocations, catch limits and individual quotas, although these tools would almost certainly have such impacts.) Table 4.1.3 likewise indicates that sector allocations would have only a minor indirect effect (as far as one can determine despite the extremely small and hard-to-read type in this table) on reducing regulatory bycatch of overfished species, which seems implausible. Elsewhere, the DEIS asserts that "[i]ndividual vessels may not have as strong of an incentive to avoid overfished species as in Alternatives 5 and 6." DEIS at 4-115. This statement suffers from the generality common to the document; the reader is left to surmise its basis and the magnitude of any such effect.

One reason the discussion of impacts of the alternatives is deficient is because it fails to connect the alternatives to the statutory goals that the agency must meet. None of the alternatives includes a discussion of specific bycatch performance standards and results associated with each bycatch minimization tool. An alternative involving hard bycatch caps and rockfish conservation areas is rendered meaningful only when analysis of the alternative addresses how much bycatch reduction will be sought and achieved from implementation. Moreover, clear goals and criteria (more generally, performance standards) help encourage more selective gear and practices and a more efficient fishery.

Performance standards are a set of goals, criteria and indicators used to identify a target and measure progress toward meeting it. An example of goals, in this case, are those set by the MSA, to minimize bycatch and, to the extent bycatch cannot be avoided, minimize the mortality of bycatch. "Criteria" refers to specific means of assessing whether management goals and objectives are being met. "Indicators" include numeric or qualitative targets for reducing various types of bycatch, e.g. reduction of bycatch amounts by a certain percent. The analysis of the alternatives should include a discussion of the role of bycatch performance standards in making sure a set of measures accomplishes its purpose. The preferred alternative acknowledges the need for the bycatch reduction program to include such goals by stating that "[b]aseline accounting of bycatch by sector shall be established for the purpose of establishing future bycatch program goals,"[1] but the DEIS provides no discussion or analysis that would assist the Council and NMFS in setting them.

Further, the discussion of the economic impact of alternative 4 contains virtually no numerical estimates of any costs of the alternative (except for an estimate of the budget

[1] 4/7/04 Draft Proposal for a Preferred Alternative for the Groundfish Bycatch PEIS, Exhibit C.13.b, April 2004 Council meeting, as amended

for observers). See DEIS 4-195 to 4-204. Nor does the document set forth even a range of costs or comparison of costs with the other alternatives. As with other issues, the discussion remains at a very general level. For example, the DEIS states that yellowtail rockfish and other healthy stocks could be more accessible if sector bycatch reduction efforts were successful, DEIS at 4-197, although a free rider problem could inhibit bycatch reduction if sectors are too large and/or there is no pressure from within the group to hold down bycatch and keep the sector open, DEIS at 4-196. The DEIS should address whether the proposed sectors are too large or lack necessary safeguards so that free riders may decrease incentives to reduce bycatch and specify the magnitude of the economic benefits that could result if the incentives are successful. The SSC highlights this problem also: "the need for quantitative information about respective costs and other practicalities under each of the alternatives is needed for the Council to make an informed choice among alternatives."

To the extent relevant information is incomplete or unavailable, the Fisheries Service must comply with the disclosure and analytical requirements of NEPA's implementing regulations. 40 C.F.R. § 1502.22. Failure to do so denies the public and decisionmaker the analysis necessary to make an informed decision and constitutes a violation of NEPA.

The DEIS must analyze impacts on habitat-forming species

The MSA regulates all "forms of marine animal and plant life other than marine mammals and birds," 16 U.S.C. § 1802(12), a definition that includes species such as coldwater corals, sponges and anemones that provide structure and habitat. The DEIS mentions these "miscellaneous species" in a paragraph in the "affected environment" section (p. 3-38) but does not include even a qualitative discussion on effects of various alternatives on these species. There exist several sources of information on the presence of these species in waters that are trawled, including observer data, trawl survey data, and data from ocean explorations. Given that many corals, sponges and anemones are generally slow growing and stationary, measures such as areas closed to bottom trawling may be more effective than other strategies for minimizing their bycatch. The DEIS must analyze fully the bycatch issues presented by these species.

