AMENDMENT 8

(TO THE NORTHERN ANCHOVY FISHERY MANAGEMENT PLAN)

incorporating a name change to:

THE COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

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DECEMBER 1998

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COVER SHEET

[x] Final Supplemental Environmental Impact Statement

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PROPOSED ACTION:

Approval and implementation of Amendment 8 to the Northern Anchovy Fishery Management Plan for the Washington, Oregon, and California coastal pelagic species fishery.

Abstract:

The proposed action is to implement Amendment 8 to the fishery management plan (FMP) for Northern Anchovy under the provisions of the Magnuson Fishery Conservation and Management Act of 1976 as amended. The FMP adds Pacific sardine (*Sardinops sagax)*, Pacific (chub) mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*) to the fishery management unit, which currently only covers northern anchovy (*Engraulis mordax*), and changes the name of the FMP to "the Coastal Pelagic Species Fishery Management Plan". In addition, the FMP contains a system of "actively managed" and "monitored only" species to allow the direction of management and research efforts where they are most needed. The amendment also includes a limited entry program for coastal pelagic finfish species south of 39° N latitude. The amendment contains harvest policies that preserve a portion of the stocks as forage for marine mammals and birds while maintaining a stable fishery, and an essential fish habitat section, both of which conform to the requirements of the Magnuson-Stevens Fishery Conservation and Management Act of 1996. The document also contains a description of stocks, fisheries, and cost estimates.

OVERVIEW

Amendment 8 to the Northern Anchovy Fishery Management Plan contains the following items:

- Executive Summary
- Final Supplemental Environmental Impact Statement (FSEIS)
- Response to Comments on the FSEIS
- Regulatory Impact Review
- Fishery Management Plan for Coastal Pelagic Species
- Appendix A: Description of the Coastal Pelagic Species Fishery
- Appendix B: Options and Analyses for the Coastal Pelagic Species Fishery Management Plan
- Appendix C: Costs Involved in Managing Coastal Pelagic Species
- Appendix D: Description and Identification of Essential Fish Habitat for the Coastal Pelagic Species Fishery Management Plan
- Appendix E: References

EXECUTIVE SUMMARY

This fishery management plan (FMP) for coastal pelagic species (CPS) constitutes Amendment 8 to the northern anchovy FMP. Amendment 8 adds Pacific sardine (*Sardinops sagax)*, Pacific (chub) mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*) to the fishery management unit, which currently only covers northern anchovy (*Engraulis mordax*), and changes the name of the FMP to "The Fishery Management Plan for Coastal Pelagic Species." In addition, the amendment contains a system of "Active" and "Monitored" management categories to allow the direction of management and research efforts where they are most needed. The amendment also includes a limited entry program for coastal pelagic finfish species south of 39° N latitude. The amendment contains harvest policies that preserve a portion of the stocks as forage for marine mammals and birds while maintaining a stable fishery, and an essential fish habitat section, both of which conform to the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

An Environmental Impact Statement and Regulatory Impact Review were prepared for Amendment 8. To avoid duplication, these documents precede the fishery management plan and its appendices, and incorporate analysis from those documents by reference to specific sections. Appendix A contains a description of the stocks and fisheries; Appendix B contains options considered by the Council and analysis of those options; Appendix C contains cost estimates for the plan amendment; Appendix D provides a description of essential fish habitat as required by the Magnuson-Stevens Act; and Appendix E provides references.

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

INDEX/SUMMARY
Amendment 8 to the Northern Anchovy Fishery Management Plan

DECEMBER 1998

This Final Supplemental Environmental Impact Statement Index/Summary to Amendment 8 to the Northern Anchovy Fishery Management Plan was published by the Pacific Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award NA87FC0008.

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1.0 Background

The Northern Anchovy Fishery Management Plan (FMP) was implemented in 1978 (43 FR 40868, September 13, 1978). The notice of availability of the Final Environmental Impact Statement was published on April 28, 1978 (43 FR 18249). Advances in scientific information concerning the size and potential yield of the northern anchovy population led to a revision of harvest strategies and other aspects of the FMP in Amendment 5. At that time, a Supplemental Environmental Impact Statement was prepared, and a notice of availability published on February 3, 1984 (49 FR 4257).

The Pacific Fishery Management Council (Council), at its meeting of March 4-7, 1997, decided to reevaluate the need to include other coastal pelagics species (CPS) in the FMP and began to review the changes that had occurred in the fishery, primarily in regard to the resurgence of Pacific sardine, which had been at extremely low biomass levels since the late 1950s and early 1960s. A public meeting of the Council's Coastal Pelagic Species Advisory Subpanel (CPSAS) on June 18, 1997 reviewed a report on the status of the sardine fishery prepared by the California Department of Fish and Game, and the Council decided at its meeting of June 23-25, 1997 to proceed with an amendment to the FMP which would include Pacific sardine, Pacific (chub) mackerel, jack mackerel, and market squid. A series of public meetings were held to identify the issues and develop proposed options. Seven public meetings of the Coastal Pelagic Species Plan Development Team (CPSPDT) were held between July 30, 1997, and February 19, 1998. Five public meetings of the CPSAS were held between July 31, 1997, and February 25, 1998. At its meeting of September 3-12, 1997, the Council added additional members to the CPSAS to fairly represent the industry in the current fishery. At its meeting of November 3-7, 1997, the Council adopted a control date for the fishery and directed the CPSAS to develop limited entry options for south of 39° N latitude. At its meeting of March 10-13, 1998, the Council directed the CPSPDT to increase the number of options for limited entry. A notice of intent to prepare an environmental impact statement for Amendment 8 was published on March 23, 1998 (63 FR 13833).

This Final Supplemental Environmental Impact Statement relies on analysis contained in Appendices A-E of the CPS FMP. As such, this document contains references to the Appendices where further analysis and detail can be found for each issue.

2.0 Purpose and Need for Action (Appendix B, Section 1.2)

Amendment 8 is intended to provide comprehensive management of CPS in response to rapid development in harvests, primarily because of a resurgence of Pacific sardine along the Pacific coast and an increase in the market demand for squid. Warming ocean temperatures have led to an increase in abundance of Pacific sardine, which are now found off Mexico, California, Oregon, Washington, and Canada, placing management of this species beyond the authority of any individual state. The collapse of the historical sardine fishery in the 1950s was due to overcapitalization and resulting overfishing at a time of unfavorable environmental conditions. If action is not taken, it is likely that the CPS fishery will become overcapitalized faster than management authorities can react if sardine, or other CPS, increase in abundance or markets develop. Federal management can best control overall harvests and bycatch in the multispecies fishery, facilitate international cooperation, and make the most efficient use of federal and State administrative and scientific resources. For more detail on the purpose and need for action, refer to Appendix B, Section 1.2.

3.0 Alternatives

3.1 Limited Entry (Appendix B, Section 3.0)

Options for managing the coastal pelagic fishery include:

Option 1: **Status Quo (Open Access Management)**: This option avoids the additional regulations and costs associated with limited entry, and avoids restrictions on operations and individual vessels and firms in the fishery.

Option 2: Limited Entry: The Council recommends limited entry for coastal pelagic species finfish.

The Council also considered Individual Transferable Quotas in this fishery, but they are not currently an option due to a Congressionally-imposed moratorium until October 1, 2000. The Council chose limited entry. The Council recognized that vessels currently participating in the CPS finfish fishery are capable of harvesting more CPS finfish than is available under current biomass conditions, and that excess harvesting capacity is expected to increase due to newcomers into the fishery, attracted by limitations in other fisheries and expanding biomasses of some CPS stocks. In the Pacific Coast CPS finfish fishery, excess harvest capacity is likely to result in an increasing number and complexity of regulations. Accordingly, in an open access situation, the Council will face increased pressure to balance the conflicting need to protect the resource with the need to provide sufficient allowable catch to sustain the fishery.

Increased number and complexity of regulations have many adverse impacts in such areas as fleet costs, resource utilization, safety, enforcement costs and effectiveness. Moreover, there is a point beyond which additional regulations, which interfere with day to day vessel operations (e.g., trip limits or mesh size regulations), will not improve the Council's ability to accomplish its management goals. For these reasons, the Council has chosen a limited entry program for CPS finfish (Appendix B, Section 3.4).

Suboptions of Limited Entry: There are a number of issues that need to be considered in the design and development of a limited entry program for CPS finfish species. The options for these issues are presented below. Full analysis can be found in Appendix B, Section 3.0.

Species

Option 1: Establish a limited entry program for finfish only (northern anchovy, Pacific [chub] mackerel, jack mackerel, and Pacific sardine). This would not include squid.

Option 2: Establish a limited entry program for finfish and squid.

The Council chose Option 1. There are no estimates of the size of the squid resource. The California Department of Fish and Game has implemented a vessel moratorium and a research program to obtain the data needed for effective management. Large vessels harvest finfish and squid; however, as the size of the vessel declines, specialization in either finfish or squid increases, which creates a basis for separate limited entry schemes for finfish and squid (Appendix B, Section 3.8.1).

Geographic Scope of Limited Entry

Option 1: Establish a coastwide CPS finfish fishery limited entry program.

Option 2: Establish a CPS finfish limited entry program for the fishery south of 39° N latitude (approximately Point Arena, California).

The Council chose Option 2. Under Option 2, any fishing north of 39° N latitude is not affected by limited entry requirements. CPS finfish fishing in the northern area would be managed as an open access fishery. Limited entry for the entire Pacific coast was considered, but during both the heyday of the sardine fishery and in recent years, more than 99% of CPS finfish and squid taken coast wide were harvested south of 39° N latitude. CPS fishing in the northern area could be most effectively managed as an open access fishery when abundance is high and distributions extend to northern areas. This would permit full utilization at high biomass levels, allowing other fishers to obtain benefits under favorable environmental conditions. When the biomass of CPS declines, the resources move south of 39° N latitude (Appendix B, Section 3.8.2).

Area Specific Endorsements South of 39° N Latitude

The state of California currently allocates the overall quota for Pacific sardine to participants in the northern and southern areas of the fishery, delimited at San Simeon Point (San Luis Obispo County, California). The state of California may also allocate the overall Pacific (chub) mackerel quota between the northern and southern areas of the fishery delimited at Point Sal (Santa Barbara County, California). Under the northern anchovy FMP, the overall reduction quota is allocated between the northern and southern areas of the fishery, delineated at Point Buchon (San Luis Obispo County, California). Division of the overall quotas into the northern and southern areas is primarily intended to prevent the larger southern CPS finfish fleet from taking the entire quota before the smaller northern fleet has a chance to fish. There is recognition of distinct northern and southern fleets in the CPS finfish fishery.

Option 1: No area specific endorsements south of 39° N latitude.
Option 2: Distinguish between northern and southern areas in the limited entry fishery south of 39° N latitude. The northern part of the area south of 39° N latitude might extend from Pt. Conception to 39° N latitude, while the southern area might extend from the Mexican border to Pt. Conception. Based on qualifying criteria (likely CPS landings in the northern and southern areas), boats could receive an endorsement to fish in one or both areas. Boats with southern area endorsements, for example, would not be able fish in northern grounds unless they also had a northern area endorsement.

The Council chose Option 1. The Council prefers no area-specific endorsements, which were considered as a way to allocate the resource to users along the coast. Area-specific endorsements involve additional administrative complexity and costs with separate sets of qualifying criteria and an increased monitoring and enforcement burden for permits in northern and southern areas. Separate north-south endorsements would eliminate harvesting options for some vessels and reduce their operational flexibility, which could make them less efficient in their overall harvesting operations (Appendix B, Section 3.8.3).

Exclude Small Catches from Limited Entry

The following options would define exempted landings at the outset of the CPS FMP. The definition of exempted landings used in limited entry for CPS finfish could be changed later using the socioeconomic framework process without amending the FMP.

Option 1: Do not distinguish between exempted and non-exempted landings (all landings of CPS finfish require limited entry permits).
Option 2: Define exempted landings as CPS finfish landings less than 0.5 mt per trip (landings less than 0.5 mt per trip are exempted from limited entry requirements).
Option 3: Define exempted landings as CPS finfish landings less than one mt per trip (landings less than one mt per trip are exempted from limited entry requirements).
Option 4: Define exempted landings as CPS finfish landings less than five mt per trip (landings less than five mt per trip are exempted from limited entry requirements).
Option 5: Allow from one mt through five mt of exempted CPS finfish landings per trip (landings from one mt , but no greater than five mt per trip are exempted from limited entry requirements).

The Council chose Option 5. Small quantities of CPS finfish species are taken incidentally by vessels targeting other species or engaged in other fisheries, and by some vessels targeting CPS finfish for high value, low volume specialty markets. The CPS finfish limited entry program could distinguish between exempted and non exempted landings of CPS finfish based on an exempted trip limit which excludes certain levels of catches from limited entry requirements south of 39° N latitude (i.e., allow small landings by boats without a limited entry permit). Exempted trips should not be confused with open access fishing. The Council's intent in adopting an exempted trip limit would be to accommodate small landings of CPS finfish that occur during fishing for other species and to accommodate those vessels that land small amounts of dead bait and provide fish for small specialty markets. It is not the Council's intention to establish an open access fishery that would operate "beside" the limited entry fishery for CPS finfish (Appendix B, Section 3.8.4).

Exclusion of Recreational Fishing from Limited Entry

Option 1: Include recreationally caught CPS finfish in a limited entry program.
Option 2: Exclude recreational anglers from CPS finfish limited entry; recreational harvest could still be restricted by quotas, area closures or any other type of management measure.

The Council chose Option 2. Pacific (chub) mackerel are the only CPS often taken by recreational anglers although they are not a major target species. During the period 1981 to 1994, the recreational catch of Pacific (chub) mackerel in southern California averaged 1,150 mt per year, and accounted for ten percent to 15% by weight of the total recreational catch. Pacific (chub) mackerel is also caught by anglers in northern California but in very modest amounts. The California recreational catch of Pacific (chub) mackerel is only two percent to three percent by weight of the total combined commercial and recreational catch.

By excluding recreational catches of CPS finfish from limited entry, no resources would be expended to manage harvesting capacity in the recreational fishery where the total catch of CPS finfish is trivial. This option maintains existing fishery segments and helps avoid discards. A recreational limited entry program would be unlikely to affect quantities of CPS finfish taken by anglers. Therefore, the impact on earnings and profitability in the commercial fishery would be minimal (Appendix B, Section 3.8.5).

Exclude Live Bait Used for Sportfishing and Commercial Fishing from Limited Entry

Live bait is defined as CPS species sold to anglers for live use in recreational or commercial fishing. Relatively small quantities of CPS finfish are harvested for use as live bait. Anchovy is the principle live bait species in southern and central California recreational fisheries. Sardine, mackerel, and squid are also harvested for live bait but to a much lesser extent. There is a relatively small, stable fleet of vessels that harvest live bait for the major sportfishing markets in California. In northern California, Oregon, and Washington, CPS finfish are used almost exclusively as dead bait. CPS species are also harvested for live bait in commercial albacore fisheries. Amounts harvested for this purpose are unknown but presumed to be very small.

Option 1: A limited entry permit would not be required for the capture and sale of CPS as live bait used in recreational or commercial fisheries (live bait landings of CPS are excluded from limited entry requirements).

Option 2: Require a limited entry permit to participate in the CPS finfish live bait fishery.

The Council chose option 1. The live bait fishery is a low-volume, high value fishery that is not currently overcapitalized and is not expected to become overcapitalized. It is already highly restricted by the amount of sportfishing that takes place in a certain area (Appendix B, Section 3.8.6).

Target Fleet Size

The options considered by the Council identify a target CPS limited entry fleet size based on a proportion of total CPS finfish landings south of 39° N latitude during the window period.

Option 1: A limited entry fleet consisting of those vessels accountable for 80% of total CPS finfish landings during the window period.

Option 2: A limited entry fleet consisting of those vessels accountable for 85% of total CPS finfish landings during the window period.

Option 3: A limited entry fleet consisting of those vessels accountable for 90% of total CPS finfish landings during the window period.

Option 4: A limited entry fleet consisting of those vessels accountable for 95% of total CPS finfish landings during the window period.

Option 5: A limited entry fleet consisting of those vessels accountable for 99% of total CPS finfish landings during the window period.

The Council's preferred options were Option 4 and Option 5. Presently, there is excess harvesting capacity in the CPS finfish fishery which leads to declines in economic efficiency and increases the likelihood of biological overfishing. The Council chose Option 5. While the Council recognized the optimal fleet size was likely smaller, Option 5 was chosen to be less disruptive in terms of displacing vessels from the fishery and to reduce impacts on existing fishing patterns, and therefore, on fishing communities. An integral part of the Council's choice of Option 5 was the presumed future attrition in fleet size that would occur gradually through the limited transferability of permits as described in Appendix B, Section 3.8.14.

Limiting Effort Beyond the Number of Vessels

Limiting the number of vessels participating in a fishery does not prevent those vessels from expanding their harvest capacity by increasing their fishing power. Therefore, limited entry might be accompanied by additional restrictions on a vessel's ability to improve its fishing power. One way this can be done is by placing endorsements on the limited entry permit with respect to the vessel's length, hold size, engine horsepower, or some other dimension of fishing effort. If, for example, a permit has a length endorsement, it can only be used on a vessel of the endorsed length. This prevents a permitted vessel from being replaced with a vessel of greater length. Thus fishing power is fixed in the dimension of vessel length. Without the length endorsement, a permitted vessel could be replaced with a vessel of greater length. Capacity in this fishery is also limited by the trip limit provisions discussed below.

Option 1: No limits on fleet harvest capacity beyond the number of vessels.
Option 2: Limit fleet harvest capacity beyond the number of vessels by restricting vessel length, hold size or other dimensions of fishing effort.

The Council chose Option 1. The Council's decision to limit transfer of limited entry permits after the first year effectively places limits on capacity, since it prevents replacement vessels of greater net tonnage from entering the fishery (Appendix B, Section 3.8.8).

Window Period

The window period establishes a time frame during which potential permit holders would be qualified based upon total CPS finfish landings. Landings of individual CPS finfish species tend to vary by year, so it is desirable that total CPS finfish landings and vessel participation levels would be relatively consistent during the proposed window period.

Option 1: A five-year window period (January 1, 1993 through November 5, 1997).
Option 2: An eight-year window period (January 1, 1990 through November 5, 1997).

The end date for both options is a notice date (also known as a control date) already adopted by Council for limited entry in the CPS fishery. The Council chose Option 1 (Appendix B, Section 3.8.9). The choice of a window period was thought to be of sufficient length to reflect typical conditions in the fishery, but not too long that it would qualify vessels that have not been recently active in the fishery.

Landings Qualifying Criteria

Vessels would qualify for a CPS finfish limited entry permit based on some minimum quantity of CPS finfish landings, or CPS finfish and squid landings, or CPS finfish landings and/or squid landings during the five-year window period. Landings criteria would be based on total CPS finfish landings of all species since availability of CPS finfish is expected to vary considerably over time by individual species, but not for CPS finfish as a whole.

Option 1: Identify current participants and issue limited entry permits for CPS finfish based on CPS finfish (northern anchovy, Pacific sardine, Pacific [chub] mackerel and jack mackerel but no market squid) landings south of 39° N latitude (Bodega Bay and ports south) during the five-year window period.
Option 2: Identify current participants and issue limited entry permits for CPS finfish based on CPS finfish plus market squid landings south of 39° N latitude with the restriction that CPS finfish landings during the five-year window period must be greater than zero.
Option 3: Identify current participants and allocate limited entry permits for CPS finfish based on CPS finfish plus market squid landings south of 39° N latitude during the five-year window period.

The Council chose Option 1 (Appendix B, Section 3.8.10).

Trip Limits

An alternative to restrictions on inputs in limiting harvest capacity in the CPS finfish fishery beyond the number of vessels is trip limits, which are restrictions on outputs. Trip limits would guard against rapid expansion in the harvest capacity in the CPS fishery by transfer of CPS limited entry permits to much larger vessels (e.g., factory trawlers). Transfer of permits to much larger vessels could further expand capacity in the CPS fishery beyond the productive capacity of fully utilized CPS stocks, induce economic inefficiency, and preclude fishing by current participants. However, trip limits would not prevent vessels in need of modernization or replacement from doing so.

Option 1: A trip limit no larger than 125 mt;
Option 2: A trip limit no larger than 100 mt;
Option 3: A trip limit no larger than 75 mt;
Option 4: No limit on the amount of CPS finfish carried, landed, transported or delivered.

The Council chose Option 1. Trip limits would apply to management of the CPS fishery at the outset of limited entry because the trip limit could be changed later under the FMP framework process.

In this context, a trip could be defined as any activity (e.g., catching, landing, transporting or delivering) by a vessel that harvests CPS finfish with a limited entry permit; (i.e., a possession limit that applies to harvesting operations only). Also in this context, a trip limit should not be confused with trip limits used in other fisheries (e.g., groundfish) to lengthen the season without exceeding harvest guidelines or to manage bycatch (Appendix B, Section 3.8.11).

Second Generation Permit Owners

Second generation permit holders are people that obtain CPS limited entry permits from their original holders (i.e., persons or corporations that receive them initially based on CPS finfish landings during the window period).

Option 1: Place no restrictions on "second generation" permit holders.
Option 2: Require second generation permit holders to be on board CPS vessels when CPS finfish are landed, and to sign the resulting fish ticket (provisions would be made for skippers hired by second generation permit holders in the case of an emergency).

The Council chose Option 1. These options were developed assuming a limited entry program with unrestricted transferability of permits. However, given the Council's recommendations on limiting transferability of permits, the options relating to second generation permit holders would only be applicable during the first year of the program and in certain circumstances beyond the first year (Appendix B, Section 3.8.12).

Permit Renewal Criteria

Reducing the size of the limited entry fleet for CPS finfish through permit renewal criteria may be useful if the number of limited entry permits in the fishery is much larger than the number of vessels required or currently used to harvest the resource. Such options will be less useful if the limited entry fleet is of an appropriate size initially.