The specific examples we have discussed above are illustrative of a wider failure by the DEIS to fully analyze the environmental consequences of the proposed action. Without substantially improving its analysis, this EIS will not provide the public, the agency, or the Council with the tools and information necessary to ensure that bycatch and bycatch mortality are minimized to the extent practicable.

Magnuson-Stevens Act

Any fishery management plan and any regulation promulgated to implement an FMP must be consistent with the ten national standards specified in the MSA. National Standard 9 requires that:

> Conservation measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

16 U.S.C. 1851(a)(9). The Act further requires that Fishery Management Plans must:

> establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority – (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided.

16 U.S.C. 1853(a)(11). Congress required these legal obligations to be met by October 1998.

DEIS inaccurately suggests the status quo complies with Magnuson-Stevens Act

Previous attempts in the Pacific Region to comply with these mandates have failed. See *Pacific Marine Conservation Council v. Evans*, 200 F. Supp. 2d 1194 (N.D. Calif. 2002) ("PMCC"). The federal court decision in *PMCC* rejected Amendment 13 to the groundfish Fishery Management Plan because, among other things, it failed to include an adequate assessment methodology and failed to minimize bycatch and bycatch mortality. The DEIS acknowledges that action is needed to reduce bycatch and collect appropriate information, DEIS at 1-1, citing the *PMCC* holding that the current system "failed to establish a standardized reporting methodology" and "failed to minimize bycatch and bycatch mortality because it failed to include all practicable management measures in the FMP itself." Further, the DEIS notes that the current structure allows for overfishing in some cases (DEIS at 4-73 n.5). As the document states, "[o]verall, the current bycatch program provides little individual bycatch accountability or opportunity or incentives for individuals to reduce bycatch." DEIS at 1-12. See also DEIS at 2-19 ("The current [bycatch monitoring] program minimizes user and agency costs of monitoring catch and bycatch at the expense of precision and timeliness").

Yet elsewhere the DEIS suggests that the status quo alternative may comply with the Magnuson-Stevens Act. See DEIS at 5-19, 5-13. This suggestion is wrong, and is very misleading to the public and the decisionmaker. The DEIS must acknowledge that the status quo violates the MSA. Inasmuch as Alternative 1 is illegal, the DEIS must point out that only alternatives that offer a substantial improvement over that alternative are legal. Thus, for example, Alternatives 2 and 3, which the summary chart on page 2-19 indicate have only "insubstantial" improvements in bycatch reduction and monitoring, would appear to continue to violate the MSA.

The DEIS must evaluate the adequacy of the standardized reporting methodology for assessing the amount and type of bycatch occurring in the groundfish fishery

A fundamental flaw of the current DEIS, under both the MSA and NEPA, is the failure to review current bycatch reporting methodologies and bycatch types and amounts in the various sectors of the groundfish fishery. While the DEIS contains a general discussion of data reporting, monitoring and reporting requirements[2] and includes the report of the 2002 West Coast Groundfish Observer Program (WCGOP) as Appendix B, it provides neither an analysis of current reporting methodologies and their effectiveness, nor estimates of the amount and type of bycatch by sector of groundfish or other species. Furthermore, information on bycatch or bycatch assessment methodologies included in other reports is not included here (for example see *Modeling Bycatch and Discard in the Limited-entry Trawl Fishery,* James Hastie, March 2004, and NMFS's report *Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs,* Powers, 2003[3]).

Appropriate goals of bias, precision and accuracy for the observer program must be identified and the program analyzed for adequacy relative to these goals, consistent with the fishery management tools proposed in the DEIS.In addition, the alternatives analysis should identify changes that would be needed in bycatch reporting methodologies to implement the alternative. Observer data is currently not tabulated during the season but is compiled in annual summaries – after being matched with the logbook information. A different system will be needed for "real-time" data collection, which would be required in some sectors for certain alternatives including the preferred alternative. Because the observer program relies on comparisons with logbook and fish ticket data for analyses, the state data-gathering programs may also need to be analyzed for necessary changes.

We urge NMFS to undertake a comprehensive review of current reporting methodologies as well as current bycatch information for each sector of the groundfish fishery. Without this analysis the DEIS will fail in its primary role of facilitating an informed decision based on an understanding of environmental impacts and the requirements of the MSA. We briefly discuss the information gaps in the DEIS for each sector below.

<u>Commercial Fishing Vessels</u>

Section 3.4.2 of the DEIS provides a general description of the commercial groundfish fishery including their range, target species, landings and revenues. However, no information is given regarding known bycatch species and amounts or current reporting methodologies to acquire this information.

<u>Limited-Entry Trawl Fisheries</u>. Section 3.4.2.1 of the DEIS describes the limited entry groundfish trawl fishery and the at-sea and shoreside whiting fisheries. Unfortunately, no bycatch information is given in this section despite available information on both reporting methodologies for these fisheries and estimates of the amount and type of bycatch occurring in the fishery.

[2] See section 4.1.4 of the EIS

[3] The Powers report, available on NMFS website, is hereby incorporated by reference.

For limited-entry non-whiting trawl fisheries, the DEIS includes a brief discussion of the WCGOP in section 3.4.9 and includes the 2003 WCGOP Report as Appendix B. The methodologies described in this document, when combined with analysis of fleet logbooks and fish tickets to quantify effort, provide information on bycatch of twenty-three species observed by the program. The DEIS should provide estimates of bycatch for these species and note limitations of the current observer program, if any, in identifying and quantifying all bycatch, not just those species that are overfished or commercially or recreationally valuable, taken in this fishery. The DEIS should also reference the Powers report which provides an analysis of the limited-entry trawl fishery, noting that the current WCGOP is classified as a "developing" reporting system and that the bycatch rank is considered "high" in terms of vulnerability of the fishery to fish bycatch.

At-Sea and Shoreside Whiting Fisheries. Again, no bycatch information or description of current bycatch reporting methods besides the general information listed above is present for these fisheries despite available information. According to analysis in the Powers report, the at-sea whiting fishery is a "mature" reporting system while the shoreside fishery has a "pilot" monitoring program. A description of these programs and limitations, if any, of accounting for all bycatch in the fishery should be included in this section. Furthermore, table 3.5.2-18 from the 2004 Groundfish Annual specifications EIS,[4] includes bycatch in the whiting fishery from 1998-2003 for overfished groundfish species. This information must be included in the EIS to allow reasoned decision-making.

Limited-Entry Fixed Gear Fisheries. Section 3.4.2.2 of the DEIS describes target species, vessel participation, landings and revenue amounts for the fixed gear (longlines and traps) groundfish fishery. This sector of the groundfish fishery is also monitored by the WCGOP as of 2003. Available information from observed bycatch must be presented in the DEIS including limitations, if any, of the program in assessing the amount and type of all bycatch occurring in these fisheries. The Powers report ranks non-trawl gear "high" in terms of vulnerability of the fishery to fish bycatch and classifies the current reporting system as "developing."

Open-Access Directed Groundfish Fishery. Section 3.4.2.3 of the DEIS estimates the number of vessels without limited-entry permits that land groundfish including participation over time. However, no information is presented describing estimates of bycatch amounts and type in these fisheries and current methodologies for assessing bycatch. If no information is available the DEIS should state as much, discuss the impacts of this information gap, and describe options for filling it.

Recreational Fishing

Section 3.4.3 of the DEIS describes estimated recreational fishing effort on the West Coast. It fails to provide any estimates of the amount and type of bycatch occurring in

[4] Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2004 Pacific Coast Groundfish Fishery, Draft Environmental Impact Statement. October 2003.

the fishery or the current reporting methodology for bycatch despite available information. Recreational effort and catch is currently monitored by the states of California, Oregon and Washington. These monitoring programs include estimates of landed catch and fish that are released (bycatch). Current monitoring programs should be described in the EIS including limitations, if any, in reporting accurate bycatch information by type and amount and steps needed to fill reporting gaps. The DEIS should utilize what information exists from Fisheries of the United States-2002[5], which details data collection and catch and bycatch amounts for recreational fisheries on the West Coast, and other sources.

Tribal Fisheries

Section 3.4.4 of the DEIS provides a description of tribal groundfish fisheries, including information on landings and revenue. Again, no information is presented regarding bycatch, bycatch-reporting methodologies for these fisheries, their limitations, or steps needed to fill the gaps.