Option 1: No renewal criteria for limited entry permits
Option 2: Impose performance criteria for permit renewal permit (e.g., minimum landings, numbers of trips, or some other performance measure). Permitted vessels that fail to meet performance criteria for renewal would have their permits retired.

The Council chose Option 1 (Appendix B, Section 3.8.13).

Permit Transfers

Limited entry programs are primarily designed to address economic problems associated with excess harvest capacity or overcapitalization in open access fisheries. Nonetheless, the limited entry program proposed for the CPS finfish fishery has multiple objectives. In most cases significant economic benefits are realized by allowing unconstrained transfer of limited entry permits if the the initial allocation of permits is suboptimal. However in some cases, there may be social, income distributional, or other benefits of greater importance that can be realized by constraining permit transfer to maintain the initial allocation. In the latter cases, the initial allocation may be optimal in terms of preserving a particular pattern of fishing operations, or fishing community structure.

Option 1: Allow CPS finfish limited entry permits to be transferred without constraints.
Option 2: Prohibit the transfer of limited entry permits.
Option 3: Fix the limited entry permit to the vessel and not allow transfer to another vessel except: 1) if the permitted vessel is stolen, lost or no longer able to participate in a federally managed commercial fishery, provided application for the permit originates from the vessel owner who must place it on a replacement vessel of the same or less net tonnage within one year of disability of the permitted vessel, or 2) the permit is placed on a replacement vessel of the same or less net tonnage provided the previously permitted vessel is permanently retired from all federally managed commercial fisheries for which a permit is required.
Option 4: Allow permit transferability (as in Option 1) for one year following implementation of limited entry. After one year, transferability would be restricted as described for Option 3.

The Council chose Option 4, which was a combination of Options 1 and 3. Under Option 4, the limited entry permit is issued to the vessel. After the first year of the limited entry program, transfer of a permit to another vessel is not allowed unless the original permitted vessel is stolen, lost or no longer able to participate in a federally managed commercial fishery. Application for the permit transfer to a replacement vessel originates from the vessel owner who must place it on a replacement vessel of the same or less net tonnage within one year of disability of the permitted vessel. During the first year of the program, permit transfers are allowed once. Option 4 represents a compromise between full transferability and completely restricted transferability. This option was chosen in conjunction with the vessel fleet size option (Appendix B, Section 3.8.7) for a fleet of 70 vessels. While the Council chose the fleet size option allowing 70 permits to accommodate current participants in the CPS fishery, it is clear that this fleet size is larger than required to efficiently harvest CPS finfish. Option 4 on transferability allows some modernization to occur while limiting growth of fishing capacity in the long term (Appendix B, Section 3.8.14).

Procedures for Issuing New Limited Entry Permits in the Future

The need to issue new limited entry permits in the future could arise with a substantial increase in the abundance of CPS finfish resources together with substantially enhanced markets. In this case, the limited entry fleet would increase beyond its current size. It might be desirable to make such permits temporary to accommodate subsequent contractions in the fishery.

Option 1: Allow for issuing additional permits in the future under a framework that would be created when the process of developing options is initiated.
Option 2: Allow issuance of additional permits to replace only those permits lost to attrition.
Option 3: No issuance of additional permits in the future.

The Council chose Option 1, but changed the wording to "Allowance for issuance of new permits consistent with the parameters of a framework that may be developed in the future" (Appendix B, Section 3.8.15).

Vessels Under Construction, Conversion or Contract for Purchase

Vessels intended for use in the CPS finfish fishery that were under construction, conversion, or contracted for purchase during the window period might not qualify for a limited entry permit due to insufficient landings. Unlike vessels that were already participating in the CPS finfish or other fisheries, these vessels, because of their state of physical preparedness, may not have had an opportunity to participate in the CPS finfish fishery and make the necessary landings to qualify for a limited entry permit.

Option 1: Would not waive CPS limited entry landings requirements for vessels under construction, conversion or contracted for purchase during the window period.

Option 2: Upon review of the specific circumstances, allow an exception for vessels under construction, conversion or contracted for purchase during the window period.

The Council chose Option 1. Since limited entry permits will be fully transferable in the first year of the program, an owner of a vessel under construction has the opportunity to purchase a limited entry permit (Appendix B, Section 3.8.16). Also, if the owner has an older vessel that is being replaced, the permit may be transferred to the new vessel.

3.2 **Management Strategies** (Appendix B, Section 2.1.2)

<u>Active Versus Monitored Management</u>

Option 1: Divide management resources equally among all CPS.

Option 2: Create two management categories for CPS fish stocks: “Active” management and "Monitored" management.

The Council chose Option 2. Under Option 2, “Active” management is for stocks and fisheries with significant levels of catch, or biological or socioeconomic considerations requiring relatively intense harvest management procedures (e.g. harvest guidelines, quotas, research surveys, and stock assessments). This category is particularly important for stocks that are or may be overfished. The second category, “Monitored”, is for stocks and fisheries not requiring intensive harvest management efforts because catches are not significant or the stock is not understood well enough to be Actively managed.

The purpose of Active and Monitored management is to use available agency resources in the most efficient and effective manner while satisfying goals and objectives of the FMP. The distinction enables managers and scientists to concentrate efforts on stocks and segments of the CPS fisheries that need greatest attention or where the most significant benefits might be expected. For more details on Active and Monitored management, refer to Appendix B, Section 2.1.2.

Decisions about which stocks are in the Actively managed and Monitored categories would be reviewed annually (Appendix B, Section 2.1.2). At the outset of the FMP, the species are proposed to be divided as follows:

Active Management	
Pacific sardine	*Sardinops sagax*
Pacific (chub) mackerel	*Scomber japonicus*
Monitored	
Northern anchovy	*Engraulis mordax*
Market squid	*Loligo opalescens*
Jack mackerel	*Trachurus symmetricus*

3.3 **Optimum Yield, MSY Control rules and Overfishing Definitions** (Appendix B, Section 4.0)

All preferred options for harvest management in the CPS fishery under Amendment 8 involve a definition of optimum yield (OY, Appendix B, Section 4.0.1); allowable biological catch (ABC); maximum sustainable yield (MSY) control rules (Appendix B, Section 4.0.2); definitions of overfishing (Appendix B, Section 4.0.3); and definitions of overfished stocks (Appendix B, Section 4.04). Rebuilding programs may be an implicit part of the MSY control rule or developed independently if stocks become overfished (Appendix B, Section 4.0.5).

MSY control rules are the most important elements in harvest management under Amendment 8. The Council adopted specific MSY control rule specifications for Pacific sardine and Pacific (chub) mackerel, which will be Actively managed at the outset of the FMP. Generic or "default" specifications were adopted for jack mackerel, northern anchovy and market squid, which will be Monitored at the outset of the FMP. Options for both Actively managed and Monitored species are compatible with the federal guidelines and the Magnuson-Stevens Act (Appendix B, sections 4.1.2 and 50 CFR 600.310).

Pacific Sardine Harvest Policy (Appendix B, Section 4.2)

For Pacific sardine, MSY control rule options are analyzed using a species and fishery specific simulation model. The general approach is to simulate the stock and fishery over a long period of time and using a large number of MSY control rule parameter values. Results are used to find MSY control rules and control rule parameters that give good results for most measures of performance.

Options for Pacific sardine and Pacific (chub) mackerel are based on the general formula (Appendix B, Section 4.0):

$$H=(BIOMASS-CUTOFF) \times FRACTION$$

where H is the harvest level, BIOMASS is the estimated stock biomass, CUTOFF is the lowest level of estimated biomass at which directed harvest is allowed and FRACTION is an exploitation rate parameter. In some cases, it is useful to define a maximum harvest level (MAXCAT) so that total harvest never exceeds MAXCAT. MSY control rule parameters might be constant from year to year or might change, depending on environmental conditions or conditions in the fishery. Most CPS are transboundary resources distributed off Mexico, the U.S. and Canada. It is therefore necessary to adjust harvest levels for U.S. fisheries in proportion to the biomass in U.S. waters. This is typically done by multiplying the overall ABC from the MSY control rule by an estimate of the percentage of the stock in U.S. waters (Appendix B, Section 4.1.3).

The options and performance measures for sardine MSY control rules are listed in Table 1. The Council chose option J because it gives biomass and catch levels comparable or better than the deterministic equilibrium F_{MSY} under Option L and because it has a CUTOFF of 150,000 mt. Options with CUTOFF = 50,000 mt might not include an implicit rebuilding program (in the event that sardine become overfished) that meets the ten years to MSY biomass requirement in the National Standards. Option J was chosen because it best achieves the FMP goals and objectives of preventing overfishing, providing adequate forage for dependent species, and promoting stability of catch.

TABLE 1. MSY control rule options for Pacific Sardine. All options evaluated in a stochastic model. Option J was chosen by the Council.

	Option A (Status Quo)	Option B	Option C	Option D	Option E	Option F	Option G	Option H	Option I	Option J	Option K	Option L (Stochastic F_{MSY})	Option M (Determ. Equil. F_{MSY} in a Stochastic Model)
Overfishing Definitions													
Overfishing Rate	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC
Overfished Threshold (mt)	50	50	50	50	50	50	50	50	50	50	50	50	50
Control Rule Parameters													
FRACTION	20%	F_{MSY} (10-30%)	20%	F_{MSY} (10-30%)	F_{MSY} (10-30%)	F_{MSY} (5-25%)	F_{MSY} (5-15%)	F_{MSY} (5-15%)	F_{MSY} (5-25%)	F_{MSY} (5-15%)	F_{MSY} (10-30%)	12%	8.8%
CUTOFF	50	50	100	100	100	100	100	100	100	150	50	0	0
MAXCAT	400	400	400	400	300	400	400	300	300	200	200	Infinite	Infinite
Performance Measure													
Average Catch	151	159	165	171	165	177	179	169	169	145	141	180	170
Std. Dev. Catch	137	140	140	143	113	143	133	105	112	67	72	180	153
Mean Biomass	936	964	1,073	1,091	1,280	1,216	1,543	1,665	1,400	1,952	1,516	1,408	1,784
StdDev Biomass	27	27	29	28	34	32	39	42	37	49	43	39	43
Mean Log Catch	4.33	4.46	4.44	4.54	4.64	4.62	4.77	4.80	4.70	4.76	4.65	4.72	4.77
Mean Log Biom	6.24	6.37	6.50	6.59	6.75	6.74	7.06	7.15	6.89	7.34	6.87	6.89	7.24
%Years Biomass>400	61%	64%	70%	73%	79%	81%	90%	92%	84%	96%	79%	84%	93%
%Years No Catch	5%	2%	7%	4%	3%	2%	1%	0%	1%	0.5%	1%	0%	0%
Median Catch	103	104	119	121	148	131	140	156	158	182	188	128	127
Median Biomass	598	600	700	748	898	850	1,248	1,349	1,048	1,648	1,099	1,500	1,049

MSY Control Rule for Pacific (Chub) Mackerel

Pacific (chub) mackerel are currently managed by the state of California. If the estimated biomass is greater than 135,000 mt, then the U.S. commercial catch is not restricted by a quota. If the biomass is between 18,200 mt and 135,000 mt, then a quota for U.S. fishers equal to 30% of the biomass above 18,200 mt tons is applied. If the biomass is below 18,200 mt, commercial fishing in the U.S. stops. Current regulations focus on U.S. harvests because they were developed when Mexican catches of Pacific (chub) mackerel were insignificant. In the last few years, however, catches in the U.S. and Mexico have been roughly equal and the same stock is exploited by fisheries in both countries.

Option 1: Status Quo: U.S. harvest based on a CUTOFF of 18,200 mt and FRACTION of 30% with no limit set when stock biomass exceeds 135,000 mt.

Option 2: Target harvest level for the whole stock (US and Mexico) based on a CUTOFF of 18,200 mt and a FRACTION of 30%. The U.S. portion of the target harvest level would be prorated based on the portion of the stock biomass in U.S. waters. MSY control rule would be applied and harvest level limited at all stock biomass levels.

The Council chose Option 2. The advantages of Option 2 are that it is more conservative but still consistent with current management and provides a good balance between the fishery and protecting the long term productivity of the stock. A disadvantage is that harvest guidelines or quotas for U.S. fishers will be lower than recent quotas set by CDFG after harvest levels are prorated by the portion in U.S. waters. However, Option 2 is consistent with the goals and objectives listed in the FMP. In particular, it attempts to manage CPS throughout their range (despite the lack of a management agreement with Mexico), achieves OY, prevents overfishing, and uses resources spent on management of CPS efficiently (Appendix B, Section 4.3).

Harvest Policies for Monitored Stocks (Appendix B, Section 4.4)

As described above, northern anchovy (northern and central subpopulations), jack mackerel and market squid would be Monitored at the outset of the CPS FMP. Default MSY control rule and overfishing specifications are recommended for use with these Monitored stocks.

The default MSY control rule is a conservative benchmark approach designed to help managers make decisions based on a framework process about when to promote stocks to an Active management status. The default MSY control rule (intended primarily for a stocks that are monitored only) sets ABC for the entire stock (U.S., Mexico, Canada, and international fisheries) equal to 25% of the best estimate of the MSY catch level. ABC in U.S. waters is prorated based on the portion of the stock biomass in U.S. waters. The technical definition of overfishing occurs and a point of concern mechanism is triggered whenever the total catch (U.S., Mexico, Canada, and international fisheries) exceeds ABC based on the default MSY control rule for the stock or whenever fishing occurs at a rate that is high enough to jeopardize the capacity of the stock to produce MSY.

Overfishing definitions as well as catch and biomass estimates used to calculate ABC and OY based on default MSY control rules are summarized below.

Recommended ABC levels and overfishing definitions for monitored only species based on the default MSY control rule.

Species and Stock	ABC for Entire Stock	ABC in U.S. Waters
Northern anchovy (northern subpopulation)	25% of MSY catch (MSY catch not available)	not available
Northern anchovy (central subpopulation)	31,000 mt yr^{-1}	25,000 mt yr^{-1}
Jack mackerel	48,000 mt yr^{-1}	31,000 mt yr^{-1}
Market squid	25% of MSY catch (MSY catch not available)	not available

Northern Anchovy-Central Subpopulation (Appendix B, Section 4.4.1)

MSY for northern anchovy in the central subpopulation is estimated to be 123,000 mt per year at a total biomass level of about 733,000 mt. The recommended default MSY control rule gives an ABC for the entire stock equal to 25% of 123,000 mt or 31,000 mt. About 82% of the stock is resident in U.S. waters. ABC in U.S. waters is therefore 82% of 31,000 mt or 25,000 mt. Under the default MSY control rule, overfishing and a point of concern would exist for Northern Anchovy in the central subpopulation when total catch exceeds or is projected to exceed (within two years) ABC.

Northern Anchovy-Northern Subpopulation (Appendix B, Section 4.4.2)

The northern subpopulation of anchovy ranges from San Francisco north to British Columbia with a major spawning center off Oregon and Washington that is associated with the Columbia River plume. The northern subpopulation supports small but locally important bait fisheries and is likely an important source of forage to local predators, including depleted and endangered salmonid stocks.

The recommended default MSY control rule gives an ABC for the entire stock equal to 25% of MSY catch but MSY catch has not been estimated. The portion of the northern subpopulation of northern anchovy resident in U.S. waters is unknown. It is likely that some biomass occurs in Canadian waters off British Columbia. ABC in U.S. waters cannot be calculated at this time.

Spawning biomass estimates for an area off Oregon and Washington during 1975 through 1976 based on estimates from the Smith Larva Method (with adjustments described in Appendix A, Section 1.1.6) are 87,000 mt to 116,000 mt. Landings of anchovy in Oregon and Washington are small (generally less than 60 mt/year) and small relative to the estimates of spawning biomass.

Jack Mackerel (Appendix B, Section 4.4.3)

Although there is little evidence of subpopulations, small jack mackerel (10 cm 30 cm FL and up to eight years of age) are most abundant in the Southern California Bight, where they are often found near the mainland coast and islands and over shallow rocky banks. Ages 0.5 through eight are harvested by the inshore fishery off southern California. Older, larger fish (50-60 cm FL and 16 to 30 years) range from Cabo San Lucas, Baja California, to the Gulf of Alaska, where they are generally found offshore in deep water and along the northern coastline. Large fish rarely appear in southern inshore waters. Fish of intermediate lengths (30 cm to 50 cm TL; nine years to 15 years of age) were recently found in considerable numbers around the 200-mile limit of the U.S. exclusive economic zone (EEZ) off southern California.

Estimates of average potential yield are ranges stratified by area and age (Appendix B, Section 4.4.3). Potential yield of jack mackerel is not meant to be an estimate of sustainable harvest but, rather, an interim limit for catches while data sufficient for management are accumulated.

Recommended ABC levels for jack mackerel were calculated by age/area from mid-range potential yield values. About 65% of the stock is resident in U.S. waters, and the ABC in U.S. waters was prorated accordingly.

Ages (Years)	Potential Yield (thousand mt)	ABC (thousand mt)	ABC in U.S. Waters (thousand mt)
0-8	95-191	36	23
9-15	22-45	8	5
16-30	11-24	4	3
Total	128-260	48	31

Market Squid (Appendix B, Section 4.4.4)

The recommended default MSY control rule gives an ABC for the entire stock equal to 25% of MSY catch but MSY catch has not been estimated. The portion of the market squid stock resident in U.S. waters is unknown. It is likely that some biomass occurs in Mexican waters off Baja California and Canadian waters off British Columbia. ABC in U.S. waters cannot be calculated at this time.

Scientific research currently underway, improvements to squid port sampling, and the moratorium on new squid permits under California state law (Appendix A, Section 1.5.5) constitute a plan for stock assessment and close monitoring of fishing effort that will make it possible to manage the market squid fishery if conditions change and Active management is required.

The Council makes decisions about Active and Monitored management for CPS annually based on socio-economic framework management procedures (CPS plan, Section 2.1.3). State managers under state law and federal managers under this FMP can be expected to manage the fishery intensively when sufficient data indicate a need.

Council and state authorities will continue to monitor squid landings while research continues. If landings increase or a biological risk to the stock develops, Council can be expected to promote squid to active management quickly under the "point of concern" framework management procedures (CPS plan, Section 2.1.2).

3.4 Essential Fish Habitat (Appendix B, Section 2.2.2.1.2 and Appendix D)

The CPS fishery includes four finfish (Pacific sardine, Pacific [chub] mackerel, northern anchovy, and jack mackerel) and the invertebrate, market squid. CPS finfish are pelagic (in the water column near the surface and not associated with substrate) because they generally occur above the thermocline in the upper mixed layer. For the purposes of EFH, the four CPS finfish are treated as a complex because of similarities in their life histories and similarities in their habitat requirements. Market squid are also treated in this same complex because they are similarly fished above spawning aggregations. Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, the proposed FMP amendment defines Essential Fish Habitat (EFH).

Option 1: No Definition of EFH (Status Quo).

Option 2: Define CPS EFH as follows: The east-west geographic boundary of EFH for CPS is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the EEZ and above the thermocline where sea surface temperatures range between 10° - 26° C. The southern boundary is the U.S.-Mexico maritime boundary. The northern boundary is more dynamic, and is defined as the position of the 10° C isotherm, which varies seasonally and annually.

Option 3: Define CPS EFH to include the entire EEZ.

The Council chose Option 2. Option 2 bases the definition of EFH on a thermal range bordered by the geographic area where CPS occur at any life stage, where CPS have occurred historically during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by CPS. This identification of EFH for CPS accommodates the fact that the geographic range of CPS varies widely over time in response to the temperature of the upper mixed layer of the ocean. Option 3, defining CPS EFH as the entire EEZ, would have included a broader area than the waters necessary for spawning, breeding, feeding, or growth to maturity. For more detail on EFH, please refer to Appendix B, Section 2.2.2.1.2 and Appendix D in whole.

In addition, the National Marine Fisheries Service (NMFS) guidelines require FMPs to identify management measures, if there is evidence that a fishing activity is having an identifiable adverse effect on EFH. The proposed FMP amendment provides a range of potential management measures to minimize adverse effects on EFH from fishing, though currently, there is not evidence that a fishing activity is having an identifiable adverse effect on CPS EFH.

Additionally, NMFS guidelines require that FMPs should identify habitat areas of particular concern. At this time, there are no habitat areas of particular concern, because the species in this plan are pelagic and not found in association with any particular habitat area.

4.0 Affected Environment (Appendix A, Sections 1.6 - 1.8, and Appendix D)

Management Area (Appendix A, Section 1.6)

The California Current is one of the world's four major eastern boundary currents characterized by coastal upwelling, high nutrient levels and high productivity. High nutrient levels result from an influx of high-nutrient, subarctic water plus upwelling of nutrient-rich water within the system. Pelagic fish species dominate the exploitable biomass of the system, with major concentrations close to the coastline. The offshore boundary for pelagic fishes is best described by the mean position of the summer wind stress maximum at about 200 km from the continental margin. In the southern California region, the offshore boundary is defined by the western coasts of the Channel Islands. The California Current ecosystem is essentially a region of divergence and upwelling.

The most intense upwelling is centered near Cape Mendocino in northern California during the spring and summer. The cool core of upwelled water near the coast is most pronounced in summer, when it occurs from near Cape Blanco along the northern and central California coasts and extends in a plumelike structure to the southwest of Point Conception. A secondary upwelling zone occurs off Baja California, with a springtime, local maximum near Punta Baja.

The combined effects of the southerly surface currents and coastal upwelling result in cool sea-surface temperatures over most of the northern part of the California Current. Winter sea-surface temperatures off Vancouver Island average 8° C and increase southwards to 22° C in southern Baja California. Summer sea-surface temperatures in the region of maximum upwelling, from Cape Blanco to Point Conception, are particularly cool. July sea-surface temperatures in the nearshore areas of northern California average less than 12° C, which is slightly colder than the July sea-surface temperatures in the northernmost Gulf of Alaska. Mean summer sea-surface temperatures are above 14° C in the region between Cape Blanco and Vancouver Island.

Seasonal and interannual environmental variability within the California Current ecosystem are associated with variations in the Pacific Basin atmospheric pressure systems, which control the local winds and Ekman transport, and affect flows of the equatorward California Current, the poleward undercurrent and the inshore countercurrent. Variations on time scales of several years are associated with alterations in the tropical pressure system, i.e., the El Niño/Southern Oscillation phenomenon. El Niño events markedly increase temperature and alter the flow of currents in the California Current.

The California Current comprises four relatively distinct, though related, ecological components: the pelagic, the littoral, the demersal, and the anadromous. The pelagic, which encompasses the offshore surface water layer and the species therein, including coastal pelagic fish and squid. Most of the forage produced in the California Current ecosystem (i.e., phytoplankton and zooplankton) comes from the pelagic component.

As in the other major eastern boundary currents, anchovy, sardine, whiting, jack mackerel, and Pacific (chub) mackerel achieve the largest populations. These populations are key to the trophic dynamics of the entire California Current ecosystem; anchovy and sardines are the only fishes in the ecosystem that consume large quantities of primary production (phytoplankton), and all five of the species are significant consumers of zooplankton. All five species, particularly mackerels and whiting, are important predators of the early stages of other fishes. The juvenile stages of all five species, and in many cases the adults, are important as forage for seabirds, pinnipeds, cetaceans, and other fishes.

Trophic interactions between CPS and higher-trophic-level fishes are poorly understood, and it is unknown if populations of individual predaceous fishes are enhanced or hindered by large populations of CPS. It is not known if the value of CPS as forage to adult predators outweighs the negative effects of predation by CPS on predator's larvae and juveniles plus competitive removal of phytoplankton, zooplankton, and other fishes. For more detail on the California current ecosystem, refer to Appendix A, Section 1.6.

Essential Fish Habitat (Appendix D, Section 2.0)

In determining EFH for CPS, the estuarine and marine habitat necessary to provide sufficient production to support MSY and a healthy ecosystem were considered. Using presence/absence data, EFH is based on a thermal range bordered within the geographic area where a managed species occurs at any life stage, where the species has occurred historically during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by the species. The specific description and identification of EFH for CPS finfish accommodates the fact that the geographic range of all species varies widely over time in response to the temperature of the upper mixed layer of the ocean, particularly in the area north of 39° N latitude. This generalization is probably also true for market squid but few data are available. Adult CPS finfish are generally not found at temperatures colder than 10° C or warmer than 26° C, and preferred temperatures and minimum spawning temperatures are generally above 13° C. Spawning is most common at 14° C to 16° C. For more detail on EFH, refer to Appendix D, Section 2.0.

Marine Mammal Predators (Appendix A, Section 1.7)

CPS are eaten by a number of marine mammals, their dependence on CPS varying from predator to predator. A great deal of information is available about the diets of marine mammals, and the total amount of CPS eaten per year has been estimated for a few. It is not currently possible, however, to estimate the total amount of CPS used as forage by all marine mammals in the California Current ecosystem or the size of CPS populations necessary to sustain predator populations. Some of the species, such as the northern fur seal and Steller's sea lion are listed as depleted. For more detail on marine mammals as predators, refer to Appendix A, Section 1.7.

Seabird Predators (Appendix A, Section 1.8)

Pelagic schooling fish are key components of marine food webs and primary prey of many seabirds. CPS are important to seabirds, because of their abundance near the sea surface, relatively small size, fusiform shape, and dense concentration. Seabird populations of the California Current system and other eastern boundary currents are large relative to areas not driven by large-scale coastal upwelling.

CPS are consumed by a large number of seabirds off the coasts of California, Oregon, and Washington. Availability of anchovies is known to directly affect the breeding success of pelicans, terns, gulls, and auks. It is likely that many predators of anchovies will also eat sardines when the population increases. Owing to their size and occurrence near the surface, Pacific (chub) mackerel are likely to be important to seabirds, especially in southern California. Pacific (chub) mackerel have been observed in the diet of pelican. Jack mackerel are probably not important to seabirds because of their large size and relatively deep schooling habits. Studies of seabird diet during autumn, however, when small jack mackerel are near shore and more available, may indicated their seasonal importance as forage. Recent increased abundance of sardines off southern California was followed by increased breeding success and abundance of brown pelicans. For more detail on Seabird Predators, refer to Appendix A, Section 1.8.

Fishery Interactions With Non-CPS Species (Appendix A, Section 2.2)

The CPS fishery could involve the "taking" (incidental mortality) of birds, fish and marine mammals that may be threatened, endangered or sensitive species. This interaction occurs in CPS fishing because anchovy, sardine and squid are forage for many predators (including threatened or endangered species) that may feed on CPS while fishing gear is deployed, become entangled or captured and drown. The problem is reduced somewhat by the fact that fishing gear used to harvest CPS (mostly purse seines made of small mesh) does not tend to entangle and drown predators although they may be captured within the net as the purse seines are closed. Available information about take of birds, fish and marine mammals during CPS fishing is summarized below. Data are limited, however, because there have been no observer programs in the CPS fishery.

Details on fishery interactions with marine mammals, birds and salmonids are included in Appendix A, Section 2.2. NMFS is engaging in informal consultation with the U.S. Fish and Wildlife Service (USFWS) and to determine if the actions in this FMP are likely to adversely affect listed species or critical habitat. Under the terms of the Marine Mammal Protection Act, the California purse seine (CPS) fishery is "Category II." Category II fisheries are characterized by incidental mortality of marine mammals at levels less than 50% of the PBR (potential biological removal) level. State and federal biologists indicate that the most significant interaction (in terms of impacts on the marine mammal stock) may be between pilot whales, which are relatively rare along the West Coast, and the squid fishery.

5.0 Environmental Consequences of Fisheries Actions

5.1 Goals, Objectives and Framework Management (Appendix B, Section 2.0)

Amendment 8 includes a "framework management" process that makes it possible for Council to change and modify management procedures in a timely and efficient manner without amending the FMP (Appendix B, Section 2.2). Framework management procedures are well defined in the FMP and build consideration of environmental impacts directly into the decision making process. They include explicit goals and objectives (Appendix B, Section 2.1) focused on concern about environmental impacts (i.e. ecosystem based principles of resource management, provide adequate forage for dependent species, prevent overfishing, and foster research).

The only known alternatives to a framework approach involve amending the FMP whenever management measures changed significantly. This alternative is impractical because of the costs involved and because biological and fishery conditions change rapidly in the CPS fishery.

With respect to environmental consequences and framework management, the most important elements in Amendment 8 are the "point of concern" framework (Appendix B, Section 2.2.1.2) and the distinction between species that are "actively managed" and "monitored only" (Appendix B, Section 2.1.2). The point of concern framework authorizes Council to act quickly and directly to address resource conservation and ecological issues.

Active management is for CPS stocks with significant levels of catch that could become overfished. Monitored management is for stocks where fishing is insignificant and for stocks that are not well enough understood to be intensively managed. The distinction between Active and Monitored management allows managers to concentrate their efforts on stocks and fishery segments where greatest attention is required (Appendix B, Section 2.1.1). Species assigned to the Actively managed and Monitored categories would be reviewed by Council on an annual basis under the framework management process. Stocks can be moved from one category to the other more rapidly under the point of concern framework (Appendix B, Section 2.1.1).

Direct, Indirect, and Cumulative Impacts

Impacts of framework management are mainly procedural and not environmental. The framework management process for CPS is similar to approaches used by the Council in FMPs for other fisheries on the west coast. The framework process is expected to protect the environment as well as or better than current approaches. Direct, indirect and cumulative environmental effects from the framework approach are therefore expected to be neutral or positive.

Conflicts Between Objectives

The goals and objectives for the FMP (Appendix B, Section 2.1) are shared by all state and federal agencies involved in managing CPS fisheries. The framework management process is designed to help Council make choices that balance conflicting goals and objectives in an efficient manner.

Management Resources

The framework management process involves no known irreversible commitments of energy or management resources. It is designed to help managers make efficient use of management resources (an important element in the goals and objectives). Costs (summarized in Appendix C) are essentially the same as status-quo.

Urban, Historical and Cultural Resources

Goals and objectives behind the framework management procedure include consideration of current participants who reside mostly in urban areas. Historical and cultural resources associated with the CPS fishery are well known and described in the FMP (Appendix A, sections 2-3).

5.2 Limited Entry (Appendix B, Section 3.0)

Limited entry and open access management were both options for managing fishing effort in the CPS fishery (Appendix B, Section 3). The Council also initially considered individual transferrable quota (ITQ) systems for managing fishing effort. ITQ options were not developed, however, because they are difficult to enforce and monitor, and would greatly increase management costs. In addition, the Magnuson-Stevens Act imposes a moratorium on ITQs until October 2000 .

As a fishery (particularly an open access fishery) becomes overcapitalized and fishing effort increases, economic efficiency is reduced and pressure to over harvest stocks usually increases. Resource depletion often results. Fishing effort in the historical open access sardine fishery grew rapidly, for example, in the 1930s through the 1950s to levels that could not be supported by CPS stocks and overfishing occurred.

Direct, Indirect and Cumulative impacts

Effects of limited entry and open access management are primarily socioeconomic although some environmental effects may arise if the tendency to overfish in open access fisheries is reduced by limited entry. Thus, any environmental effects from limited entry are likely to be beneficial. Open access is status quo so environmental impacts are expected to be neutral unless fishing effort increases and overfishing occurs.

Conflicts Between Objectives

The goals and objectives for the FMP (Appendix B, Section 2.1) are shared by all state and federal agencies involved in managing CPS fisheries. With respect to goals and objectives, limited entry would increase the complexity of management but this might be offset by long term benefits from controlling fishing effort.

Management Resources

A limited entry program would commit the Council and federal authorities to maintaining the program at an estimated annual cost of about $7,000 (Appendix C, Section 1.4). There are no other known irreversible commitments of energy or management resources.

Urban, Historical and Cultural Resources

There are no known impacts on historical or cultural resources associated with the CPS fishery (Appendix A, sections 2-3) from either limited entry or open access management. All existing sectors are accommodated in both options. Limited entry is not expected to result in substantial restructuring of the fishery in the foreseeable future.

5.3 Optimum Yield, MSY Control rules and Overfishing Definitions (Appendix B, Section 4.0)

MSY control rules are the most important elements of harvest management under Amendment 8 (Appendix B, Section 4.1). Species specific MSY control rules were adopted for Pacific sardine and Pacific (chub) mackerel, which will be actively managed at the outset of the FMP. Generic or "default" specifications were adopted for jack mackerel, northern anchovy and market squid, which will be monitored only at the outset of the FMP.

The Council selected Option J for Pacific sardine from a range of 13 options (Appendix B, Section 4.2). All options were reviewed based on extensive simulation analyses. All of the recommended options gave relatively high biomass levels (Appendix B, Table 4.2.5-1) compared to the deterministic equilibrium F_{MSY}

option (Option L) and the status-quo option (Option A), but Option J was thought to provide the greatest stability to the fleet, the sardine resource, and the predators that may depend on sardine for forage.

The Council chose an MSY control rule for Pacific mackerel (Appendix B, Section 4.3) that is similar to the status quo but more conservative because harvest levels are reduced in proportion to the estimated fraction of the stock biomass in U.S. waters. The only alternative considered for Pacific (chub) mackerel is the status quo. Both the status quo and preferred options were based on published simulation analysis.

The Council's preferred "default" MSY control rule used primarily for monitored only species sets harvest for U.S. fisheries equal to 25% of the best estimate of the MSY catch level for U.S. fisheries (Appendix B, Section 4.1.1). Other options were not considered because the default MSY control rule is conservative and expected to be used primarily when catches are not significant. Stocks with catch levels in excess of the default MSY control rule level will normally be promoted to the actively managed category.

Direct, Indirect and Cumulative Impacts

Harvest of forage fish like sardine involves direct, indirect and cumulative impacts on the environment. Impacts may be particularly important for forage species like Pacific sardine and northern anchovy. Species specific options recommended for Pacific sardine and Pacific (chub) mackerel minimize environmental impacts to the extent possible. The default MSY control rules recommended for northern anchovy and jack mackerel (which are underutilized species with low levels of catch) are conservative and likely involve no impacts on the environment. There is not enough information available to evaluate impacts of the default MSY control rule for market squid because squid are not well understood. As information accumulates, approaches to harvest management for market squid and other CPS will be refined.

Conflicts Between Objectives

The goals and objectives for the FMP (Appendix B, Section 2.1) are shared by all state and federal agencies involved in managing CPS fisheries. Recommended options for the sardine and anchovy MSY control rules balance the conflicting goals of promoting full fishery utilization while providing adequate forage for dependent species.

Management Resources

Recommended MSY control rules and harvest management options commit state and federal authorities to periodic stock assessments for actively managed stocks and (at minimum) monitoring of catches for all CPS. Annual costs ($2.8 million for science plus $1.3 million for monitoring) are essentially status quo (Appendix C). Costs are minimized for stocks that are monitored only.

Urban, Historical and Cultural Resources

There are no known impacts on urban, historical or cultural resources associated with the CPS fishery (Appendix A, sections 2-3) from recommended options for harvest management.

5.4 Bycatch, Incidental Catch and Allocation (Appendix B, Section 5.0)

"Bycatch" is defined in the Magnuson-Stevens Fishery Conservation Act as "fish which are harvested in a fishery, but not sold or kept for personal use and includes economic discards and regulatory discards". In the CPS fisheries, fish are caught and sold incidental to catching other species, because they sometimes school together. Options for managing incidental catches in Amendment 8 (Appendix B, Section 5.1) deal primarily with CPS as incidental catch. However, many non-CPS species (bird, fish, and marine mammal predators in particular) may be taken in fisheries that target CPS, but this problem does not seem to be significant at this time (Appendix A, Section 2.2). A variety of management measures are authorized in the FMP (Appendix B, Section 2) including closed areas, closed seasons and gear restrictions that can be used to address bycatch of predators and other non-CPS species if problems arise.

Incidental catch allowances permit fishermen to land a certain percentage of fish that would otherwise be considered bycatch. Incidental catch allowances are percentages of catch, landings, or deliveries. For CPS, incidental allowances are normally measured in units of weight rather than numbers of fish or other units, but additional approaches may be used depending on circumstances.

Incidental catch allowances are applied when a stock is overfished or a directed harvest guideline is met, and may be changed inseason to avoid premature attainment of a harvest guideline due to incidental catch. Loads of fish that exceed incidental catch allowances for overfished species or species with no harvest guideline cannot be delivered or sold. The Council will recommend incidental catch allowances according to guidelines described in the FMP.

Management and monitoring of bycatch and incidental catch is less important for CPS than other fisheries. Incidental catches tend to be low for CPS because they are harvested mostly in relatively pure schools near the surface where fish are easily identified. Environmental impacts will be few as long as options for managing incidental catch result in relatively accurate estimates of total catch. Harvest levels include adjustments for incidental catches so the overall level of harvest should be unaffected as long as relatively accurate estimates of incidental catches are available.

Environmental impacts from management of and incidental catches are most likely to be important when stocks are overfished or at low biomass levels. Sardine, for example, were taken as bycatch in the Pacific (chub) mackerel fishery during the 1980s while sardine abundance was low and mackerel abundance was high. Options for managing incidental catch in the CPS are more restrictive for overfished stocks at low biomass levels (Appendix B, Section 5.1) than for stocks at higher biomass levels (Appendix B, Section 5.2).

Allocation is authorized under framework procedures in the FMP (Appendix B, Section 2) and allocation could potentially affect coastal communities dependent on the CPS fishery. The only option for direct allocation in Amendment 8 assigns one-third of the annual sardine harvest to fishers north of Point Piedras Blancas (35° 40' N latitude) and two-thirds to fisheries south of Point Piedras Blancas (Appendix B, Section 5.2). This allocation is a status quo measure that extends current California state law with no environmental impacts.

Direct, Indirect and Cumulative Impacts

As described above, there are no direct, indirect or cumulative impacts from any of the recommended options for managing incidental catch or allocation in Amendment 8.

Conflicts Between Objectives

The goals and objectives for the FMP (Appendix B, Section 2.1) list goals and objectives shared by all state and federal agencies involved in managing CPS fisheries. There are no conflicts among goals related to options for managing incidental catch or allocation.

Management Resources

Recommended incidental catch and allocation options commit managers (primarily in the State of California) to monitoring costs at status-quo levels estimated to be about $1.3 million per year (Appendix C, Section 1.2.2).

Urban, Historical and Cultural Resources

There are no known impacts on urban, historical or cultural resources associated with the CPS fishery (Appendix A, sections 2-3) from recommended options.

6.0 List of Preparers

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7.0 List of Agencies, Organizations, and Persons Receiving Statement

Alaska Department of Fish and Game
California Department of Fish and Game
Conservation Organizations
Environmental Protection Agency
Idaho Department of Fish and Game
Grays Harbor Regional Planning Commission
National Marine Fisheries Service Alaska Fisheries Science Center
National Marine Fisheries Service Law Enforcement
National Marine Fisheries Service Northwest Region
National Marine Fisheries Service Pacific Environmental Group
National Marine Fisheries Service Southwest Fisheries Science Center
National Marine Fisheries Service Southwest Region
National Oceanic and Atmospheric Administration Northwest Region General Counsel
National Oceanic and Atmospheric Administration Southwest Region General Counsel
News Media
Northwest Indian Fisheries Commission
Oregon Department of Fish and Wildlife
Oregon State Police Department
Oregon State University
Other Organizations and Individuals
Pacific States Marine Fisheries Commission
Port Authorities
Recreational Fishing Organizations
Sea Grant Agencies
Washington Department of Fish and Wildlife
U.S. Coast Guard 11th District
U.S. Coast Guard 13th District
U.S. Coast Guard Pacific Area Training Team
U.S. Department of State
U.S. Fish and Wildlife Service
University of Alaska
University of California

Responses to Comments from Environmental Protection Agency
(October 19, 1998 letter attached)
on the Coastal Pelagic Species Draft Supplemental Environmental Impact Statement

1-2. The reviewer notes that both Pacific sardine and Pacific (chub) mackerel have been identified as overfished in recent reports prepared by the National Marine Fisheries Service (NMFS) and that harvest policies under the fishery management plan (FMP) will be similar to the status-quo. In view of the overfishing designations, the reviewer suggests that more conservative management measures may be required to manage fishing effort and harvest levels and the FMP should include rebuilding programs for overfished stocks.

Response: The maximum sustainable yield (MSY) control rule adopted for Pacific sardine is conservative and reflects the Council's policies and concern for the preeminent role of small pelagic fishes like sardine in the California Current Ecosystem. Compared to the status-quo for sardine (Option A in Appendix B, Table 4.2.5-1), long term average biomass under the new MSY control rule is expected to increase by 108% (from 936,000 mt to 1,952,000 mt) and median biomass will increase by 176% (from 598,000 mt to 1,648,000 mt). No fishing (other than a few thousand mt per year for use as live bait) is allowed in U.S. waters when the sardine biomass falls below 150,000 mt (50,000 mt under the status quo). Long term average catch levels are expected to decrease by four percent (from 151,000 mt to 145,000 mt per year) compared to the status quo. However, in the near term, (assuming 87% of a 600,000 mt coast-wide biomass in U.S. waters and current warm water conditions which are favorable for Pacific sardine), maximum U.S. catch will drop by 39% from 96,000 mt to 59,000 mt.

The MSY control rule for Pacific (chub) mackerel (Appendix B, Section 4.3) is similar to the status quo but more conservative, because U.S. catch is based on the biomass of mackerel *in U.S. waters*, rather than the coast-wide biomass in U.S. and Mexican waters. Roughly 70% of the stock is resident in U.S. waters so U.S. catch levels will decrease by about 30%. Even without the reductions in U.S. catch, the MSY control rule for mackerel tends to maintain relatively high biomass levels (MacCall et al. 1985 cited in the FMP).

Decisions about target fleet size and other aspects of limited entry in the CPS fishery reflect the need to balance benefits from accommodating existing participants in the CPS fishery against biological, management and economic benefits from reducing fleet size. The fishery and management process will likely benefit from implementation of limited entry. A more restrictive program would not have likely gained enough support to be implemented.

Reports describing Pacific sardine and Pacific (chub) mackerel as overfished are based on old information and are easy to misinterpret. The most recent stock assessments indicate that neither Pacific sardine nor Pacific (chub) mackerel are at a low biomass level. According to California Department of Fish and Game (CDFG) estimates, coast-wide sardine biomass was about 631,000 mt in 1997 and increasing at roughly 30% per year. Similarly, CDFG estimates a stable coast-wide Pacific (chub) mackerel biomass of about 120,000 mt. Neither stock is overfished or a candidate for a rebuilding program at this time.

3. The reviewer suggests a more complete discussion of the "take" of non-CPS species (especially endangered and threatened species of marine mammals, salmon and birds) in the Final Supplemental Environmental Impact Statement (FSEIS) for the CPS FMP. In particular, the reviewer recommends modifying the FSEIS to include information on the level of take, species most likely to be affected, potential mitigation and avoidance measures, and legal requirements for take, management, recovery and preservation of non-CPS species encountered in the CPS fishery.

Response: The information requested by the reviewer (legal requirements, estimates of take, species most likely to be affected) has been inserted into Appendix A as a new Section 2.2. References to Appendix A have been inserted into the FSEIS where appropriate. The relevant material in Appendix A is not repeated in the FSEIS to limit printing costs.

4. The reviewer is concerned that recent increases in sardine harvest levels may not be supported by accurate biomass estimates and sound science.

Response: Biomass estimates used to manage the sardine fishery tend to be imprecise (coefficient of variation [CV] of roughly 40%), because sardine are highly dynamic, the available abundance index data is noisy, and because the fishery (an important source of data) is relatively minor. State and federal biologists make every effort to apply the best science to the data available for sardine and other CPS. The MSY control rule for sardine was chosen in view of the underlying uncertainty and was designed to work well with imprecise biomass estimates (i.e., with CV's of roughly 50%). It is expected to provide adequate protection for the stock as long as biomass estimates are not biased high (i.e., estimated biomass consistently higher than actual).