Other Fisheries That Affect Groundfish

Section 3.4.10 of the DEIS describes open-access non-groundfish fisheries that may take groundfish as bycatch. However, the description is limited to a brief characterization of the fishery. No information is included on the amount or type of groundfish bycatch, current reporting systems and their limitations for collecting information on bycatch, or additional steps needed to quantify bycatch of groundfish in these fisheries.

The DEIS fails to provide adequate information to determine which measures are practicable

With respect to compliance with National Standard 9, the DEIS should note that the MSA requires that practicable bycatch reduction measures be implemented. Except insofar as two alternatives provide the same benefits with respect to bycatch reduction, practicability is not "part of" (DEIS at ES-10) the decision. The Council and NMFS cannot reject a practicable bycatch alternative because it does not "provide the optimal balance" (DEIS at 1-21) between costs and benefits. Instead, the MSA requires that regulators implement all practicable means of reducing bycatch – period. This legal requirement attached in 1998, not at the conclusion of a follow-on NEPA process tiered to this "programmatic" DEIS.

In rejecting Amendment 13, the court specifically criticized the Amendment because it "ignored the fact that overfished Pacific groundfish species need protection from excessive bycatch now, not at some undetermined time in the future." Years later, these legal mandates have yet to be met, and this DEIS does not provide adequate information to allow the agency to immediately implement all practicable bycatch minimization measures. The DEIS must be improved to provide the necessary information to decisionmakers and the public to determine which bycatch reduction measures are

[5] Fisheries of the United States 2002. National Marine Fisheries Service. September 2003.

practicable. Such measures must be evaluated by the agency and be implemented through FMP amendments at the conclusion of the NEPA process. A "programmatic" and non-specific evaluation resulting in future NEPA process complies with neither NEPA nor MSA, serves neither the public nor the decisionmaker, and disserves the fish and those who rely upon them. The DEIS must provide sufficient information about the environmental and related socio-economic effects of the alternatives to enable NMFS to make a practicability determination about each technique in the record of decision on the DEIS. Because the DEIS fails to provide this necessary information, it violates the requirements of NEPA.

The Preferred Alternative

We are pleased that the preferred alternative adopted by the Council at its April 2004 meeting, as we understand it, appears to contain elements of an adequate program. However, additional analysis of the adequacy of the bycatch reporting methodology and the steps needed to make it more complete and useful is essential. Likewise, identification of bycatch amounts and type by sector is necessary to allow NMFS and the Council to identify priorities, goals, and detailed measures to implement a bycatch reduction program. Lacking those details, we provide brief general comments to supplement our recommendations prior to the April Council meeting regarding the preferred alterative (attached).

The Preferred Alternative Must Include an Adequate Reporting Methodology

The preferred alternative must establish a comprehensive bycatch reporting methodology that measures the amount and type of bycatch consistent with the criteria in the Powers and Pikitch[6] reports, as opposed to simply continuing the status quo or better describing the current reporting methodology. Where data on the amount and type of bycatch are available, they should be included in the DEIS. The gaps in the data, and the additional requirements imposed by the measures to be applied under the preferred alternative, such as more real-time accounting for bycatch in sectors with hard bycatch caps, should help guide the development of a more comprehensive and timely reporting methodology. The Powers and Pikitch reports provide guidance for the development of sector-based reporting methodologies and priority setting based on bycatch threat and other factors. A timeline must then be developed for establishment of a reporting methodology for each sector.

The Preferred Alternative Must Minimize Bycatch to the Extent Practicable

We support a preferred alternative that employs a combination of hard bycatch caps by sector, continued and evolving use of bottom fishing closures and other current tools, and performance standards that set clear goals for bycatch reduction. The preferred alternative should ensure not only that overfishing is prevented and rebuilding is accomplished consistent with the MSA, but also that bycatch of all marine life is reduced and

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[6] Pikitch, Ellen K and Elizabeth A. Babcock. How Much Observer Coverage is Enough to Adequately Estimate Bycatch? This report is hereby incorporated by reference.

minimized. We believe the bycatch reduction program is most likely to succeed if it includes incentives for individuals and groups of fishermen to lower their bycatch rates. Our suggestions for initial sector divisions, incentive programs, and other features of a preferred alternative using hard bycatch caps are described in our previous comments.

Conclusion

As currently drafted, the DEIS is an improvement on previous NEPA documents on Pacific groundfish but falls short of the requirements of NEPA and the MSA. The preferred alternative holds the potential to achieve significant reductions in bycatch, if designed and implemented well, and if modified to include a more complete bycatch reporting methodology. We look forward to working with NMFS to assist in improving the document to facilitate sound management decisions, and help develop an effective bycatch reporting and minimization program.

Exhibit C.13
April 2004

Attachment 1

** Natural Resources Defense Council ** The Ocean Conservancy **
** Oceana ** Pacific Marine Conservation Council **

April 2, 2004

Mr. Don Hansen, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place NE, Suite 200
Portland, OR 97220-1384

Re: Agenda Item C.13: Bycatch Environmental Impact Statement (EIS)

Dear Mr. Hansen:

Please find enclosed a draft proposal for counting and minimizing bycatch in the Pacific groundfish fishery. This draft proposal is a modification of Alternative 4 in the Groundfish Bycatch Environmental Impact Statement (EIS) issued by NOAA Fisheries in February 2004. We ask that the Pacific Fishery Management Council (PFMC) recommend that NOAA Fisheries analyze this modification of Alternative 4 in the final EIS. Furthermore, we ask that the PFMC adopt this option as its preferred alternative.

This proposed alternative (we'll call it 4b) combines sector caps with continued use of spatial management to minimize bycatch. It provides incentives, in the form of a higher trip limit provided from a reserved portion of the optimum yield, to fishermen who want individual caps and will fund their own observer coverage. Furthermore, the proposal details a standardized reporting methodology to assess the amount and type of bycatch in the fishery.

Our proposal focuses on an effective alternative that provides accountability and that can be readily implemented. We thank the PFMC for considering our request and would be happy to answer any questions about our proposal.

Sincerely,

Chris Dorsett
The Ocean Conservancy

Peter Huhtala
Pacific Marine Conservation Council

Karen Garrison
Natural Resources Defense Council

Phil Kline
Oceana

Attachment

Attachment 2

Draft Proposal for Counting and Minimizing Bycatch in the West Coast Groundfish Fishery

March 31, 2004

This proposal to count and minimize bycatch relies on enhanced bycatch observation in the groundfish fishery, the use of bycatch caps for sectors of the groundfish fishery, and the continued use of spatial management to reduce bycatch. The sectors referred to in this document match those currently used in the Council's "bycatch scorecard" and can be further subdivided by area. We propose that a statistically adequate reporting methodology to assess the amount and type of bycatch occurring in each sector of the fishery be established using the criteria contained in "Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs" (Powers Report) and "How Much Observer Coverage is Enough to Adequately Estimate Bycatch" (Pikitch report). Implementation will be phased in over time based on a ranking of need and feasibility consistent with these reports.

Proposed Alternative to Minimize Bycatch in the Groundfish Fishery

The proposed alternative is a modification of Alternative 4 in the Bycatch EIS. This proposed alternative would combine sector caps with continued use of spatial management to minimize bycatch. The groundfish fishery will initially be subdivided into the sectors defined by gear type (limited entry trawl, fixed gear, etc), as used in the bycatch scorecard (attached). These sectors may be further subdivided by the Cape Mendocino line (40-10) into North and South components and by the RCA, into fishing zones seaward and landward of the RCA. Vessel operators who want to fish both seaward and landward of the RCA must provide proof of past fishing in both of these areas using catch history for that vessel over the past three years. Upon further analysis, these sectors may be further subdivided into geographical areas to fit area-based management initiatives.

Caps on total mortality of each overfished species will be established for each sector, and a sector will be closed to fishing upon attainment of any of theses caps. Additional management measures will be employed to ensure that the total mortality of every managed species stays within its OY.

Boats from within a sector can opt out of the sector cap, thereby preserving the opportunity to continue fishing if their sector is shut down, by meeting some established criteria such as funding 100% observer coverage for one's vessel. Upon opting out, a commercial vessel would get individual bycatch caps and incentives such as higher trip limits from a reserved portion of target species OY. This cap would be deducted from that of the vessel's sector. Vessels that opt out of sector allocations can form collectives to pool bycatch quotas amongst collective members. The entire collective is prohibited from further fishing once a collective bycatch cap is met.