There has been a trend in recent years towards a negative bias in sardine biomass estimates, despite improvements in stock assessment models and data, because the sardine stock has increased very rapidly in abundance and its distribution has increased beyond the range of the surveys used to collect abundance information. This negative bias operates to the detriment of the fishery, but not the sardine stock, because harvest levels tend to be lower than required.

5. The reviewer recommends that a preferred option and more detail be provided regarding the existing closed areas.

Response: In adopting the FMP, the Council decided to retain all existing area closures for anchovy reduction fishing, with exempted fishing permits.

6. The reviewer was concerned about the lack of limited entry for market squid and recommended monitoring of the fishery with a commitment to implement limited entry if required at some point in future.

Response: The Council decided early in development of Amendment 8 that limited entry for market squid was too controversial and would be impossible to implement in time for Amendment 8 with available staff and resources. In addition, the State of California had just implemented a license limitation program designed to fund a dedicated research fund for market squid. It may be possible; however, to implement limited entry for market squid at some point in the future if such an action becomes feasible or desirable and sufficient staff are available.

7. The reviewer requested that the FSEIS more clearly state how the Council or NMFS intend to ensure the conservation and enhancement measures contained in Appendix D (Essential Fish Habitat) are implemented.

The FMP and NMFS cannot ensure that the recommended nonfishing conservation measures are followed, because NMFS does not have authority over regulations for nonfishing activities. The final rule implementing the EFH provisions of the Magnuson-Stevens Act at 50 CFR 600.815 requires FMPs to *describe* these conservation and enhancement measures. Introductory language in publication of the interim final rule indicates the described measures are advisory in nature, non-binding, and not mandatory (62 FR 66540 and 66543).

However, NMFS may use these conservation and enhancement measures to guide consultation efforts. The EFH section of the FMP addresses consultation procedures as follows:

> The Magnuson-Stevens Act requires federal agencies undertaking, permitting or funding activities that may adversely affect EFH to consult with NMFS. Under section 305 (b)(4) of the Magnuson-Stevens Act, NMFS is required to provide EFH conservation and enhancement recommendations to federal and state agencies for actions that adversely affect EFH. However, state agencies and private parties are not required to consult with NMFS. EFH consultations will be combined with existing interagency consultations and environmental review procedures that may be required under other statutes such as the Endangered Species Act, Clean Water Act, the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the Federal Power Act, or the Rivers and Harbors Act. (Appendix D)

The FSEIS and Appendix D to the CPS plan have been updated with the following text to include language providing more detail on the consultation process:

EFH consultation may be at either a broad programmatic level or project-specific level. Programmatic is defined as "broad" in terms of process, geography, or policy (e.g., "national level" policy, a "batch" of similar activities at a "landscape level", etc.) Where appropriate, NMFS will use a programmatic approach designed to reduce redundant paperwork and to focus on the appropriate level of analysis whenever possible. The approach would permit project activities to proceed at broad levels of resolution so long as they conform to the programmatic consultation. The wide variety of development activities over the extensive range of EFH, and the Magnuson-Stevens Act requirement for a cumulative effects analysis warrants this programmatic approach. (Appendix D).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

OCT 19 1998

James Morgan
National Marine Fisheries Service
Southwest Region
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Long Beach, CA. 90802-4213

Dear Mr. Morgan:

The Environmental Protection Agency (EPA) has reviewed the Draft Supplemental Environmental Impact Statement (SDEIS) for **Amendment 8 to the Northern Anchovy Fishery Management Plan for the Washington, Oregon, and California Coastal Pelagic Species Fishery.** Our review is pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act.

The Pacific Fishery Management Council and National Marine Fisheries Service (NMFS) propose to implement an amendment to the fishery management plan (FMP) for Northern Anchovy. The plan amendment proposes to add Pacific sardine, Pacific (chub) mackerel, jack mackerel, and market squid to the fishery management unit, which currently only covers northern anchovy, and to change the name of the plan to the Coastal Pelagic Species Fishery Management Plan. The plan proposes a system of "actively managed" (Pacific sardine, Pacific mackerel) and "monitored only" (northern anchovy, market squid, jack mackerel) species to help focus scarce resources and the direction of management and research efforts where they are most needed. The plan also proposes a limited entry program for coastal pelagic finfish species south of 39 degree N latitude. Tools to be used include limited entry permits to limit fleet size, limited harvest levels per trip, and a targeted geographical area. The option to utilize other tools without additional formal amendments is provided for in the FMP. The FMP contains harvest policy options that preserve a portion of the stocks as forage for marine mammals and birds while maintaining a stable fishery, and an Essential Fish Habitat section, both of which conform to the requirements of the Magnuson-Stevens Fishery Conservation and Management Act of 1996.

EPA recognizes the significant challenges in managing a complex international resource and balancing biological, ecological, social, and economic demands. Maintaining a conservative balance between utilization and preservation of a resource is especially critical for highly variable, environmentally sensitive, unknown, and vulnerable resources such as the coastal pelagic species (CPS). We also believe a protective approach is necessary to minimize the "tragedy of the commons" which encourages competition and over exploitation of the common resource. Thus, we urge a commitment to active stewardship of the CPS resource and to seeking agreements with Mexico and Canada on the sustainable management of this resource.

EPA supports the overall approach outlined in Amendment 8. We also strongly advocate consolidation of CPS management under a single FMP, increased international and interstate cooperation, and control of future fishery expansion; especially given the historical collapse of the pacific sardine resource and evidence that Pacific sardine and Pacific mackerel are being overfished (pg. B-4). Implementation of a limited entry management strategy in the highly utilized southern range of the CPS fishery appears very appropriate. The actively managed and monitor-only approach and goals and objectives (pg. B-7) are also commendable features of the proposed FMP.

Although we support your efforts to balance resource preservation and efficient utilization, we remain concerned with potential impacts to endangered marine mammals and birds, the minimal development of stock recovery plans (rebuilding program, pg. B-81), and scarcity of firm data upon which to base management decisions. Because of these concerns, we have classified this SDEIS as category EC-2, Environmental Concerns - Insufficient Information (see attached "Summary of the EPA Rating System").

We appreciate the opportunity to review this SDEIS. Please send one copy of the Final EIS to this office at the same time it is officially filed with our Washington, D.C. office. If you have questions or wish to discuss our comments, please call Ms. Laura Fujii, of my staff, at (415) 744-1601.

Sincerely,

David J. Farrel, Chief
Federal Activities Office
Cross Media Division

Enclosure: (3 pages)
Filename: cpsfish.wpd
MI003157

cc: USFWS, Sacramento
Pacific Fishery Mgmt Council

COMMENTS

1. The SDEIS states that a recent report has identified both Pacific sardine and Pacific (chub) mackerel as being overfished (pg. B-4). At the same time, proposed management appears to maintain 95-99% of existing harvest levels, the maximum allowable trip harvest limit, and no limits on fleet harvest capacity (pg. EIS-5). Given the possible precarious condition of the stock, we urge you to reconsider the preferred options for target fleet size, limiting effort, and trip limits and to chose more conservative options.

2. In addition, we strongly recommend the FMP include, at a minimum, the framework for a rebuilding program for overfished stocks. While we recognize the difficulties in meeting the rebuilding requirement to reach in ten years the maximum sustainable yield (MSY) biomass (pg. EIS-9), we believe every effort should be made to approach this goal.

3. The SDEIS states that many non-CPS species (bird, fish and marine mammal predators) may be taken when harvesting target CPS and that the problem does not seem to be significant at this time (pg. EIS-18). Reference is made to appendices to provide additional detail. The appendices are lengthy and technical and do not appear to address the specific issue of "take" of non-CPS species. We note that some of the non-CPS species are listed as sensitive, endangered, or threatened (e.g., marine mammals, salmon, Fin whale) and therefore require special protection. We recommend the Supplemental Final EIS (SFEIS) expand the discussion regarding the "take" of non-CPS species. Include summarized information on the level of take, species most likely to be effected, and potential mitigation and avoidance measures. The discussion should also include background information regarding the legal requirements for "take", management, recovery and preservation of these species.

4. As stated in the SDEIS, Pacific sardine experienced a dramatic collapse in the 1940s due to overfishing and poor environmental conditions (pg. A-31). A moratorium on harvesting and a recovery plan were implemented. The recovery plan allowed a small directed harvest quota only when the spawning biomass reached a certain minimum level. Anecdotal reports and incidental occurrence of sardines in other fish catches have suggested an increased abundance. As a result, the annual directed quota has been steadily increasing (pg. A-32). It is unclear whether the increased annual quotas have been based on sound science and an accurate estimate of the spawning biomass. Given the past collapse of Pacific sardine and the tendency to overfish this species, we remain very concerned with the wisdom of increasing annual harvest quotas when accurate data of the spawning biomass may be lacking. We have a similar concern regarding the northern anchovy quota. The SFEIS should persuasively demonstrate that the increasing directed quotas for Pacific sardine and

northern anchovy are based upon accurate and verifiable estimates of the spawning biomass and sound science.

5. Although options for closed fishing areas are described, it does not appear as if a preferred option has been selected (Section 2.2.2.2.4 Option for Closed Fishing Areas, B-17). The description also states that the FMP authorizes the issuance of exempted fishing permits for fishing in closed areas. We recommend the SFEIS include a preferred option and provide additional detail regarding the potential management scenario. For example, one scenario for evaluation may be retaining all closed areas to all CPS fishing with the issuance of exempted fishing permits.

6. We are concerned with the proposal not to limit entry for market squid especially given the lack of understanding of the harvest potential of this species (pg. B-52). We understand the possible difficulty of reducing the number of vessels currently harvesting squid and recognize that California is implementing its own vessel licensing program for squid. State management may help reduce the potential for overfishing. Nevertheless, the lack of scientific knowledge regarding market squid warrants extreme caution. Thus, we urge you to implement reliable, rigorous monitoring of the squid fishery and to firmly commit to implementation of limited entry, if necessary, to conserve this resource.

7. Table 4.0.1 describes adverse nonfishing activities, their impacts, and possible conservation and enhancement measures that can be taken to minimize and mitigate these impacts (pg. D-20). While we support the conservation measures, it is not clear how the Pacific Fishery Management Council or NMFS intend to ensure these measures are implemented. The SFEIS should clearly state how the FMP and implementing agencies will ensure conservation measures are followed so that nonfishing activities will have minimal adverse impact on the CPS resource.

SUMMARY OF EPA RATING DEFINITIONS

This rating system was developed as a means to summarize EPA's level of concern with a proposed action. The ratings are a combination of alphabetical categories for evaluation of the environmental impacts of the proposal and numerical categories for evaluation of the adequacy of the EIS.

ENVIRONMENTAL IMPACT OF THE ACTION

"LO" (Lack of Objections)

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

"EC" (Environmental Concerns)

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

"EO" (Environmental Objections)

The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

"EU" (Environmentally Unsatisfactory)

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

ADEQUACY OF THE IMPACT STATEMENT

Category 1" (Adequate)

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

"Category 2" (Insufficient Information)

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analysed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

"Category 3" (Inadequate)

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analysed in the draft EIS, which should be analysed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640, "Policy and Procedures for the Review of Federal Actions Impacting the Environment."

RESPONSES TO COMMENTS RECEIVED ON COASTAL PELAGIC SPECIES DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
(Comments summarized from attached letters)

Comment: One commenter recommended that the Council not authorize a commercial fishery for sardine off the Washington coast to avoid bycatch of coho salmon and so that sardine in that area remain available as forage for salmon.

Response: While the fishery management plan (FMP) amendment involves procedures to set a coastwide harvest guideline of sardine and specifies a portion of that harvest guideline to be taken north of Pt. Piedras Blancas (35°40' N latitude), the FMP also defers to state fishery regulations. State fishery regulations in Washington currently prohibit commercial sardine fishing except under strictly monitored experimental fishing permits. States can request a consistency determination from the Council for new or existing state regulations under procedures specified in the plan.

Comment: One commenter proposed numerous changes to the essential fish habitat (EFH) portion of the FMP amendment, primarily with respect to the proposed conservation and enhancement measures.

Response: At its September 1998 Council meeting, National Marine Fisheries Service and Council staff worked with the commenter to develop language acceptable to all parties. That language was adopted by the Council and has been incorporated into the final coastal pelagic species (CPS) FMP.

Comment: One commenter recommended a target fleet size in a limited entry program of the vessels accountable for at least 99% of total CPS finfish landed in the window period (January 1, 1993 through November 5, 1997).

Response: The Council chose a target fleet size of vessels that were accountable for at least 99% of total CPS finfish landed in the window period (January 1, 1993 through November 5, 1997).

Comment: One commenter thought the limited entry program should contain provisions whereby a vessel under construction or conversion during the window period should be allowed to receive a permit under certain conditions.

Response: The Council chose not to allow such exceptions in the limited entry program with the explicit reasoning that owners who receive permit(s) are allowed, within the first year of the program, to transfer their permit(s) to any vessel.

Comment: One commenter opposed the inclusion of market squid in the CPS FMP on the grounds that squid is harvested almost exclusively within three miles and is currently being managed by California Department of Fish and Game.

Response: Market Squid is included in the FMP, but currently is assigned to the "Monitored" management category and is not subject to limited entry provisions. Monitored species are those not requiring intensive management efforts and stocks not well enough understood to be managed. The purpose of Active and Monitored management categories is to use available agency resources in the most efficient and effective manner while satisfying goals and objectives of the FMP. The distinction enables managers and scientists to concentrate efforts on stocks and segments of the CPS fisheries that need greatest attention or where the most significant benefits might be expected. Monitored management involves tracking trends in catches and qualitative comparison to available abundance data, but without periodic stock assessments, periodically adjusted target harvest levels, or other types of active management.

Although market squid is Monitored, it is included in the CPS FMP because it is a mainstay of the CPS fishery, it supports a significant level of harvest, and it is harvested throughout its north-south range (from Baja California to Southeast Alaska) and in federal and state waters (though the majority is harvested in California state waters). There is also substantial overlap between fishing activities for squid and CPS finfish.

Comment: One commenter was opposed to the use of limited entry as a means of limiting effort in the CPS fishery.

Response: Vessels currently participating in the CPS finfish fishery are capable of harvesting more CPS finfish than is available under current biomass conditions. Fisheries characterized by excess harvesting capacity are described as overcapitalized in terms of the number of vessels and the amount of gear and equipment devoted to harvesting. This situation represents an economically inefficient use of society's productive resources and causes several problems for managers and the fishing industry when abundance declines and catches are reduced. As harvest capacity in the fisheries increases, problems arising from the need for more restrictive management measures and resolution of allocation issues become more acute. No relief from these problems will occur if harvest capacity continues to rise.

In addition to current CPS finfish participants, newcomers are likely to be attracted to the fishery, because of the expanding sardine biomass and squid fishery, and as competition in other Pacific Coast fisheries becomes more intense. Nearly all groundfish stocks are now fully harvested by domestic fishers in the Pacific Coast groundfish fishery.

In the Pacific Coast CPS finfish fishery, excess harvest capacity is likely to result in an increasing number and complexity of regulations. Accordingly, the Council will face increased pressure to balance the conflicting need to protect the resource with the need to provide sufficient allowable catch to sustain the fishery.

Increased number and complexity of regulations have many adverse impacts in such areas as fleet costs, resource utilization, safety, enforcement costs, and effectiveness. Moreover, there is a point beyond which additional regulations, which interfere with day-to-day vessel operations (e.g., trip limits or mesh size regulations), will not improve the Council's ability to accomplish its management goals. Pressures on industry arise not only from management measures which restrict operations, but also from increased competition for the allowable catches among larger numbers of vessels.

For these reasons, the Council has chosen a limited entry program for CPS finfish.

Ronald Wagner.
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Potential Fishery for Sardine, Mackerel and Squid

I would hope that you would not authorize a Commercial Fishery for Sardine off the Washington Coast. A Fishery of this nature would not fall under the Forage Fish plan. The primary objection is the Bycatch of Coho Salmon. The Forage Fish plan very clearly points out that the Sardines are alternate food source for the Salmon when Herring are not abundant. We must decide weather we are going to have a good crop of Salmon that would be enjoyed by all user groups or harvest BaitFish.

Thankyou,
Ronald Wagner

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August 31, 1998

FILE NO. SFH 200.241

Mr. Lawrence D. Six
Executive Director
Pacific Fishery Management Council
2130 SW Fifth Avenue, Suite 224
Portland, Oregon, 97201

FAXED TO (503) 326-6831 ON 8/31/98

Subject: **ESSENTIAL FISH HABITAT - PROPOSED AMENDMENTS TO THE COASTAL PELAGIC SPECIES FISHERIES MANAGEMENT PLAN**

Dear Mr. Six:

SDG&E herein submits its comments on the proposed amendments[1] to the Pacific Fishery Management Council's Fishery Management Plan for Coastal Pelagic Species regarding essential fish habitat.

SDG&E appreciates this opportunity to provide comments on the proposed amendments. These comments are based upon our initial review of the proposed amendments. As we conduct further review, we may have additional comments for your consideration.

SDG&E operates two steam electric generating power plants utilizing waters which may be affected by this plan amendment and these two power plants have been designated as must-run facilities by the Independent System Operator (ISO) in accordance with California AB1890, as their operation has been determined to be essential to maintain the required availability and reliability of service. Overly broad regulation may impact the availability of power as required by the ISO and AB1890 and, as written in their proposed form, the amendments are perceived by us to be unnecessarily broad. Although the proposed conservation and enhancement measures are considered to be "advisory", they have the potential to play a significant role in various regulatory proceedings, such as NPDES discharge permit proceedings. Consequently, it is very important that they be clear and specific in order to prevent being misconstrued or misapplied.

These comments address the definition of essential fish habitat, the description of non-fishing related effects, and the proposed conservation and enhancement measures. Comments on the description of non-fishing effects and the proposed conservation and enhancement measures are grouped together by each identified non-fishing related activity.

[1] Comments are in reference to the Pacific Fishery Management Council's *Draft Amendment 8 (CPS), Appendix D - Description and Identification of Essential Fish Habitat for the Coastal Pelagic Species Fishery Management Plan*, dated August 1998.

At the end of each section of the enclosed comments are proposed revisions that would incorporate SDG&E's comments into the plan. A table summarizing these revisions is also attached.

DEFINITION OF ESSENTIAL FISH HABITAT

The definition of essential fish habitat (EFH) in Section 2.0 (Appendix D) appears to be inclusive of all marine waters in California, from estuarine habitats out to the Exclusive Economic Zone (EEZ). This definition does not differentiate between habitat which is "essential" or "necessary" (as considered in the context of the Sustainable Fisheries Act) from habitat which is not "necessary". The legislative history (as described by the NOAA Office of General Council[2]) indicates that both the House and the Senate intended to include the "...idea that these waters must be "necessary" to the fish, presumably to prevent inclusion of less important habitat." In other words, there exists different grades of habitat within the range of a species, only some of which would be considered essential. The proposed definition appears to contradict the intent of the legislation. This has resulted in many areas being designated as EFH that are not truly "necessary" as specified by the legislation and will result in excess federal, state and private resources being expended to assess and mitigate impacts to EFH which do not have a significant effect on the managed species. Additionally, it appears unnecessary to identify the entire geographic ranges, both current and historic, of the species. For example, although Jack Mackerel occur from the coast to off-shore, the document indicates that they are more commonly found offshore and much of their range occurs outside of the 200 mile EEZ. Furthermore, Table 2.0, of the plan, states that "CPS may occur in shallow embayments and brackish water **but do not depend on these habitats to any significant degree." [emphasis added].** Therefore it appears off-shore habitats may be more important to this species than other habitats and should be the habitat identified as "essential". **At a minimum the definition should be revised to exclude shallow embayments and brackish water areas.** Additionally, the definition should only identify geographical areas which are high quality habitats and have high usage by the species, with an emphasis on those areas which do not have existing anthropogenic influences.

SDG&E appreciates that obtaining higher level data for all species may not have been possible within the time period allowed for preparing the EFH designations, but this approach places a high resource burden on both regulatory and regulated communities.

Recommended Revisions[3]

1. Revise Section 2.0 (Description and Identification of Essential Fish Habitat for the Coastal Pelagic Species Fishery) as follows:

   a) At a minimum, revise the first sentence in paragraph No. 3 to read as follows: "The east-west geographic boundary of EFH for each individual CPS finfish and market squid is defined to be all marine ~~and estuarine~~ waters, except for

[2] See "Essential Fish Habitat" discussion in the document "A Guide to the Sustainable Fisheries Act Public Law 104-297" prepared by the NOAA Office of General Counsel, February, 1997, located at http:\\kingfish.ssp.nmfs.gov/sfa/sfaguide/102.htm.

[3] Note that in the proposed revisions, underlined words are to be inserted and ~~lined-out~~ words are to be deleted.

shallow embayments and brackish water areas, from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the exclusive economic zone (EEZ) and above the thermocline where sea surface temperatures range between 10°C to 26°C."

NON-FISHING EFFECTS

Appendix D contains a discussion of a number of non-fishing activities that are considered to have the potential to have adverse effects on EFH. The broad categories of activities listed in the National Fisheries Marine Service's (NMFS) EFH interim final regulations are restated, along with NMFS's proposed conservation measures, in Appendix D.

One comment that is common to all of the categories below is that the adverse impacts sections should include examples of benefits to habitats that also result from the same activities evaluated for adverse effects. Beneficial effects, not just adverse effects, should be considered in any analysis of an action's net effect by agencies conducting adverse effects analyses.

Following are comments on several of these categories that are of interest to SDG&E.

Dredging

Dredging activities are identified as having a periodic impact on benthic and adjacent habitats during the construction and operation of marinas, harbors and ports.

It appears that dredging activities are not likely to have significant impacts on CPS because:

- dredging activities most likely to occur in bays and estuaries, not open coastal areas;
- the CPS Habitat/Life History Descriptions (Appendix D, Section 6.0) indicate that CPS are primarily open coastal and offshore species and not dependent upon bays and estuaries for stages of their life cycles; and
- where dredging does occur in bays and estuaries the overall net effect may be to increase usable habitat, as some dredging activities provide for better circulation and/or keep coastal lagoons open which would otherwise be naturally closed off to the ocean, resulting in no useable habitat to the CPS.

Dredging activities are conducted using several different types of equipment. The type of equipment used and its manner of operation will determine the type and degree of potential impacts.

Maintenance of previously dredged areas should be considered differently than new dredging activities that affect previously undisturbed habitat. For example, routine maintenance dredging of existing dredged channels and areas which support existing surface water dependent facilities should have less impact to overall habitat values than dredging of new areas.

The conservation and enhancement measures for dredging identify six measures. **Measure No. 1** ("To the maximum extent practicable, dredging should be avoided.") should be revised to apply to "New activities that require new dredging..." as many existing ports and facilities are dependent upon the maintenance of existing dredged areas.

Measure No. 2 ("Dredging in estuarine waters shallower than 20' in depth should be performed during the time frame when prey species are least likely to be entrained.") would be an unreasonable restriction for certain types of dredging activities and would not result in minimizing entrainment of prey species. Typical dredging activities are conducted 24 hours a day, six days a week in order to complete dredging over relatively short periods of time. SDG&E's experience in conducting dredging activities with the cutter head suction method is that the vibration and noise created by the operation keeps almost all fish away from the immediate vicinity of the dredging activities, thus preventing their entrainment. Use of this restriction should be dredging method specific, if at all.

Measure No. 6 ("To the extent possible, dredging should be conducted during ebb tides to minimize turbidity.") would also be an unreasonable restriction for certain types of dredging methods and would not result in minimization of turbidity. For example, cutter head suction type dredges do not result in significant turbidity as the material dislodged by the cutter head is removed from the water body by suction. As typical dredging activities are conducted 24 hours a day, six days a week, this measure would be very disruptive to dredging operations. Use of this restriction should be dredging method specific, if at all.

Recommended Revisions

1. Revise Section 4.2.1.1 (Adverse Impacts) as follows:

   a) Revise the first sentence in the first paragraph to read:
   "Dredging events <u>using certain types of dredging equipment</u> can result in greatly elevated levels of fine-grained mineral particles, usually smaller than silt, and organic particles in the water column habitat utilized by CPS finfish <u>(some equipment types, such as cutter head suction equipment, do not result in significant turbidity plumes).</u>"

   b) Add the following language to the end of the second paragraph:
   "<u>Routine maintenance dredging of existing dredged channels and areas which support existing surface water dependent facilities likely have less impact to overall habitat values than dredging of new areas. Dredging, however, can have certain beneficial effects to the habitat which need to be considered in the assessment of effects. For example, dredging of coastal lagoons can result in systems continuously open to the ocean making them available to CPS and overall more biologically productive. Also, in some cases dredging can improve the water circulation in bays, thereby enhancing its use.</u>"

2. Revise Section 5.2.1 (Dredging) as follows:

   a) **Measure No. 1** - Revise the first sentence to read:

"To the maximum extent practicable, new activities that require new dredging should be avoided."

b) **Measure No. 2 -** Revise to read:
"Where the dredge equipment employed could cause significant long term impacts due to entrainment of prey species, d~~D~~redging in estuarine waters shallower than 20 feet in depth should be performed during the time frame when prey species are least likely to be entrained."

c) **Measure No. 6 -** Revise to read:
"Where a dredging equipment type is used that is expected to create significant turbidity (e.g., clamshell), ~~To the maximum extent possible,~~ dredging should be conducted using adequate control measures ~~during ebb tides~~ to minimize turbidity."

Dredge Material Disposal/Fills

This section should also recognize the potential benefits of dredging activities, including dredge material disposal. Some dredged materials are suitable (i.e., chemical composition and grain size) for beach replenishment. This is very important in southern California, not only from economic and land protection standpoints, but also for supplementing the coastal sand budget resulting in enhanced near-shore sandy bottom habitat. Beach replenishment with appropriate dredging materials may also provide an increased food supply near beach replenishment disposal sites. The text, therefore, should clarify that dredge disposal can also have beneficial effects. Where adverse effects do occur, they should be weighed against any short-term and long term benefits.

The conservation and enhancement measures for "Fills/Dredge Material Disposal" identify six measures. **Measure No. 1** ("To the extent possible, fill materials resulting from dredging operations should be placed on an upland site.") should be revised to not preclude the use of permitted USEPA or ACOE off-shore dredge disposal sites that have been permitted for such use.

Measure No. 3 states that the disposal of contaminated dredge material should not be allowed in EFH. To eliminate the use of the vague term "contaminated", the measure should be revised to state that any disposal of dredge material in EFH meet applicable state and/ or federal quality standards for such disposal.

Measure No. 5 states that all non-avoidable impacts should be fully mitigated. This should be revised to apply to significant long-term impacts. Short term or insignificant impacts should not necessarily require mitigation.

Recommended Revisions

1. Revise Section 4.2.2.1 (Adverse Impacts) as follows:

   a) Add the following language as the third paragraph:

"Disposal of dredge materials may also have beneficial effects. For example, beach replenishment can supplement the coastal sand budget resulting in enhanced near-shore sandy bottom habitat. Beach replenishment with appropriate dredging materials may also provide an increased food supply near beach replenishment disposal sites. Where short-term adverse effects do occur, they should be weighed against any short-term and long term benefits."

2. Revise Section 5.2.2 (Fills/Dredge Material Disposal) as follows:

   a) **Measure No. 1** - Revise the first sentence to read:
   "To the extent possible, fill materials resulting from dredging operations should be placed on an upland site, although this should not preclude the use of permitted USEPA or ACOE offshore disposal sites."
   b) **Measure No. 3** - Revise to read:
   "Any disposal of dredge material in EFH, should meet applicable state and/ or federal quality standards for such disposal. ~~The disposal of contaminated dredge material should not be allowed in EFH.~~"
   c) **Measure No. 5** - Revise to read:
   "All non-avoidable, adverse impacts (other than insignificant or short-term impacts) should be fully mitigated."

Water Intake Structures

Water intake structures are identified as potentially causing adverse effects to EFH. This section should also state that the operation of intake systems can provide benefits in terms of increased water circulation and playing a role in keeping coastal lagoons open to the ocean, resulting in enhanced habitat values.

The conservation and enhancement measures for "Water Intake Structures" identify four measures. **Measure No. 1**, second sentence ("Discharge points should be located in areas that have low concentrations of living marine resources, or they should incorporate cooling towers...") should be revised to clarify that it applies to new facilities, as relocation of existing facilities or retrofitting with cooling towers is not economically feasible. Additionally, this sentence should be revised to specify that discharges from cooling towers employ safeguards to ensure against release of blowdown pollutants into the aquatic environment in concentrations that exceed limits established pursuant to state and/ or federal NPDES regulations.

Measure No. 2 states that all intake structures should be designed to **prevent** entrainment or impingement of prey species **[emphasis added]**. Prevention is not a practical standard and is inconsistent with the Clean Water Act. This measure should be revised to state that intake structures should be designed to meet the best technology available (BTA) requirements as developed pursuant to Section 316b of the Clean Water Act.

Measure No. 3 ("Discharge temperatures (both heated and cooled effluent) should not exceed the thermal tolerance of the biota in the receiving body of water") is inconsistent with the State of California "Thermal Plan" and possibly the thermal requirements in the other affected states. It should be revised to require compliance with applicable temperature limits established pursuant to state and federal NPDES regulations.

Measure No. 4 states that mitigation should be provided for the loss of fish larvae and eggs that may be entrained by large intake systems as well as the loss of prey organisms. This measure should be deleted as it is addressed by Measure No. 2 (see above comment) that would require intakes to meet the BTA standard of the Clean Water Act, thereby minimizing the impingement and entrainment at intake structures. Again, entrainment and impingement effects should be addressed by compliance with Clean Water Act Section 316b requirements.

Recommended Revisions

1. Revise Section 4.2.4.1 (Adverse Impacts) as follows:

   a) Add the following language as a second paragraph:
   "Intake systems can also provide benefits in terms of increased water circulation and playing a role in keeping coastal lagoons open to the ocean, resulting in enhanced habitat values. These benefits should be considered when assessing potential impacts."

2. Revise Section 5.2.4 (Water Intake Structures) as follows:

   a) **Measure No. 1** - Revise the second sentence to read:
   "New d~~D~~ischarge points should be located in areas that have low concentrations of living marine resources, or they should incorporate cooling towers that employ sufficient safeguards to ensure against release of blow-down pollutants into the aquatic environment in concentrations that exceed state and/ or federal limits established pursuant to state and/ or federal NPDES regulations;"

   b) **Measure No. 2** - Revise to read:
   "All intake structures should be designed to minimize ~~prevent~~ entrainment or impingement of prey species. Power plant intake structures should be designed to meet the "best technology available" requirements as developed pursuant to Section 316b of the Clean Water Act."

   c) **Measure No. 3** - Revise to read:
   "Discharge temperatures (both heated and cooled effluent) should comply with applicable temperature limits established pursuant to state and/ or federal NPDES regulations ~~be below the upper range of the thermal tolerance of the biota in the receiving body of water~~."

   d) **Measure No. 4** - Delete as follows:
   ~~"Mitigation should be provided for the loss of fish larvae and eggs that may be entrained by large intake systems as well as the loss or prey organisms."~~

Wastewater Discharges

The wastewater discharges section contains a long discussion regarding the significance of pollutants discharged from point sources. Much of the data in this discussion dates back to the 1970s and 1980s. Significant progress has been made in the regulation of point source discharges, both municipal and industrial, since that time. The most significant remaining source of pollution to the coastal areas and the ocean is non-point source/stormwater runoff. In fact, EPA and States are shifting their strategies to address water quality issues on a watershed basis, which looks at all of the sources of pollutants within a watershed which contribute to pollutant problems. A brief paragraph at the end of the description describes stormwater pollutants. It would seem appropriate to revise this section to provide more information regarding non-point source/stormwater pollution.

The use of biocides is also mentioned in the text. The text should clarify that discharges are made pursuant to state and federal NPDES permit requirements which set both technology-based and water quality-based effluent limits (including toxicity) for the discharges.

The conservation and enhancement measures for "Wastewater Discharges" identify three measures. **Measure No. 1,** second sentence ("Discharges should be treated using the best available technology, including implementation of up-to-date methodologies for reducing discharges of biocides (e.g., chlorine) and other toxic substances.") should be revised to specify that discharges should comply with the technology and water quality based effluent limits in their NPDES permits.

Recommended Revisions

1. Revise Section 4.2.6 (Wastewater Discharge) as follows:

   a) Revise the paragraph as follows:
   "The discharge of point and nonpoint source wastewater from activities including municipal wastewater treatment plants, power generating stations, industrial plants (e.g., pulp mills, desalination plants) and storm drains into open ocean waters, bay or estuarine waters can introduce pollutants detrimental to estuarine and marine habitats. These pollutants include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, hydrocarbons and other toxics. Historically, wastewater discharges have been one of the largest sources of contaminants into coastal waters. However, non-point source/ stormwater runoff is considered the most significant remaining source of pollution to the coastal areas and ocean. Outfall-related changes in community structure and function, health and abundance may result. Many of the changes can be long-lasting."

2. Revise Section 4.2.6.1 (Adverse Impacts) as follows:

   a) Revise the first sentence of the first paragraph to read as follows:
   "Wastewater effluent and non-point source/ stormwater discharges may affect the growth and condition of fish associated with ~~wastewater~~ outfalls should high contaminant levels (e.g., chlorinated hydrocarbons; pesticides; herbicides) be discharged."

b) Revise the ninth paragraph to read as follows:

"The use of biocides (e.g., chlorine; heat treatments) to prevent biofouling or the discharge of brine as a byproduct of desalinization may reduce the suitability of water bodies for populations of fish species and their prey in the general vicinity of the discharge pipe. The impacts of chlorination and heat treatments, if any, are minimized due to their intermittent use and regulation pursuant to state and/ or federal NPDES permit requirements. These compounds may change the chemistry and the physical characteristics of the receiving water at the disposal site by introducing chemical constituents in suspended or dissolved form. In addition to chemical and thermal effects, discharge sites may adversely impact sensitive areas such as emergent marshes, seagrasses, and kelp beds if located improperly."

3. Revise Section 5.2.6 (Wastewater Discharge) as follows:

a) **Measure No. 1 -** Revise the second sentence to read:

"Discharges should be managed to comply with applicable state and/ or federal NPDES permit requirements, including compliance with applicable technology-based and water quality-based effluent limits. ~~treated using the best available technology, including implementation of up-to-date methodologies for reducing discharges of biocides (e.g., chlorine) and other toxic substances."~~

Discharges of Oil or Release of Hazardous Substances

This section should clarify that it does not apply to discharges which are permitted pursuant to, and conducted in accordance with, the conditions of applicable state and/ or federal NPDES permits.

Recommended Revisions

1. Revise Section 4.2.7.1 (Adverse Impacts) as follows:

a) Revise the first sentence in the first paragraph as follows:

"Exposure to petroleum products and hazardous substances from spills or other unauthorized releases can have both acute and chronic effects on fish resources and their prey, and also potentially reduce the marketability of target species."

2. Revise Section 5.2.7 (Discharge of Oil or Release of Hazardous Substances) as follows:

a) Measure No. 2 - Revise to read:

"Each facility should have a "Spill Contingency Plan" and ~~all~~ employees identified in the plan as having responsibility for responding to a spill should receive appropriate training ~~be trained in how to respond to a spill~~. A Spill Contingency Plan(s) developed for another agency can be used to fulfill this measure."

Again, SDG&E appreciates this opportunity to submit comments. Please fell free to call me (619) 696-2511, if you would like to discuss these comments.

Sincerely,

Fredrik J. Jacobsen
Sr. Environmental Specialist

Attachment

cc: Mark Helvey (NMFS)

Summary Table of SDG&E's Recommended Plan Revisions

Issue	Recommended Revision
Description and Identification of Essential Fish Habitat for the Coastal Pelagic Species Fishery	1. Revise Section 2.0 (Description and Identification of Essential Fish Habitat for the Coastal Pelagic Species Fishery) as follows: a) At a minimum, revise the first sentence in paragraph No. 3 to read as follows: "The east-west geographic boundary of EFH for each individual CPS finfish and market squid is defined to be all marine ~~and estuarine~~ waters, except for shallow embayments and brackish water areas, from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the exclusive economic zone (EEZ) and above the thermocline where sea surface temperatures range between 10°C to 26°C."
Dredging	1. Revise Section 4.2.1.1 (Adverse Impacts) as follows: a) Revise the first sentence in the first paragraph to read: "Dredging events using certain types of dredging equipment can result in greatly elevated levels of fine-grained mineral particles, usually smaller than silt, and organic particles in the water column habitat utilized by CPS finfish (some equipment types, such as cutter head suction equipment, do not result in significant turbidity plumes)." b) Add the following language to the end of the second paragraph: "Routine maintenance dredging of existing dredged channels and areas which support existing surface water dependent facilities likely have less impact to overall habitat values than dredging of new areas. Dredging, however, can have certain beneficial effects to the habitat which need to be considered in the assessment of effects. For example, dredging of coastal lagoons can result in systems continuously open to the ocean making them available to CPS and overall more biologically productive. Also, in some cases dredging can improve the water circulation in bays, thereby enhancing its use." 2. Revise Section 5.2.1 (Dredging) as follows: a) **Measure No. 1** - Revise the first sentence to read: "To the maximum extent practicable, new activities that require new dredging should be avoided." b) **Measure No. 2** - Revise to read: "Where the dredge equipment employed could cause significant long term impacts due to entrainment of prey species, d~~D~~redging in estuarine waters shallower than 20 feet in depth should be performed during the time frame when prey species are least likely to

Issue	Recommended Revision
Dredging (cont.)	be entrained." c) **Measure No. 6 -** Revise to read: "Where a dredging equipment type is used that is expected to create significant turbidity (e.g., clamshell), ~~To the maximum extent possible,~~ dredging should be conducted using adequate control measures ~~during ebb tides~~ to minimize turbidity."
Dredge Material Disposal/ Fills	1. Revise Section 4.2.2.1 (Adverse Impacts) as follows: a) Add the following language as the third paragraph: "Disposal of dredge materials may also have beneficial effects. For example, beach replenishment can supplement the coastal sand budget resulting in enhanced near-shore sandy bottom habitat. Beach replenishment with appropriate dredging materials may also provide an increased food supply near beach replenishment disposal sites. Where short-term adverse effects do occur, they should be weighed against any short-term and long term benefits." 2. Revise Section 5.2.2 (Fills/Dredge Material Disposal) as follows: a) **Measure No. 1 -** Revise the first sentence to read: "To the extent possible, fill materials resulting from dredging operations should be placed on an upland site, although this should not preclude the use of permitted USEPA or ACOE offshore disposal sites." b) **Measure No. 3 -** Revise to read: "Any disposal of dredge material in EFH, should meet applicable state and/ or federal quality standards for such disposal. ~~The disposal of contaminated dredge material should not be allowed in EFH.~~" c) **Measure No. 5 -** Revise to read: "All non-avoidable, adverse impacts (other than insignificant or short-term impacts) should be fully mitigated."
Water Intake Structures	1. Revise Section 4.2.4.1 (Adverse Impacts) as follows: a) Add the following language as a second paragraph: "Intake systems can also provide benefits in terms of increased water circulation and playing a role in keeping coastal lagoons open to the ocean, resulting in enhanced habitat values. These benefits should be considered when assessing potential impacts." 2. Revise Section 5.2.4 (Water Intake Structures) as follows: a) **Measure No. 1 -** Revise the second sentence to read:

Issue	Recommended Revision
Water Intake Structures (cont.)	"New d~~D~~ischarge points should be located in areas that have low concentrations of living marine resources, or they should incorporate cooling towers that employ sufficient safeguards to ensure against release of blow-down pollutants into the aquatic environment in concentrations that exceed state and/ or federal limits established pursuant to state and/ or federal NPDES regulations;" b) **Measure No. 2 -** Revise to read: "All intake structures should be designed to minimize ~~prevent~~ entrainment or impingement of prey species. Power plant intake structures should be designed to meet the "best technology available" requirements as developed pursuant to Section 316b of the Clean Water Act." c) **Measure No. 3 -** Revise to read: "Discharge temperatures (both heated and cooled effluent) should comply with applicable temperature limits established pursuant to state and/ or federal NPDES regulations ~~be below the upper range of the thermal tolerance of the biota in the receiving body of water~~." d) **Measure No. 4 -** Delete as follows: ~~"Mitigation should be provided for the loss of fish larvae and eggs that may be entrained by large intake systems as well as the loss or prey organisms."~~
Wastewater Discharge	1. Revise Section 4.2.6 (Wastewater Discharge) as follows: a) Revise the paragraph as follows: "The discharge of point and nonpoint source wastewater from activities including municipal wastewater treatment plants, power generating stations, industrial plants (e.g., pulp mills, desalination plants) and storm drains into open ocean waters, bay or estuarine waters can introduce pollutants detrimental to estuarine and marine habitats. These pollutants include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, hydrocarbons and other toxics. Historically, wastewater discharges have been one of the largest sources of contaminants into coastal waters. However, non-point source/ stormwater runoff is considered the most significant remaining source of pollution to the coastal areas and ocean. Outfall-related changes in community structure and function, health and abundance may result. Many of the changes can be long-lasting." 2. Revise Section 4.2.6.1 (Adverse Impacts) as follows: a) Revise the first sentence of the first paragraph to read as follows:

Issue	Recommended Revision
Wastewater Discharge (cont.)	"Wastewater effluent and non-point source/ stormwater discharges may affect the growth and condition of fish associated with ~~wastewater~~ outfalls should high contaminant levels (e.g., chlorinated hydrocarbons; pesticides; herbicides) be discharged." b) Revise the ninth paragraph to read as follows: "The use of biocides (e.g., chlorine; heat treatments) to prevent biofouling or the discharge of brine as a byproduct of desalinization may reduce the suitability of water bodies for populations of fish species and their prey in the general vicinity of the discharge pipe. The impacts of chlorination and heat treatments, if any, are minimized due to their intermittent use and regulation pursuant to state and/ or federal NPDES permit requirements. These compounds may change the chemistry and the physical characteristics of the receiving water at the disposal site by introducing chemical constituents in suspended or dissolved form. In addition to chemical and thermal effects, discharge sites may adversely impact sensitive areas such as emergent marshes, seagrasses, and kelp beds if located improperly." 3. Revise Section 5.2.6 (Wastewater Discharge) as follows: a) **Measure No. 1 -** Revise the second sentence to read: "Discharges should be managed to comply with applicable state and/ or federal NPDES permit requirements, including compliance with applicable technology-based and water quality-based effluent limits. ~~treated using the best available technology, including implementation of up-to-date methodologies for reducing discharges of biocides (e.g., chlorine) and other toxic substances.~~"
Discharge of Oil or Release of Hazardous Substances	1. Revise Section 4.2.7.1 (Adverse Impacts) as follows: a) Revise the first sentence in the first paragraph as follows: "Exposure to petroleum products and hazardous substances from spills or other unauthorized releases can have both acute and chronic effects on fish resources and their prey, and also potentially reduce the marketability of target species." 2. Revise Section 5.2.7 (Discharge of Oil or Release of Hazardous Substances) as follows: a) Measure No. 2 - Revise to read: "Each facility should have a "Spill Contingency Plan" and ~~all~~ employees identified in the plan as having responsibility for responding to a spill should receive appropriate training ~~be trained in how to respond to a spill~~. A Spill Contingency Plan(s) developed for another agency can be used to fulfill this measure."

Monterey Fish Company, Inc.