Furthermore, vessels are permitted to switch to another sector by changing gear type. Similar to those vessels that opt for individual bycatch caps, bycatch cap amounts will transfer with the vessel to the new sector.

The initial bycatch caps will be for those species identified on the bycatch scorecard (bocaccio, canary rockfish, etc.), and the most current bycatch scorecard will be used to apportion the OY of each species among the sectors. The Council will review bycatch rates for other managed species not contained on the bycatch scorecard. If bycatch rates for these species are higher than an established threshold, a bycatch cap will be set for those species, and gradually reduced over time. As OY levels increase for the capped species, the increase beyond what may be needed as a buffer will be allocated to operators with the lowest bycatch rates among those with individual caps, and through other means that provide incentives for bycatch reduction individually, by sector and within collectives.

For species without set OYs (for example, unassessed species), information will be collected through a standardized reporting methodology for bycatch. After a to-be-determined time period of data collection, a bycatch cap will be established for individual species or species groups if bycatch of any unmanaged species is found to increase or decrease by 10% or more relative to the previous year. After a set number of years (e.g. five) after establishment of a bycatch cap, bycatch would be reduced by some set percentage (10%, for example) per time period through reductions in the caps, while providing incentives for those most successful at avoiding bycatch. In the interim, bycatch of unassessed and other species will be minimized by use of the RCA and additional spatial management measures as needed (for example, on the slope).

Establishing a Standardized Reporting Methodology for Bycatch

A bycatch reporting methodology will be established consistent with the criteria in the Powers and Pikitch reports. Groundfish fishing sectors will be analyzed consistent with these reports within the following categories: (1) status of current reporting methodologies and (2) bycatch interaction (fish, endangered animals and marine mammals). The sectors will then be ranked within the two categories. After consultation with appropriate NMFS and PSMFC staff, decisions will be made as to which sectors should be considered priorities for an enhanced reporting methodology. A timeline will be developed for establishment of this reporting methodology for each sector.

Reference Documents:

Powers report:
Bycatch EIS:
Pikitch report: http://www.oceana.org/uploads/BabcockPikitchGray2003FinalReport.pdf

AR040381
4/9/04

U.S. Department of Homeland Security

United States Coast Guard

Commander
U. S. Coast Guard Pacific Area

Bldg 51-6
Alameda, CA 94501
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16214

APR - 9 2004

United States Department of Commerce
National Oceanic and Atmospheric Administration
Domestic Fisheries Division
Attn: Galen R. Tromble, Chief
National Marine Fisheries
Silver Spring, MD 20910

Dear Mr. Tromble:

Thank you for providing us the opportunity to comment on the *Pacific Coast Groundfish Draft Programmatic Environmental Impact Statement (DPEIS)*. After careful review, we offer no comment, as the changes recommended in this amendment will not affect the Coast Guard's ability to perform its living marine resources statutory responsibilities.

Sincerely,

TERRY M. CROSS

(04-15-2004-08-010104)

AR04047(
4/28/04

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

April 28, 2004

Reply To
Attn Of: ECO-088

Ref: 03-077-NOA

NOAA-NMFS
RECEIVED
APR 29 2004
NORTHWEST REGIONAL OFFICE

D. Robert Lohn, Regional Administrator
NMFS/NOAA - Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115-0070

Dear Mr. Lohn:

The U.S. Environmental Protection Agency (EPA) has reviewed the draft Environmental Impact Statement (EIS) for **The Pacific Coast Groundfish Fishery Management Bycatch Mitigation Program** (CEQ #040081) in accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. Section 309, independent of NEPA, specifically directs EPA to review and comment in writing on the environmental impacts associated with all major federal actions and the document's adequacy in meeting NEPA requirements.

The draft EIS analyzes the Pacific Fishery Management Council's (Council) objectives for its bycatch mitigation program and evaluates alternative programs to achieve those objectives. This EIS was developed to meet Magnuson-Stevens Fishery Conservation and Management Act National Standard 9 and Section 303(a)(11) requirements to minimize bycatch and bycatch mortality and standardize reporting methodologies to assess the amount and type of bycatch occurring in the fishery.