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September 14, 1998

Mr. Jerry Mallet, Chair
Pacific Fishery Management Council
2130 SW 5th Avenue, Suite 224
Portland, OR 97201

Dear Mr. Mallet

I would like to take this opportunity to present the Council with written comments on plan amendments proposed for coastal pelagic species. I am the owner as well as the vice-president of Monterey Fish Company, a wholesale seafood processor located in the Monterey area and I am also a member of the Coastal Pelagic Species Advisory Panel representing processors. Coastal pelagic species, including market squid, Pacific mackerel, sardine and anchovy make up the majority of the fish processed by the Monterey Fish Company. In addition, I own the Seawave, a boat which fishes primarily for coastal pelagic species.

I continue to support federal management of coastal pelagic species (CPS). Further, if the Council chooses to implement a limited entry system for CPS, then I want to go on record with the following:

1. Target Fleet Size
The Council should select a fleet size that represents those vessels accountable for a least 99% of total CPS finfish landed during the 5-year window period (January 1, 1993 through November 5, 1997). This percentage will provide for a fleet upwards of 70 boats. The CPS Development Team has recommended a percentage of 95%, which translates to a fleet of about 40 boats. This smaller fleet size is unacceptable. While the Team claims that 40 boats have the capacity to catch all the CPS finfish that is available, they ignore the impact of CPS finfish fishing in conjuction with squid fishing. Squid is a much higher-valued product then CPS finfish. One ton of squid often fetches 6-8 times the amount a ton of CPS finfish would receive. Referring to Table 3.8.7-1 on page B-58 of Draft Amendment 8, only 25% or 10 of the 41 boats that would receive permits land their catch in the Monterey area. Of those 10 boats, only 1 boat (or 3%) did not land any squid during the window period. If squid are abundant and markets exist; the majority of boats landing their catch in Monterey will be fishing for squid instead of CPS fin-fish. With larger fleet size of at least 70 boats, more boats

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would be apt to stay and fish for finfish. Again, referring to Table 3.8.7-1, at least 11 boats (or 16%) landed less than 10 mt of squid during the windowperiod; which means finfish made up much more of their catch. This larger fleet size provides a mechanism for a continued supply of CPS finfish into the seafood processors in Monterey, maintains necessary product flow to the processing plants, and allows more employment of plant workers.

2. Vessels under Construction

The Council must allow issuance of permits to those vessels under construction or conversion during the window period as long as they meet specific qualifications. Stringent qualification language was drafted that includes:

> "Under Option 2, the owner of a vessel constructed or converted for use in the CPS finfish fishery qualifies for a CPS limited entry permit if the owner:
>
> 1. Submits, along with the application for a permit, receipts showing that $100,000 or more was invested during the window period for purchase or towards the conversion or construction of a vessel with a purse seine net having mesh size 1-3/8 inches or less, power blocks, and a seine winch; and
> 2. Uses the newly constructed or converted vessel before year end of 1999 to land coastal pelagic finfish species."

Precedents for accommodating vessels under construction is found in Amendment 6 to the Pacific Coast Groundfish Fishery Management Plan, which allowed boats that were under construction or conversion during the window period to receive a limited entry permit. In fact, the provisions set forth in the groundfish limited entry system were much more broad than those intended for the CPS fishery.

In any case, I began constructing a vessel in good faith in June of 1997 specifically for utilization in the CPS finfish fishery. This was well before the control date set by the Council of November 5, 1997. I have invested well over $100,000 on the boat under construction and meet the other criteria specified. I also believe that vessels that qualify under this option should be forced to use their boats by a specific date (say 2 years after the end of the window period) to land CPS finfish or their permit will become defunct.

Monterey Fish Company, Inc.

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Thank you for the opportunity to provide the above comments. I hope the Council will seriously consider the major investments that I and others have made in good faith for continued participation in the CPS finfish fishery.

Sincerely,

Sal Tringali
Monterey Fish Company
Vice-President

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TO: PACIFIC FISHERIES MANAGEMENT COUNCIL ALL COUNCIL MEMBERS	DATE: SEPTEMBER 10, 1998
RE: COASTAL PELAGIC SPECIES	FROM: WARREN K. NOBUSADA

Our Tim Sweeney attended the September 9th hearing in Monterey regarding the CPS draft plan amendments. After meeting with him it is apparent that there is a significant misunderstanding between what myself and many fishermen believed was being drafted by the council and what has taken place. In part I feel much of this is due to either poor or misleading information from CPS advisory subpanel members. I strongly oppose many of the options from which the PFMC will develop a CPS FMP and ask that you consider the following:

1) A lot of time was spent last year in California by the California Fisheries and Seafood Institute, Squid Packers and Squid Fishermen in finalizing the passage of SB364 Sher which funds a 3 year study for squid with a moratorium for the number of boats "only" during this 3 year study period. When Tim Sweeney returned from the PFMC meeting in Seattle in June of this year, he informed me that Squid was included in the CPS management plan. I iniated discussions with CPS advisory panel members Joe Cappuccio and Sal Tringali about the inclusion of Squid in the FMP and was told that while there was discussion about the inclusion of Squid in the plan, they did not feel that this was going to occur. Mr. Sweeney informs me that when he asked about the possibility of removal of Squid from the FMP as even an option for the council to consider, he was informed that, no, that was not an option, and that it was the intention of the PFMC to include Squid in the CPS FMP from the beginning. CONSOLIDATED FACTORS, INC. IS OPPOSED TO SQUID BEING INCLUDED IN THE CPS FMP AS SQUID IS HARVESTED ALMOST EXCLUSIVELY WITHIN CALIFORNIA'S 3 MILE EEZ RATHER THAN IN FEDERAL WATERS AND IS CURRENTLY MANDATED BY STATE LAW TO BE STUDIED AND MANAGED BY THE CALIFORNIA FISH & GAME DEPARTMENT.

2)Anchovy, Mackerel and Sardine are secondary fisheries for boats that fish for Tuna and Squid. The vast majority of vessels qualifying for a CPS finfish permit have the ability and market to harvest Squid or Tuna. Therefore, in years of abundance for Squid and Tuna, along with favorable market conditions, there will be no boats, or very few boats, available to fish for CPS finfish. It would be a shame to have spent so much time and money to research this fishery, manage this fishery, implement quotas, and have little or no fishing effort. Therefore, CONSOLIDATED FACTORS, INC. IS OPPOSED TO LIMITING THE NUMBER OF BOATS IN THE CPS FMP.

3) Any fishery can be managed without limiting the number of participants involved in the fishery. The economics of any fishery will automatically limit the number of boats from year to year. Therefore, CONSOLIDATED FACTORS INC. IS OPPOSED TO LIMITING THE NUMBER OF BOATS IN THE CPS FMP.

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4) California currently has limited entry for Dungeness Crabs and Pink Shrimp, both of which have seasons set by the States of California, but no quota. It was perceived by some that limited entry would be advantageous in negotiating ex-vessel price. It has since been realized that price is solely determined by supply and demand. Limited entry management has played no role in improving the economics of the fishery for the participants. Therefore, CONSOLIDATED FACTORS INC. IS AGAINST USING LIMITED ENTRY AS A MEANS OF MANAGING A FISHERY.
5) California's Herring and Salmon fisheries have a State and/or Federal mandated season and/or quota. These fisheries are also subject to State and/or Federal limited entry programs. Due to economic conditions many fishermen who are "licensed" through limited entry to participate in the fishery, have made the decision not to fish and the quotas have not been met. Many young or new fisherman have been denied the right to fish for these species due to limited entry while the resource goes unharvested. Limited entry has not been an effective means of managing these fisheries, only a deterrent to others harvesting the quota. Therefore, CONSOLIDATED FACTORS INC. IS AGAINST USING LIMITED ENTRY AS A MEANS OF MANAGING A FISHERY.

We have been in business over 50 years and have seen changes in all of the coastal fisheries. Further changes are due to come, so management, when needed, should be done effectively. Limited entry is not an ecologically or ecomically effective management method. The State of California has been mandated to conduct a 3 year study of the squid resource. Until the completion of that study, Squid should be removed from any federal management plan. If upon completion of the study it is determined that management is necessary, it should then be determined whether Federal or State Government should manage the fishery and what method(s) are effective. Since Anchovies, Mackerel, and Sardines each have a seperate quota and season, limited entry for participants will not effectively manage the goal of achieving maximum ecologic and economic benefits from these fisheries.

Thank You for reading my comments.

Regards,

WARREN K. NOBUSADA

President and CEO
Consolidated Factors, Inc.
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FINAL REGULATORY IMPACT REVIEW INDEX/SUMMARY

Amendment 8 to the Northern Anchovy Fishery Management Plan

DECEMBER 1998

This Final Regulatory Impact Review Index/Summary to Amendment 8 to the Northern Anchovy Fishery Management Plan was published by the Pacific Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award NA87FC0008.

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Introduction (Appendix A, Sections 2.0 inclusive and 3.0 inclusive)

Amendment 8 to the Fishery Management Plan for the Northern Anchovy Fishery (FMP) proposes to place Pacific (chub) mackerel (*Scomber japonicus*), Pacific sardine (*Sardinops sagax*), Jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*) in a management unit with northern anchovy (*Engraulis mordax*). All of these small coastal pelagic species (CPS) are harvested by a fleet of vessels using mainly roundhaul nets. The FMP divides the species into two general categories: 1) Actively managed species, those that require federal harvest guidelines or quotas, and 2) Monitored species, those that are adequately managed without federal harvest guidelines or quotas. Management measures other than federal harvest guidelines and quotas may be used for both Actively managed and Monitored species. Amendment 8 provides a framework process for moving species from one category to another as biological and economic circumstances change.

Vessels using roundhaul gear (purse seines and lampara nets) are responsible for 99% of CPS total landings and revenues in any given year. The southern California round haul fleet, known locally as the "wetfish fleet", is the most important sector of the CPS fishery in terms of landings. The wetfish fleet is based primarily in Los Angeles Harbor, with smaller segments in the Monterey and Ventura areas. It harvests Pacific bonito, market squid, bluefin tuna and other tunas, as well as CPS. The fleet consists of about 40 active purse seiners averaging 20 meters in length. Approximately one-third of the wetfish fleet are steel-hulled boats built during the last 20 years. The rest are wooden-hulled, built in the heyday of the Pacific sardine fleet, from 1930 to 1949.

Anchovy is used for reduction to fish meal and oil, live and dead bait, and human consumption. Reduction landings, which generally receive much lower exvessel prices than nonreduction landings have been exceedingly low since 1983 due to competition with other sources of protein meal. Reduction was the main use for anchovy prior to 1983. Anchovy is more recently a critical source of live bait for recreational fishing.

Commercially harvested Pacific (chub) mackerel is processed into canned products for pet food and human consumption, and a small but increasing amount is sold to fresh fish markets that cater to California's growing Asian population. Jack mackerel, when available in southern California, is processed in the same canned product.

Pacific sardine is canned for human consumption and sold as live and dead bait. With sardine biomass increasing after years of low biomass levels, markets are being developed.

Squid are generally frozen or canned and exported for human consumption. Smaller amounts are sold domestically in fresh fish markets and used for live and dead bait. In the last several years, the demand for squid has increased greatly, which has raised concerns about protecting the resource. Very little is known about the biology of squid.

Growth or decline in fishing affects production, trade and employment throughout the California economy, as fishers make purchases and as the fish are processed, distributed, and marketed. Revenues from these expenditures filter through local, state, and regional economies. Economic multipliers can be used to calculate change in income and employment resulting from a change in the level or the success of fishing. Economic multipliers have been used to estimate indirect benefits of wetfish fishing, but the estimates are probably not reliable.

The most important counties along the West Coast in the context of CPS revenues and landings are Los Angeles/Orange, Santa Barbara/Ventura and Monterey (totals for 1993-1997).

Area	Landings (in metric tons)	1997 Revenues (in dollars)
Los Angeles/Orange County	246,204	41,268,508
Santa Barbara/Ventura County	209,401	73,148,255
Monterey County	80,999	18,669,794
Other California Areas	10,355	3,857,902
Oregon State	3,654	49,365
Washington State	684	314,753
Total	551,297	37,308,577

No Federal regulations governing gear restrictions and area closures are proposed above those already in place in California, Oregon, and Washington. Reporting requirements are managed by the respective states.

Purpose and Need for Amendment 8 (Appendix B, Section 1.2 inclusive)

The Pacific Fishery Management Council (Council) intends Amendment 8 to provide effective and comprehensive management of interjurisdictional resources, and make the most efficient use of state and federal administrative and scientific resources.

The collapse of the historical sardine fishery in the 1950s was due to overcapitalization and overfishing at the time of unfavorable environmental conditions. Environmental conditions are now favorable to sardine. The biomass has increased by about 35% per year since 1983 and is currently at more than 500,000 mt. It is likely that the CPS fishery will become overcapitalized faster than management authorities can react if sardine, or other CPS, increase in abundance or markets develop. Experience with CPS and other fisheries indicates that the process of developing fishery management programs at the state or federal level is slower than the rate at which a fishery can become overcapitalized. There is substantial excess capacity in the groundfish, herring and salmon fisheries, including the factory trawler fleet, for example, that could enter the CPS fishery in a matter of months if markets develop. Boats from overcapitalized herring fisheries off Oregon, Washington and Alaska recently entered the California squid fishery in response to increased availability and prices. The total number of boats harvesting squid in the California squid fishery approximately doubled during 1994-1997.

Increased abundance of sardine has extended the range of the species into Canada, which puts the resource beyond the management authority of any individual state. Commercial interest in sardine and in squid is likely to lead to increased harvesting capacity directed at CPS in general, which raises issues of managing bycatch, international and interstate cooperation, and cooperative research. An FMP for CPS would ensure that CPS are managed according to risk averse principals, which is particularly important for CPS. CPS are highly variable and often at low abundance levels, but potentially very productive. They also are ecologically important as forage for predators that include sportfish, marine mammals, and endangered species.

Goals and Objectives of Amendment 8 (Appendix B, Section 2.1)

The goals of Amendment 8 are:

1. Promote efficiency and profitability in the fishery, including stability of catch.
2. Achieve optimum yield (OY).
3. Encourage cooperative international and interstate management of CPS.
4. Accommodate existing fishery segments.
5. Avoid discard.
6. Provide adequate forage for dependent species.
7. Prevent overfishing.
8. Acquire biological information and develop a long-term research program.
9. Foster effective monitoring and enforcement.
10. Use resources spent on management of CPS efficiently.
11. Minimize gear conflicts.

The Proposed Management Regime (Appendix B, Section 2.1.2; 3.8.2; 4.0.1 through 4.1.3; 5.2 through 5.2.2)

1. Divide the managed resources into Actively managed species and Monitored species.
2. Limited entry for finfish south of 39° N latitude.
3. Comprehensive harvest policies.
4. North/South allocation of available harvest for sardine based on current state law.
5. Area closures (presently in Anchovy FMP).

Small Entities Affected

Vessels that harvest CPS (Pacific sardine, Pacific [chub] mackerel, jack mackerel and northern anchovy) or market squid along the west coast would be affected by Amendment 8. Most or all of these vessels represent small entities with annual receipts of less than $3 million.

Landings receipt data (Appendix A, Table 2.1.2-2) indicate that about 423 vessels landed CPS finfish or market squid during 1997 (215 landed CPS finfish but no squid, 108 landed both finfish and market squid and 100 landed market squid but no CPS finfish). Numbers of vessels landing appreciable (>50 mt) quantities of CPS finfish or squid are smaller. During 1997, for example, only 56 roundhaul vessels landed appreciable amounts (>50 mt) of CPS finfish (Appendix A, Table 2.1.2-3). Most of the vessels landing appreciable quantities (>50 mt) of CPS finfish use roundhaul gear and operate out of ports in Orange/Los Angeles, Ventura/Santa Barbara and Monterey counties (Appendix A, Table 2.1.2-5).

Fish receipt data indicate that 173 processors (including parent processing plants and associated buying stations) purchased CPS finfish and squid from vessels during 1997 (Appendix A, Table 2.1.2-9). Processors, particularly when buying stations are aggregated by parent plants, probably have gross receipts in excess of $3 million per year but some may qualify as small businesses.

Long term effects of Amendment 8 on small entities are expected to be neutral or positive (see below) because MSY control rule options will lead to higher levels of average long term catch and biomass (see below) with less risk of overfishing. Short term negative effects are, however, likely because catch quotas for Pacific sardine and Pacific (chub) mackerel may be reduced in the short term from status-quo levels (see below).

Effects on employment in the long term will likely be neutral or positive because MSY control rule options tend to maximize long term average revenues. Short term effects on employment are unlikely because few vessels rely on Pacific sardine or Pacific (chub) mackerel for the bulk of their revenues (Appendix A, Table 2.1.2-7).

Alternatives Considered

The Council considered options for all conservation and management measures it is recommending. A comparison of options was made on the basis of the following criteria:

1. The biological impact on the managed species.
2. Economic and social impacts relating to competition, employment, investment, productivity, exports, innovation and the cost and price of goods and services.
3. Information collection costs incurred by the government to implement Amendment 8.
4. Compliance costs and recordkeeping requirements imposed on small business, i.e., vessel operators.

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires that a fishery resource be managed as a unit stock throughout its range, but gives little guidance regarding management of transboundary stocks. All coastal pelagic resources are shared between the U.S. , Mexico, and Canada, and no international agreement for managed resources exists between the two countries; therefore, Mexico harvests managed resources independent of U.S. regulations. The FMP presents harvest control rules that take the Mexican harvest into consideration when establishing OY, understanding that whatever choice is made, the Mexican harvest is beyond the control of the U.S.

Limited Entry (Appendix B, Section 3.0 inclusive)

Purpose and Need for Action

As described in the FMP (Appendix B, section 3.4), the CPS fishery is overcapitalized and vessels currently participating (105 vessels characterized as potential low-volume producers and 63 vessels characterized as potential high-volume producers, Appendix B, Section 3.4) are capable of harvesting more CPS finfish (Pacific sardine, Pacific [chub] mackerel, jack mackerel and northern anchovy) than is ever likely to be available. Current capacity may be as much as 20% greater than the combined maximum sustainable yield (MSY) for anchovy, Pacific (chub) mackerel and Pacific sardine (about 400,000 mt per year). Recent experience in the fishery and crude calculations indicate that about 75 vessels would have sufficient harvesting capacity to take all of the CPS finfish likely to ever be available (Appendix B, Section 3.4).

Vessels currently participating in the CPS finfish fishery are capable of harvesting more CPS finfish than is available under current biomass conditions. Harvest capacity is linked to effort production which in turn corresponds to the size of the fleet and its use of available inputs. Fisheries characterized by excess harvesting capacity are described as overcapitalized in terms of the number of vessels, and the amount of gear and equipment devoted to harvesting. As fisheries become overcapitalized, harvesting costs increase while catches remain constant, resulting in economically inefficient use of society's fishery resources. Problems for managers and the fishing industry are more severe in overcapitalized fisheries when abundance declines and catches must be reduced. In particular, more restrictive management measures are required and allocation issues are more acute. No relief from these problems will occur if harvest capacity continues to rise.

Managing harvest capacity, therefore, entails controlling vessel effort production, the number of vessels, or both. As a first step, limiting access of vessels to the fishery may be particularly useful.

Alternatives for Management of Fishing Effort

Three general alternative approaches to managing fishing effort in the CPS fishery were considered (Appendix B, Section 3.5). Alternative 1 was open access (status-quo). Alternative 2 was limited entry. Alternative 3 was ITQs, but ITQs are currently prohibited under a Congressional moratorium.

Open access management inevitably leads to overcapitalization and pressure on managers to allow high harvest levels. An increase in fleet size will result in greater fixed costs with more vessels in the fishery, and increased capital costs associated with expanded investment in the fishery. Also, a larger fleet will probably result in decreased revenue per boat, as more boats compete for a fixed allowable harvest, and increased operating costs per boat as a result of increased congestion and excess mobility on the fishing grounds. With open access there is also an increased likelihood for high mid-term and long-term management costs associated with the development and implementation of other regulatory measures to address overcapitalized fisheries and depleted stocks.

Expected Effects of Limited Entry

Limited entry programs are primarily designed to address economic problems associated with excess harvest capacity or overcapitalization in open access fisheries. A limited entry program for CPS would contain the number of vessels participating in the fishery and give managers a tool for controlling the overall level of effort and harvest capacity in the fishery. With the number of vessels limited, competition between vessels for a fixed allowable harvest is likely to be less intense and net revenues per vessel would improve. Limited entry would be an imperfect control, however, and increases in harvest capacity are still likely to occur under limited entry and a variety of possible conditions without controls on other productive inputs. Nonetheless, increases in capacity would probably be faster and more dramatic under open access management.

Limited entry is expected to encourage economic efficiency in the CPS fishery over the long term to the extent that: 1) further increases in capital investments from new vessels entering the fishery are slowed or prevented; 2) fixed costs associated with additional vessels are avoided; and, 3) harvesting and management costs remain low. Economic efficiency with limited entry is expected to be as high as, or higher than, under open access management. A limited entry program for CPS is expected to reduce socioeconomic problems over the long term by reducing harvest levels during inevitable periods of low CPS production and biomass.

In the short term, limited entry is expected to have little effect on routine operations in the fishery, though a few operations could be greatly affected (see Section entitled "Initial Regulatory Flexibility Analysis"). Preferred options for target fleet size, window period qualifying criteria and exempted landings accommodate current participants by either issuing limited entry permits to vessels that harvest significant quantities of CPS or allowing small exempted landings of CPS by vessels without a limited entry permit.

Benefits and Costs of Limited Entry

A qualitative benefit-cost analysis indicates that net benefits from a limited entry program for CPS would likely be positive (Appendix B, Section 3.9). Reduced fixed costs and variable (operating) costs are associated with fewer vessels competing for a fixed harvest. Costs to federal authorities in issuing and administering limited entry permits are probably less than $10,000 per year (Appendix C, Section 1.4).

Limited Entry Options

Within limited entry, the Council considered various options (Appendix B, Section 3.8 inclusive). The Council's decisions about which species to include (Appendix B, section 3.8.1), target fleet size (based on window period qualifying criteria; Appendix B, Sections 3.8.7-3.8.10), and permit transferability (Appendix B, Section 3.8.14) are most important and described in subsequent sections.

Other limited entry options described in Appendix B would apply limited entry requirements to fishing south of 39° N. latitude with no area specific endorsements (Sections 3.8.2-3.8.3); exclude small ("exempted") landings, recreational fishing, and the live bait fishery from limited entry requirements (Sections 3.8.4-3.8.6); use trip limits to avoid dramatic increases in fishing effort (Section 3.8.11); establish permit renewal criteria (sections 3.8.12-3.8.13); and establish policies for issuing new permits in the future (Section 3.8.15).

Species to Include under Limited Entry

There were two options considered by the Council: 1) CPS finfish only; and, 2) CPS finfish and squid. The Council recommends a limited entry program for CPS finfish only, rather than limited entry for CPS finfish and squid (Appendix B, Section 3.8.1). Although there is considerable overlap between fishing activity for finfish and squid, enough squid and finfish specialists exist in the fleet to warrant separate limited entry programs. Currently, California Department of Fish and Game is implementing a vessel licensing program for squid.

Expected Effects of Species Option1

Given the nature of CPS finfish fisheries, growth in the sardine segment of the fishery could be short-lived. A limited entry program for CPS finfish now would prevent excessive buildup of harvest capacity directed toward sardine, and future spillover into other finfish species and squid.

Although the squid harvest potential is not well known, there may be room for additional harvest capacity in this segment of the CPS fishery. A federal limited entry program for squid is not deemed to be necessary at this time. However, familiarity with open access fisheries indicates this situation could change quickly.

Benefits and Costs of Species Option1

Limited entry for the CPS finfish fishery should result in efficiency gains through a reduction in the fixed and operating costs that are incurred to take the available harvest, and therefore increased net benefits from the fishery (see below).

Excluding the squid fishery from limited entry while carefully monitoring its growth, will allow it to develop to its full economic potential without unnecessary constraints on harvest capacity at this point. Additional net benefits are expected as harvest capacity approaches an optimum.

Species Option 1 should therefore result in increased net benefits from the overall CPS fishery.

Target Fleet Size

Based on the Council's recommendations regarding geographic scope of the limited entry program, window period, and history of CPS species landed (Appendix B, Sections 3.8.2, 3.8.9 and 3.8.10), options for the target fleet size were based on a proportion of total CPS finfish landings south of 39° N latitude during a five-year (1993-1997) window period.

There were six options, including the status quo, considered for CPS finfish limited entry target fleet size (Appendix B, Section 3.8.7). Of these, the Council chose Option 5, a limited entry fleet consisting of those vessels accountable for 99% of total CPS finfish landings during the window period.

Expected Effects of Target Fleet Size Option 5

In 1997 (under open access management), 229 vessels landed 67,621 mt of CPS finfish south of 39° N latitude (295 mt per vessel) with an exvessel value of $8 million ($34,934 per vessel). There were 640 vessels with CPS finfish landings south of 39° N latitude during the 1993-1997 window period.

Under Option 5, 70 vessels would comprise the CPS finfish limited entry fleet (Appendix B, Table 3.8.7-1). Sixty of these vessels had CPS finfish landings south of 39° N latitude in 1997, accounting for 73% of total CPS finfish landings in 1997 and 66% of total finfish revenues. Average finfish landings were 741 mt per vessel, 37% of each vessel's total landings. Average finfish revenues were $77,922 per vessel, 16% of each vessel's total revenues. Squid provided the bulk of exvessel revenues for most of these vessels in 1997.

Under Option 5, there would be 570 vessels not qualifying for CPS finfish limited entry permits based on minimum CPS finfish landings for the window period. Of these, 172 landed CPS finfish south of 39° N latitude in 1997, accounting for one percent of total CPS finfish landings in 1997 and three percent of total finfish revenues. Average finfish landings were two mt per vessel, less than one percent of each vessel's total landings. Average finfish revenues were $1,100 per vessel, less than one percent of each vessel's total revenues. Most of these vessels depended on groundfish for the bulk of their revenues in 1997.

Under the status quo option (open access), patterns observed in finfish catches during 1997 would likely continue although squid landings may change in response to the 1997-1998 El Niño. This situation could change dramatically, however, with a substantial increase in the abundance of CPS finfish resources or with additional development of CPS finfish markets. It is difficult to predict the size of an open access fleet under conditions of higher biomass and better markets. Based on historical data and experience during the peak of the sardine fishery, a fleet size of 175-250 vessels seems plausible, particularly since the fleet would also harvest other species (e.g., squid, bonito, and tuna).

A limited entry fleet consisting of 70 vessels is more than capable of taking the total amount of CPS finfish landed in California during 1997. CPS finfish landings per vessel for those vessels qualifying for limited entry under Option 5 averaged about 50% of the vessel's total landings for the window period. This suggests that these vessels could redirect effort to CPS finfish and almost double their landings if conditions were right. Consider an intermediate size fleet of 55 vessels. In the course of a six-month season (26 weeks or 130 days without counting weekends), and assuming 50 mt/day for each vessel, 55 CPS limited entry vessels could land about 360,000 mt of CPS finfish per year which is near the upper bound of what might be expected under the best conditions.

The Council recommendations include an "exempted" landings provision which excludes small landings (one to five mt per trip) of CPS finfish from limited entry (Appendix B, Section 3.8.4). Therefore, most of the vessels not qualifying for limited entry permits that land small quantities of CPS per trip, either incidently or as a target species, would not be affected by limited entry.

Benefits and Costs of Target Fleet Size Option 5

The approach used by the Council to specify a target fleet size in the CPS limited entry program automatically selects vessels that constitute the core CPS finfish fleet. Vessels qualifying likely represent a reasonable level of harvest capacity.

A qualitative benefit-cost analysis (Appendix B, Section 3.9) indicates that there would likely be increased net benefits from limited entry, because current landings would be realized with fewer vessels which would lower fixed costs, and probably lower operating costs. A target limited entry fleet of 70 vessels would likely be less efficient than a fleet of 55 vessels which would probably be capable of landing all the CPS finfish that might be expected under the best conditions. However, a 70 vessel fleet might better accommodate existing fishery segments, which is another objective of the CPS FMP.

Permit Transferability

There were three options initially considered for CPS finfish limited entry permit transferability (Appendix B, Section 3.8.14). The Council crafted a fourth option under which the limited entry permit is issued to the qualifying vessel, and can be transferred once within the first year of the limited entry program. After the first year of the limited entry program, transfer of a permit to another vessel is not allowed unless the original permitted vessel is stolen, lost or no longer able to participate in a federally managed commercial fishery. Application for the permit transfer to a replacement vessel originates from the vessel owner who must place it on a replacement vessel of the same or less net tonnage within one year of disability of the permitted vessel.

Expected Effects of Permit Transferability Option 4

In most cases significant economic benefits are realized by allowing unconstrained transfer of limited entry permits if the initial allocation of permits is suboptimal. However in some cases, there may be social, income distributional, or other benefits of greater importance that can be realized by prohibiting or constraining permit transfer. In the latter cases the initial allocation may be optimal in terms of preserving a particular pattern of fishing operations, or fishing community structure, which are also addressed by the objectives of the CPS Fishery Management Plan.

Option 4 allows permit transfers during the first year of the program. Permit transfers in the first year may lead to improvements in economic efficiency to the extent that more efficient fishers obtain permits from less efficient ones. It is likely however, that the 70 vessels comprising the "target fleet" (Appendix B, Section 3.8.7, also see above) represent the optimum harvest capacity in terms of quantities landed, given recent conditions of resource availability in the CPS finfish fishery. Also, because the 70 vessels that would qualify for a limited entry permit accounted for the highest shares of CPS finfish landings during the window period, they are probably those with the greatest investments in the fishery, and are likely to be the most efficient harvesters in the fishery. If this is the case, transfer of permits to non-qualifying vessels is unlikely to result in a significant efficiency gains. However, there may be vessels of advanced design that are under construction for the CPS finfish fishery, or vessels being used in other fisheries, which are perceived as being able to operate more efficiently in the CPS finfish fishery than many of the qualifying vessels. In this case permit transfers are likely and overall efficiency gains could occur through improved technology without an undue increase in fleet harvest capacity. Because of this transferability feature, a limited entry permit can be a highly valued asset to its holder in the first year of the program.

After the first year of the program, Option 4 constrains permit transfers by limiting the transfer of a permit to situations where the original vessel is either lost, stolen, or no longer operable. The replacement vessel must be of equal or lesser net tonnage. This prevents a large influx of larger, higher powered vessels into the fishery after the first year of the program. Constrained transferability also tends to reduce the asset value of a permit. However, Option 4 does allow permit holders to modernize and upgrade the permitted vessels. This fosters reduced operating costs through improved technology without an excessive increase in fleet harvest capacity, and could lead to improvements in product quality. Option 4 also allows the sale of a permitted vessel to a new owner who can then operate the vessel in the CPS finfish fishery. The new owner can replace the vessel if it is lost, stolen, or otherwise no longer operable, with a vessel not greater in net tonnage. Because of this limited opportunity for transfers, permits are likely to maintain significant asset value under Option 4.

Benefits and Costs of Permit Transferability Option 4

Under an open market for limited entry permits during the first year of the program, permits would tend to be sold to fishers who use the most efficient technology to take the available harvest. Fishers who use the most efficient harvesting technology will be able to outbid less efficient competitors. Moreover, vessels most willing to sell their permits are those that would be the least efficient of those qualifying. This should lead to efficiency gains through a reduction in fleet harvesting costs and hence, to increased net benefits from the fishery.

Constrained transfer of permits after the first year probably will probably reduce the number of vessels over time, but not at the rate and to the extent that would occur with no transferability. This is because a permitted vessel can be sold to a new owner, who can then continue to operate the vessel in the CPS finfish fishery, thus slowing the rate of attrition. While this situation may not reduce fixed costs, motivation to purchase a permitted vessel is usually based on the purchaser's expectation of being able to operate the vessel more efficiently than the previous owner. Thus, this form of permit transfer is likely to increase net benefits from the fishery. Option 4 would also allow permitted vessels to be replaced -- under certain conditions -- upgraded and modernized to improve their productivity. This could lead to lower harvesting costs and in turn, increased net benefits from the fishery.

Harvest Policy Options (Appendix B, Section 4.0 inclusive)

Purpose and Need for Action

Maximum sustainable yield (MSY) is central to requirements for managing fisheries under the Magnuson-Stevens Act. National Standard Guidelines were developed by the National Marine Fisheries Service (NMFS) to aid in preparation of FMPs. National Standard 1 describes how MSY control rules are the preferred approach to implementing MSY based policies. The Council considered several MSY control rule options for CPS.

As described in Appendix B, sections 2.1.2 and 4.0, CPS are managed as two groups. Stocks proposed to be "Actively managed" generally have species specific MSY control rules. Stocks proposed to be "Monitored" generally have generic or default MSY control rules. The distinction between Actively managed and Monitored stocks enables managers and scientists to concentrate on stocks and segments of the CPS fishery that need the greatest attention and where the greatest benefits are expected. Under Amendment 8 to the CPS FMP, Pacific sardine and Pacific (chub) mackerel will be Actively managed while northern anchovy, jack mackerel and market squid will be Monitored.

Operationally, the objective of an MSY control rule is to achieve relatively high and consistent levels of biomass in the population and catch in the fishery (Appendix B, Section 4.0.2). Biomass is particularly important for CPS used as forage (i.e. Pacific sardine, northern anchovy and market squid; Appendix A , Section 1) by fish, birds and marine mammals in the California Current Ecosystem. Biomass is less important for CPS (i.e. Pacific [chub] mackerel and jack mackerel) that are not important as forage.

Alternatives for Pacific Sardine MSY Control Rule

Thirteen MSY control rule options, including the status quo, were considered for sardine and evaluated based on simulation analyses (Appendix B, Table 4.2.5.1). MSY control rules for sardine can be explained by considering one as an example. Under the status quo option, the total target harvest would be FRACTION=20% x estimated biomass in excess of CUTOFF of 50,000 mt, not to exceed the maximum catch (MAXCAT) harvest level of 200,000 mt. The stock would be overfished and directed harvest would cease if the estimated biomass was < 50,000 mt. Harvest levels for U.S. fisheries would be reduced in proportion to the percentage of the stock in U.S. waters.

Of the 13 options, the FMP Development Team recommended five (options G-K) because they performed as well or better than the deterministic equilibrium F_{MSY} option (Option L) and had CUTOFFs greater than 50,000 mt (Appendix B, Section 4.2.5.3). The deterministic equilibrium F_{MSY} (Option L) option is a traditional approach viewed as a minimum acceptable standard under the MSFCMA (Appendix B, Section 4.2.3.1). CUTOFF was a parameter in the MSY control rules that sets a lower bound on biomass levels at which directed fishing occurs (Appendix B, Section 4.1.2). Options with CUTOFFs greater than 50,000 mt were recommended because they included an implicit rebuilding program in the event sardine become overfished (Appendix B, Section 4.2.5.2). The Council chose Option J.

<u>Expected Effects of Pacific Sardine Control Rule</u>

Expected long term benefits of Option J and all other options for the MSY control rule for sardine are given in Appendix B, Table 4.2.5.1. Recommended options all perform well at preventing overfishing and maintaining relatively high and consistent catch levels over the long term.

Short term effects can be contrasted by applying MSY control rule options to the most recent estimate of coast wide biomass for sardine. Target harvest levels that would result under each option can be compared to the target harvest from Option 1, the status quo. Calculations in Table 1 below are based on a coast wide biomass estimate of 573,000 mt in 1997 and assume that the portion of the stock in US waters was 87% (Appendix B, Section 4.1.3). MSY control rule options involving sea surface temperature data use a three season average sea surface temperature of 18.1° C (the actual average sea surface temperature at Scripps Pier California during 1995-1997).

The actual quota set by California for 1998 (44,000 mt) is different from that calculated using Option A because of uncertainty about the geographic range of the biomass estimate and portion of the stock in U.S. waters. In setting the actual quota for 1997, California used an estimated 421,000 mt of sardine off northern Baja, southern and central California and assumed that 59% of that biomass was in U.S. waters (K. Hill, California Department of Fish and Game, Southwest Fisheries Science Center, La Jolla, California).

Harvest levels for 1998 from the various MSY control options (see Table 1) would be substantially different for sardine if water conditions had been cold rather than warm in recent years. Target harvest levels decline rapidly with three season average temperature in MSY control rules that are temperature dependent because sardine are less productive in cold water ocean conditions (Appendix B, Section 4.2.3.4).

<u>Benefits and Costs of Sardine MSY Control Rule Options</u>

Benefits arise from using sardine either as catch or as forage and spawning biomass in the California Current ecosystem. In the long term, spawning biomass is important as "seed stock" to the extent that it results in higher biomass for use as catch and forage in future years.

Benefits and costs from fishery utilization are approximately proportional to catch times recent average price (about $127 per mt during 1997). Thus, short term benefits and costs from fishery utilization can be approximated (see Table 1) by multiplying U.S. catch levels for 1998 under each option times recent average price. Similarly, long term benefits and costs from fishery utilization can be approximated (see Table 1) by multiplying average long term catches in the U.S. (average catches from Appendix B, Table 4.2.5.1, prorated assuming 87% of the sardine stock in U.S waters) by recent average price.

Long term benefits and costs from using sardine as forage and seed stock may be roughly proportional to the expected long term average biomass expected under each MSY control rule option (Appendix B, Table 4.2.5.1 and Table 1 below). Unfortunately, it is not possible to convert average biomass to monetary units because no estimates of value per unit of biomass are available.

TABLE 1. MSY Control Rule Options for Pacific Sardine. Option J was chosen by the Council.								
	Temperature Dependent	FRACTION for 1998	CUTOFF (1,000 mt)	MAXCAT (1,000 mt)	U.S. Harvest in 1998 Based on 1997 Biomass (1,000 mt)	1998 Revenue ($1,000)	Average Long Term Revenue ($1,000)	Average Long Term Biomass (1,000 mt)
Option A (Status Quo)	no	20%	50	400	91	$11,553	$16,731	936
Option B	yes	30%	50	400	136	$17,330	$17,560	964
Option C	no	20%	100	400	82	$10,448	$18,209	1,073
Option D	yes	30%	100	400	123	$15,673	$18,894	1,091
Option E	yes	30%	100	300	123	$15,673	$18,262	1,280
Option F	yes	25%	100	400	103	$13,061	$19,502	1,216
Option G	yes	15%	100	400	62	$7,836	$19,753	1,543
Option H	yes	15%	100	300	62	$7,836	$18,642	1,665
Option I	yes	25%	100	300	103	$13,061	$18,629	1,400
Option J	***yes***	***15%***	***150***	***200***	***55***	**$7,008**	**$16,056**	**1,962**
Option K	yes	30%	50	200	136	$17,330	$15,563	1,516
Option L (Stochastic Fmsy)	no	11.8%	0	Infinite	59	$7,437	$19,880	1,408
Option M (Deterministic Equilibrium Fmsy)	no	8.8%	0	Infinite	44	$5,538	$18,772	1,784

Alternatives for Pacific Mackerel MSY Control Rule

Two MSY control rule options were developed for Pacific (chub) mackerel (Appendix B, Section 4.3.2). Option 1 is the status quo and currently used by state authorities to manage the California fishery. Option 2 is a modification to the status quo that makes an adjustment for catch by fisheries in Mexico. Both options are based on published[1] simulation analysis that estimate average yield and spawning biomass as a function of FRACTION and CUTOFF parameters (MacCall et al. 1985). The analysis suggests that FRACTIONS close to 30% for the fishery as a whole and CUTOFFs close to 20,000 mt maximize long term average catch (i.e. provide MSY). The Council chose Option 2.

Under Option 1 (status-quo), the target harvest level for Pacific (chub) mackerel in U.S. fisheries is set equal to FRACTION=30% of the estimated biomass above a CUTOFF=18,200 mt. No target harvest level is calculated when estimated biomass is above 135,000 mt. The harvest level under Option 1 is not reduced to account for biomass resident in Mexican waters because mackerel catch in Mexico was insignificant when Option 1 was developed and implemented in state law. The fishery for mackerel in Mexico has increased in recent years and Mexican catches amounted to 40% of total catch during 1997.

Option 2 is similar to Option 1 except that the total target harvest level (30% of the estimated biomass above 18,200) is prorated by the estimated fraction of the biomass in U.S. waters (70%, Appendix B, Section 4.1.3.2). Thus, the target harvest level for U.S. fisheries under Option 2 is 70% of the total target harvest and 70% as large as under Option 1. In addition, a target harvest level is calculated even when estimated stock biomass exceeds 135,000 mt.

Expected Effects of MSY Control Rules for Pacific Mackerel

The immediate effect of Option 2 will be a reduction in harvest by U.S. fisheries of 30%. For example, the quota set by the State of California for the fishery during 1988 (about 31,000 mt) based on an estimated biomass of 120,000 mt under Option 1 would have been about 21,000 mt under Option 2.

1/ MacCall, A.D., R.A. Klingbeil, and R.D. Methot. 1985. Recent increased abundance and potential productivity of Pacific mackerel (*Scomber japonicus*). CalCOFI Rep. 26: 119-129.

However, the long term effects of Option 2 will likely be increased biomass and catch levels. Simulation analyses indicate highest average long term catch levels (MSY) when the harvest rate for the fishery as a whole is near 30%. Reductions in the U.S. harvest rate bring the total harvest rate down near 30% and closer to levels that provide MSY for the stock as a whole.

Benefits and Costs of Pacific Mackerel MSY Control Rules

The primary benefit of Option 2 is greater harvest levels over the long term. Risk of overfishing (catches in excess of MSY for the stock as a whole) would be reduced. Overfishing results in relatively low catch and revenue levels in the long term.

Default MSY control rule for Monitored species

Monitored stocks may be managed based on species-specific or a conservative default MSY control rule. The default MSY control rule (intended primarily for a stocks that are Monitored) is a conservative benchmark approach that sets ABC for the entire stock (U.S., Mexico, Canada and international fisheries) equal to 25% of the best estimate of the MSY catch level (Appendix B, Section 4.1.1). The primary purpose of the default MSY control rule was to help managers decide based on a framework management process (Appendix B, Section 2.1.2) when to promote stocks from the Monitored to Actively managed categories. As described in Appendix B, Section 2.2.6.3, catch levels in a Monitored fishery that exceed or are projected to exceed (within two years) ABC trigger a point of concern that should result in promotion of the stock to Actively managed status.

Expected Effects, Benefits, and Costs of Default MSY Control Rule

The default MSY control rule for species that are Monitored will have no effect on persons in the CPS fishery. If catch levels for Monitored species increase beyond 25% of the best estimate of the MSY catch level, or if concerns about the status of the stock develop, then the Council is obligated to move the stock to the Actively managed category (Appendix B, Section 2.1.2). In most cases, this would involve developing a stock species MSY control rule similar to those recommended for Pacific sardine and Pacific (chub) mackerel (see above).

Benefits from the default MSY control rule are primarily operational. The default rule makes it possible for managers to use an efficient two-tiered management approach that devotes few resources to stocks with low levels of catch, while meeting requirements of the Magnuson-Stevens Act.

Reporting, Recordkeeping and Compliance Requirements

Vessels landing CPS and other fish at ports in Oregon, Washington, and California are required to obtain landing receipts (fish tickets) at point of sale according to state laws. Landing receipts are used by the states to monitor total landings. MSY control rules in the CPS fishery rely on landing receipt data, and do not require any additional or new reporting or recordkeeping.

Issuance of limited entry permits relies on landings documentation (e.g. official landings receipts) for the specified window period. These data are readily available to managers in centralized and readily accessible databases. The necessary data are collected automatically because vessels making commercial landings at ports in California, Oregon and Washington are required to obtain landings receipts (fish tickets) at point of sale under state law. Vessel owners must provide landing receipts or other documentation to verify landings only in cases where existing records are inadequate. Additional reporting, recordkeeping and compliance requirements under limited entry are expected to be minimal (Appendix B, Section 3.5.2).