The EIS describes the No Action/Status Quo alternative (Alternative 1) and five action alternatives. Alternative 2 proposes to reduce groundfish regulatory discard by increasing groundfish trip limit sizes and reducing the number of commercial fishing vessels (50% reduction) while maintaining as long a fishing season as possible. Alternative 3 would reduce regulatory discard by increasing groundfish trip limit size and reducing fishing time without further reducing the number of trawl vessels as proposed in Alternative 2. Alternative 4 would reduce bycatch by expanding the definition of "trip limit" to include catch or mortality limits for overfished species. Catch limits would not be transferable between vessels and would expire at the end of each period. Catch limits would be established for overfished groundfish species and vessels would be required to stop fishing when a catch limit for a sector is reached. Alternative 5 would reduce bycatch by assigning annual catch limits or individual quotas to each limited entry commercial fisher, vessel, or other qualified entity. Catch limits would apply to overfished groundfish stocks, but quotas would also be established for other groundfish stocks. Certain gear restrictions and other regulations would be relaxed to allow fishers to develop practices to catch healthy groundfish stocks while avoiding the catch of overfished groundfish stocks. Alternative 6 would reduce bycatch by establishing long term closed areas where overfished groundfish and other sensitive species are most likely to be encountered, establishing incidental catch limits for individual vessels, prohibiting or severely restricting discard of groundfish species and accurately accounting for all catch. This alternative would emphasize the identification and use of alternative fishing gears and methods that avoid capture of restricted species.

Based on our review and evaluation, we have assigned the following ratings to the alternatives evaluated in the draft EIS.

Alternative	Rating
Alternative 1 No Action/Status Quo	EC-2 (Environmental Concerns-Insufficient Information)
Alternative 2 Larger Trip Limits and Trawl Fleet Reduction	EC-2 (Environmental Concerns-Insufficient Information)
Alternative 3 Larger Trip Limits and Shorter Fishing Season	EC-2 (Environmental Concerns-Insufficient Information)
Alternative 4 Vessel and Sector Catch Caps	EC-2 (Environmental Concerns-Insufficient Information)
Alternative 5 Individual Fishing Quotas and Increased Retention	EC-2 (Environmental Concerns-Insufficient Information)
Alternative 6 No-Take Reserves, Individual Catch Quotas and Full Retention	LO (Lack of Objections)

An overall rating of EC-2 (Environmental Concerns - Insufficient Information) along with a summary of our comments will be published in the *Federal Register*. A copy of the rating system used in conducting our review is enclosed for your reference.

Our concerns with Alternatives 1 through 5 are that while they propose actions that would reduce bycatch, they do not minimize bycatch of all species and the mortality of such bycatch. In addition, Alternatives 1 through 5 do not avoid or minimize adverse effects upon the quality of the environment as required by NEPA regulation.

In addition, as described in the enclosed detailed comments, we recommend that the EIS be revised to address the following topics:

- Observer coverage;
- Actions to address "high grading" and "market limits;"
- Environmental Justice impacts on fishers, processors and consumers.

Thank you for the opportunity to review this draft EIS. If you would like to discuss these issues or need additional information regarding these comments, please contact Mike Letourneau at (206) 553-6382 or myself at (206) 553-6911.

Sincerely,

Judith Leckrone Lee

Judith Leckrone Lee, Manager
Geographic Unit

Enclosure

cc: T. Eaton, EPA-WOO
D. Opalski, EPA-OOO
S. Draheim, EPA-R9

EPA's Detailed Comments
The Pacific Coast Groundfish Fishery Management Plan
Bycatch Mitigation Program
Draft Environmental Impact Statement

Minimizing Bycatch and Mortality of Bycatch

Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) National Standard 9 and Section 303(a)(11) require that bycatch and bycatch mortality be minimized, and standardized reporting methodologies to assess the amount and type of bycatch occurring in the fishery be developed. In addition, the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, require that proposed actions avoid or minimize adverse effects of actions upon the quality of the environment. While all of the alternatives propose actions that would reduce bycatch and bycatch mortality and thereby reduce adverse effects on the environment, Alternative 6 clearly proposes actions that minimize bycatch of all species.

Fish stock data demonstrates that the status quo (Alternative 1) does not adequately minimize bycatch of many species, most importantly, overfished species. Alternatives 2 and 3 would reduce only regulatory discard, that portion of bycatch that results from fishers complying with the regulations. These alternatives do not propose actions to minimize economic bycatch, which according to the EIS, could account for 66% of the discarded bycatch. While Alternatives 4 and 5 reduce all groundfish bycatch, they do not minimize bycatch of other non-groundfish species. In particular, impacts on Pacific halibut, salmon and seabirds would not be minimized.

Alternative 6 proposes actions that would minimize bycatch and mortality to bycatch for all species by employing large area closures, gear restrictions, bycatch caps and increased retention requirements. The trading and consolidation of restricted species catch quotas (RSQ) and individual fishing quotas (IFQ) would reduce the "race for fish." Alternative 6 takes a two pronged approach to reducing bycatch through the use of both a traditional "command-and-control" approach and a "market-base" approach. In addition, Alternative 6 forbids discarding which produces a strong incentive to develop and apply more selective gear because the cost of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial.

Observer Coverage

Monitoring is a fundamental mechanism for accounting for and in turn minimizing bycatch. Requiring 100% observer coverage is the most effective means of accurately accounting for bycatch. Camera monitors onboard ships are a good mechanism for monitoring the retention of bycatch. They do not, however, provide a means of accurately accounting for species composition and weight of bycatch that is discarded. At present, electronic monitoring technology is not accurate enough to identify species and estimate the weight of discarded fish more than 63% of the time. Therefore, we support 100% observer coverage as proposed in Alternatives 5 and 6 until such time that video and electronic monitoring of bycatch equals or exceeds that of the observer program. In addition, we support the proposed quota incentives to those fishers and vessels that accommodate observers, until such time that 100% observer coverage can be provided.

"High Grading" and "Market Limits"

Observer data indicates that 66% of the bycatch was discarded for "market" reasons. The high grading of fish for certain attributes (size, sex or physical condition) in some cases makes them more marketable. High grading occurs when the price differential between high- and low-valued fish is greater than the cost of discarding and replacing the catch and results in increased discarded bycatch. The incentive to high grade is enhanced if the cost to catch additional fish is very low. Related to high grading, processors impose "market limits" to prevent market gluts or to match their processing capacity. A fisher who catches more than their "market limit" may high grade if there is a price differential, or may simply dump the entire excess regardless of size or other factors.

While the EIS proposes various actions for fishers to minimize economic bycatch, it does not propose any such actions for processors. The EIS does not discuss what provisions exist under the Magnuson-Stevens Act that relate to processors for addressing "high grading" and "market limits." The EIS should evaluate and discuss whether sections of the Magnuson-Stevens Act such as those that address processing capacity and processor permitting, could be employed to minimize economic bycatch.

Environmental Justice

Section 6.2.2 of the EIS states that the alternatives under consideration could affect groundfish allocations or harvest levels that could in turn disproportionately impact low income and minority populations. While the EIS mentions coastal and tribal communities, it does not discern which populations may be disproportionately impacted by the proposed actions. In particular, there is no discussion of the minority (people of color) and low income populations that may be fishers, processors or consumers. In addition, the EIS does not discuss what actions were taken to achieve meaningful participation from those minority and low-income communities that might be disproportionately impacted. The EIS should include the following:

- A comprehensive accounting of all impacts on low income and people of color, including (but not limited to) cumulative and indirect impacts, and impacts to cultural, historic and protected resources. In addition, the EIS needs to demonstrate that the impacts to low income and people of color communities will be disproportionately higher than those on non-low income and non-people of color communities. For such a determination, the EIS must identify a reference community, provide a justification for utilizing this reference community, and include a discussion of the methodology for selecting the reference community.

- The EIS should demonstrate that communities bearing disproportionately high and adverse effects have had meaningful input into the decisions being made about the proposed action. The EIS needs to describe what was done to inform the communities about the proposed action (notices, mailings, fact sheets, briefings, presentations, exhibits, tours, news releases, translations, newsletters, reports, community interviews, surveys, canvassing, telephone hotlines, question and answer sessions, stakeholder meetings, and on scene information), the potential impacts it would have on their communities, what input was received from the communities, and how that input was utilized in the decisions that were made regarding the proposed action.