Implementation Costs (Appendix C, Sections 1.0 through 1.4)

Costs were grouped into the categories of administrative, scientific, and enforcement, with a separate estimate for the administrative costs of issuing permits. The costs of employee benefits and NOAA overhead costs were added to direct labor costs. Scientific costs are the largest component under any option one might choose to manage coastal pelagic species. Administrative costs can be multiplied by any reasonable factor to account for underestimating those costs, and they would remain small compared to the costs of scientific research. A summary of the costs follow[2]:

Administrative	$24,057
Additional Scientific Costs	$1,036,896
Enforcement	$210,997
Permits	$7,600
Total	$1,089,652

Other Applicable Law

Effects on Endangered Species and Marine Mammals

The purposes of the Endangered Species Act of 1973 (ESA) are to provide a means whereby the ecosystems upon which threatened and endangered species depend may be conserved, to provide a program for the conservation of such threatened and endangered species, and to take such steps as may be appropriate to achieve the objectives of the treaties and conventions created for these purposes. Section 7 of the ESA requires all federal agencies to ensure that any action authorized, funded or carried out by such an agency is not likely to jeopardize the continued existence of any threatened or endangered species. Under the ESA, species in danger of extinction throughout all or a significant portion of their range can be listed as endangered, and species likely to become endangered in the foreseeable future can be listed as threatened.

Marine mammal management is based on the Marine Mammal Protection Act of (MMPA) of 1972 and the ESA. Under the MMPA, marine mammals whose abundance falls below the optimum sustainable population level (the number of animals at which productivity is maximum, usually regarded as 60% of carrying capacity or maximum population size) can be listed as depleted. Populations listed as threatened or endangered under the ESA are automatically depleted under the terms of the MMPA. Fisheries that interact with species listed as depleted, endangered, or threatened may be significantly affected under the terms of the ESA and MMPA.

Northern anchovy, market squid, and sardine are forage for at least two bird species (brown pelican and least tern) and four marine mammals (fin whale, humpback whale, sei whale, and Guadalupe fur seals) classified as endangered under the ESA; one marine mammal species (Northern or Steller's sea lion) classified as threatened under the ESA; and one marine mammal species (northern fur seal) classified as depleted under the MMPA. In addition, anchovy, sardine, and squid are forage for all depleted, threatened, and endangered salmon stocks along the coast (See Appendix A, Section 1.7 for details on marine mammals and Appendix A, Section 1.8 on seabirds).

It is not currently possible to estimate the total amount of CPS used as forage by all marine mammals in the California Current ecosystem, or the size of CPS populations necessary to sustain predator populations. However, the CPS plan contains the goal of providing adequate forage for dependent species (see Appendix B, Section 2.1), and this goal is implemented through harvest policies that reserve a portion of the biomass as forage for all dependent species (Appendix B, Section 4.0).

NMFS Southwest Region is in the process of consulting with the U.S. Department of Fish and Wildlife on the effects of the CPS FMP on endangered or threatened species or critical habitat.

Coastal Zone Management Act

Section 307(c)(1) of the Federal Coastal Zone Management Act (CZMA) of 1972 requires all federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. The Council believes the proposed action is consistent to the maximum

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2/ These costs may take the form of additional costs, or a reallocation of existing funds. In particular, additional scientific costs may be a shift in resources from groundfish to CPS efforts.

extent practicable with applicable State coastal zone management programs. The NMFS has corresponded with the responsible state agencies under Section 307 of the Coastal Zone Management Act to obtain their concurrence in this finding.

Executive Order 12866

Executive Order 12866 regarding regulatory planning and review, was signed on September 30, 1993, and established guidelines for promulgating new regulations and reviewing existing regulations. While the executive order covers a variety of regulatory policy considerations, the benefits and costs of regulatory actions are a prominent concern. The regulatory philosophy in the executive order stresses that agencies should assess all costs and benefits of all regulatory alternatives. In choosing among regulatory approaches, the philosophy is to choose those approaches that maximize net benefits to society.

Executive Order 12866 requires that the Office of Management and Budget review proposed regulatory programs considered "significant." A significant regulatory action is one likely to:

1. have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;
2. create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
3. materially alter the budgetary impact of entitlements, grants, user fees, or loan programs of the rights and obligations of recipients thereof; or
4. raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

A regulatory program is "economically significant" if it is likely to result in the effects described in item #1 above. This RIR is designed to provide information to determine whether the proposed regulation is likely to be economically significant. Consistent with Executive Order 12866, NMFS requires the preparation of an RIR for all regulatory actions that either implement a new FMP or significantly amend an existing FMP.

Goals and policy objectives for Amendment 8 are described earlier in this document and in Appendix B, Section 2.0. Federal costs under Amendment 8 are estimated to be low and near status-quo levels (Appendix C), while costs to state and other agencies are expected to be unchanged.

Overall, net benefits from Amendment 8 are expected to be positive and higher than for alternatives. Benefits would accrue from implementation of a limited entry system, more effective management, and more efficient use of scarce state and federal resources. The total value of the CPS fishery may exceed $100 million but the total amount would be only minimally affected by Amendment 8. The portion of the total value that might be redistributed would likewise not exceed $100 million.

The proposed action would not have significant adverse effects on the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities.

The proposed action is not expected to adversely affect State, local, or tribal governments or communities because the action is not expected to impact supply or markets for CPS.

Regulatory Flexibility Act

The RIR is also designed to determine whether the proposed rule has a "significant economic impact on a substantial number of small entities" under the Regulatory Flexibility Act (RFA). The purpose of the RFA is to relieve small businesses, small organizations and small governmental entities from burdensome regulations and record-keeping requirements. If the proposed action meets both the "significant" and "substantial" criteria, preparation of an initial regulatory flexibility analysis (IRFA) is required. This proposed action meets neither the "significant" nor the "substantial" criteria; therefore, the Council and/or NOAA may waive the requirement to prepare a Regulatory Flexibility Analysis.

The businesses likely to be affected by Amendment 8 are commercial harvesters engaged in the coastal pelagic species fishery. The following discussion of impacts focuses specifically on the consequences of Amendment 8 on the participants in that fishery.

The Small Business Administration defines a small business in commercial fishing as a firm with receipts of up to $3 million annually. All fishing vessels which would be affected by the alternatives to status quo have annual revenues of less than $3 million. For many of the CPS business entities, landings of CPS represent only a portion of annual revenue. Annual exvessel revenues from CPS species averaged 16% of total exvessel revenue for the 811 vessels coastwide that landed CPS finfish, or squid, or both during the 1993-97 period vessels; less than five percent depended on CPS for all of their exvessel fishing revenues. On average, only 17% of the 811 vessels depended on CPS species for most of their annual exvessel fishing revenues. Many of these entities are vessels that participate in the groundfish, herring, salmon, and other fisheries in addition to CPS.

In general, NMFS has indicated a "substantial number" of small entities to be more than 20% of those small entities engaged in the fishery. Economic impacts on small business entities are considered to be "significant" if the proposed action would result in any of the following: (a) reduction in annual gross revenues by more than 5 percent; (b) increase in total costs of production by more than five percent as a result of an increase in compliance costs; (c) compliance costs as a percent of sales for small entities are at least 10% higher than compliance costs as a percent of sales for large entities; (d) capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow and external financing capabilities; or (e) as a rule of thumb, two percent of small business entities being forced to cease business operations.

LIMITED ENTRY

The Council recommends limited entry for CPS finfish species only. There were 811 vessels coastwide that landed CPS finfish, or squid, or both during the 1993-97 period (Appendix B, Section 3.8.10). Of the 811 vessels with CPS landings during 1993 to 1997, 640 had CPS finfish landings south of 39° N latitude. For the purposes of this analysis the 640 vessels with finfish landings south of 39° N latitude will be treated as the affected population. Of this group, 128 vessels would have to be affected significantly for there to be a substantial number (20%) of vessels significantly affected. Under the option chosen by the Council, 570 vessels (90% of the 640) would not qualify for a limited entry permit (Appendix B, Section 3.8.7). However, limited entry is not expected to affect most of the non-qualifying vessels, primarily because any vessel that does not receive a limited entry permit will still be allowed to land from one to five mt per trip of CPS finfish under exempted landing limits (Appendix B, Section 3.8.4). The exempted landing limit currently proposed is five mt per trip.

Impacts will be analyzed in terms of quantities of CPS finfish and all other species landed, and corresponding exvessel revenues for each of the 640 vessels in the affected population. The primary source of data is Washington, Oregon, and California landings receipts (fish tickets), which contain basic information including the date of the landing, the fishing vessel's identification number, pounds landed by species and the exvessel price per pound received for each species. Data from fish tickets are accessible through the Pacific States, PacFIN Management database to individuals with confidential data clearance. Cost data are unavailable for these vessels, as well as any information about revenues a vessel earns from landings outside Washington, Oregon, and California, and from non-fishing activities.

Analysis based on 1993 to 1997 participation

Reduction in annual gross revenues by more than five percent

Based on landings and exvessel revenues from 1993 to 1997, 122 of the 570 vessels that would not qualify for a limited entry permit depended on CPS finfish landings for at least five percent of their total exvessel revenues for the period. Since 122 vessels is 19% of the affected population (640) and 21% of the non-qualifying vessels (570), there is a possibility that this action may affect a substantial number of small entities. For all other non-qualifying vessels, CPS finfish represented 5% or less of total annual revenue for the period.

For the 122 non-qualifying vessels that relied on CPS finfish for at least five percent of their total exvessel revenues from 1993 to 1997, their dependence on CPS finfish during the period can be summarized as follows:

CPS finfish landings, CPS finfish revenues and total landings summaries for 122 vessels not qualifying for a limited entry permit, but dependent on CPS finfish landings for at least 5% of their total exvessel revenues during 1993 to 1997.

Number of Vessels	Dependence on CPS Finfish (fin rev/tot rev)	Finfish Landings (mt/vessel) 1993 - 1997			Finfish Revenues($1,000/vessel) 1993 - 1997			Total Revenues ($1,000/vessel) 1993 - 1997		
		Ave	Max	Min	Ave	Max	Min	Ave	Max	Min
17	100%	13.03	55.50	0.05	2,958	23,227	25	2,958	23,227	25
10	75 - 99%	16.52	36.79	0.16	12,944	54,871	79	15,760	70,497	92
9	50 - 74%	12.91	47.97	0.04	5,729	19,235	38	9,282	29,722	71
22	25 - 49%	15.24	67.14	0.11	8,908	74,000	84	25,801	213,282	225
64	5 - 24%	5.77	75.14	0.03	2,941	39,876	24	28,165	366,962	167
122	>= 5%	9.90	75.14	0.03	5,045	74,000	24	21,816	366,962	25

Out of the 122 non-qualifying vessels realizing more than five percent of their revenue from CPS finfish, 70 landed no more than five mt and 44 landed no more than one mt of CPS finfish for the entire 1993 to 1997 period. These 44 to 70 vessels (depending on the exempted landing limit) would likely be able to continue landing CPS finfish at the levels allowed under the proposed exempted landings limits. This leaves between 78 (landing more than one mt of CPS finfish from 1993 to 1997) and 52 (landing more than five mt of CPS finfish from 1993-1997) non-qualifying vessels that received more than five percent of their total exvessel revenue from CPS finfish that may be constrained by the one to five mt per trip exempted landings limit.

Capital costs of compliance

This analysis does not compare compliance costs as a percentage of sales among small and large businesses, because all of the entities affected are small businesses under the definitions of the RFA. This section examines capital costs of compliance as a significant portion of capital available to small entities. Total exvessel revenues of less than $2,000 per year are probably not sufficient to support any kind of viable fishing entity over the long term. Of the 122 non-qualifying vessels that depended on CPS finfish for more than five percent of their total exvessel fishing revenue during 1993-1997, 63 had average total exvessel fishing revenues of less than $2,000 per year. Of the 78 non-qualifying vessels that depended on CPS finfish for more than five percent of their total exvessel revenues and landed more than one mt of CPS finfish during 1993-1997, 12 had average CPS finfish landings greater than one mt per year, and average total exvessel fishing revenues less than $2,000 per year.

Vessels that do not initially receive a limited entry permit can purchase a permit to participate in the fishery in the first year of the program, therefore CPS finfish revenue need not be forgone if the vessel was not given a permit in the initial allocation. This represents an additional capital cost for a non-qualifying vessel desiring to participate in the Pacific coast CPS finfish fishery south of 39° N latitude. Non-qualifying vessels that depend on CPS finfish for the bulk of their exvessel revenues, have annual exvessel revenue greater than $2,000 and would be constrained by the one to five mt exempted landings limit would probably be those most interested in purchasing a CPS finfish permit from a qualifying vessel.

Permit prices are likely to represent a significant portion of the capital available to vessels with annual exvessel revenues below $2,000. It is doubtful that vessels with this level of annual exvessel revenue would be able to finance the purchase of a permit from their internal cash flow. Moreover, because transferability of a CPS finfish limited entry permit becomes highly constrained after the first year of the program, its value as an asset or collateral is greatly reduced. Therefore, external sources of permit financing would seemingly be extremely limited for vessels with annual exvessel revenues less than $2,000. Participation in the CPS finfish fishery by the 12 non-qualifying vessels averaging more than one mt of CPS finfish landings per year, highly dependent on CPS finfish revenues, but with average total exvessel revenue less than $2,000 per year, would appear to be in greatest jeopardy under the limited entry options selected by the Council, more so than any other vessel group.

Two percent of small business entities being forced to cease business

There were 12 non-qualifying vessels that depended on CPS finfish for more than five percent of their total exvessel revenues, averaging more than one mt of CPS finfish landings, and less than $2,000 total exvessel revenue per year during 1993-1997. Given these circumstances, a one mt per trip exempted landing limit, and depending on the purchase price of a limited entry permit, these vessels could be forced to reduce their harvests of CPS finfish south of 39° N latitude under the limited entry options chosen by the Council. Twelve vessels is less than two percent of the affected population of 640 vessels.

Five of the 21 non-qualifying vessels that depended on CPS finfish for more than five percent of their total exvessel revenues, landed more than one mt of CPS finfish, and averaged less than $2,000 total exvessel revenue per year during 1993-1997, had average CPS finfish landings greater than five mt per year. Under a five mt exempted landing limit, these vessels might be forced to reduce their harvests of CPS finfish south of 39° N latitude under the limited entry options chosen by the Council. Five vessels is less than one percent of the affected population, and less than one percent of the 570 vessels not qualifying for a CPS finfish limited entry permit under the chosen options.

During the 1993-1997 period there were 17 non-qualifying vessels that depended on CPS finfish for 100% of their exvessel revenue. Based on the number of years during the 1993-1997 period a vessel had CPS finfish landings, only six of these 17 vessels had average annual landings greater than five mt, but none of these six vessels had average annual CPS finfish landings greater than 18 mt, and only two out of the six vessels had average exvessel revenue greater than $2,000 per year. Under these circumstances, a five mt per trip exempted landing limit, and depending on the purchase price of a limited entry permit, there might be at least four non-qualifying vessels that would be forced to reduce their harvests of CPS finfish south of 39° N latitude under limited entry. Four vessels is less than two percent of the 570 vessels that would not qualify for a CPS finfish limited entry permit under the limited entry options chosen by the Council, and less than one percent of the affected population.

Alternative analysis based on 1997 participation

Reduction in annual gross revenues by more than five percent

1997 is the most recent year for which complete CPS landings data are available. In 1997 there were 229 vessels landing 67,621 mt of CPS finfish south of 39° N latitude. Of the 172 vessels that would not qualify for a limited entry permit, only 44 depended on CPS finfish for five percent or more of their total exvessel fishing revenues in 1997. For the other 128 vessels, CPS finfish represented less than five percent of total annual revenue in 1997. Thus, the inability to land CPS over the exempted landing limits is not expected to reduce annual gross revenues by more than five percent for those 128 vessels.

The 44 non-qualifying vessels that depended on CPS finfish for five percent or more of their total exvessel fishing revenues in 1997 represented 19% of the 229 vessels that had CPS finfish landings in 1997. These vessels were relatively small harvesters that mainly used hook-and-line gear to land 268 mt of CPS finfish at a weighted average exvessel price of $.23 per pound. This compares to 67,353 mt of CPS finfish landed by predominantly purse seine vessels at a weighted average exvessel price of $.05 per pound. It would seem that these 44 vessels supply CPS finfish to high value speciality markets (e.g. fresh fish), although the disposition of these landings is unknown from fish tickets. However this does suggest that a particular segment of the CPS finfish fishery may be especially vulnerable to limited entry.

For each of the 44 vessels with more than five percent of their 1997 exvessel revenue from CPS finfish it was assumed that the number of days for which there were CPS finfish landings in 1997 equaled the number of CPS finfish trips. For two of these vessels it was not possible to derive the number of CPS finfish trips in 1997. Out of the remaining 42 vessels, 34 averaged one mt or less landings per trip and 40 averaged five mt or less landings per trip of CPS finfish. These 34 to 40 vessels (depending on the exempted landing limit) would likely be able to continue landing CPS finfish at the levels allowed under the proposed exempted landings limits. Out of the 42 vessels this leaves between eight (with CPS finfish landings greater than one mt per trip in 1997) and two (with CPS finfish landings greater than five mt per trip in 1997) non-qualifying vessels that received more than five percent of their total exvessel revenue from CPS finfish and may be constrained by the one to five mt per trip exempted landings limit.

Two percent of small business entities being forced to cease business

Of the 44 non-qualifying vessels that depended on CPS finfish for more than five percent of their total exvessel revenue during 1997, 10 had total exvessel fishing revenue of less than $2,000 for the year. Of the eight non-qualifying vessels that depended on CPS finfish for more than five percent of their total exvessel fishing revenue and landed more than one mt of CPS finfish during 1997, one had total exvessel revenue of less than $2,000 for the year. This vessel averaged more than five mt of CPS finfish landings per trip, and depended on CPS finfish for most of its total exvessel revenue during 1997. Under a one to five mt per trip exempted landing limit, and depending on the purchase price of a limited entry permit, this vessel would probably be forced to substantially reduce harvests of CPS finfish south of 39° N latitude under the limited entry options selected by the Council.

Summary

The exempted landings provision significantly reduces the impact of CPS finfish limited entry on vessels that would fail to qualify for a limited entry permit under the options chosen by the Council. Based on landings and exvessel revenues for the 1993-1997 period there are 122 vessels, nearly 20% of the affected population, that would not qualify for limited entry permits, but depended on CPS finfish landings for more than five percent of their total exvessel revenues for the period. Therefore the impact of CPS finfish limited entry could be significant in terms of a "substantial number" of small entities potentially foregoing more than five percent of their annual gross revenues. However, average CPS finfish landings for these 122 vessels for the 1993-1997 period was 10 mt, or two mt per year. Given this low level of landings, even at one trip per year (two mt per trip), most of the 122 non-qualifying vessels would be allowed to continue landing CPS finfish under the proposed five mt exempted landing limit. If the exempted landing limit were one mt then up to 12 of the 122 vessels could be forced to reduce harvests south of 39° N latitude and, depending on per trip costs, could potentially be forced out of business because with annual total exvessel revenues less than $2,000 it is doubtful that they could afford to purchase a limited entry permit. Twelve vessels is less than two percent of the affected population of 640 vessels.

The 70 vessels that would qualify for limited entry permits probably would not be significantly impacted in terms of expected revenues under limited entry options chosen by the Council. However, they do stand to receive a potential windfall, at least during the first year of the program, by being awarded a permit with a value on the open market.

Under the limited entry options selected by the Council, potential CPS finfish harvesting capacity would be reduced and capped by eliminating some vessels from the fishery -- non-qualifying vessels that land more than five mt per trip -- and preventing the entry of additional high volume vessels. Vessels that land minor amounts of CPS finfish would be able to continue fishing without a limited entry permit. Even though their share of total CPS finfish landings is expected to be minimal, landings by these vessels are important in terms of supplying high value speciality markets. However, this segment of the CPS finfish fishery appears less likely to become overcapitalized since specialized markets (e.g. fresh fish) are thought to be greatly limited.

Paperwork Reduction Act (PRA)

<u>Limited Entry Forms</u>

If a limited entry option is chosen by the Council and approved, vessel owners would be required to submit applications for permits to participate in the fishery. Permits would probably be fully transferable. The estimated costs of implementing a permit system are presented in Appendix C (see Section 1.4). Such a limited entry scheme would effect from 48 to 101 vessels, depending on the option chosen. Appendix C uses a mid-point of 75 vessels to arrive at the estimate of permit costs. As stated, the estimated cost of a permit is approximately $43.00.

Two forms would be needed to implement the program, an application form and an official permit form. These two forms must be approved by the Office of Management and Budget before permits can be issued.

Permits are proposed to be renewed every two years; therefore, once the initial permits are issued, the number of annual respondents would be 38 (75 x ½). However, a figure of 10% was used to estimate the number of transfers that might take place during the year. This brings the number of annual respondents to 45 (37.5 + 7.5). There is one response required per individual, and the form would require about 30 minutes to complete, taking into consideration the necessary tasks such as gathering the data, as well as filling out the form. The total number of hours added to the reporting burden would be 22.5 hours (45 x ½ hr/response).

Maintaining the data base and to enter the required information during the year is estimated to require about 25 hours annually.

Vessel Markings

If limited entry is approved, federal regulations will require that all permitted vessels be identified by displaying each vessel's official number on the port and starboard sides of the deckhouse or hull, and on an appropriate weather deck so as to be visible from enforcement vessels and aircraft. The official number would be affixed to each vessel in block Arabic numerals at least 14 inches in height. This is a common marking procedure for U.S. fishing vessels. Approximately 15 minutes is required to paint each number on a vessel at the three locations. The total burden would be 56 hours (75 X ¾ hr/vessel).

For the two requirements above, assuming they are approved, public comment is sought regarding whether the proposed collection of information and the time required to mark individual vessels is necessary. Comment is also sought on how the two tasks might be improved, especially regarding the potential of minimizing the burden on the fishing industry.

Executive Order 12612

This rule does not contain policies with federalism implications sufficient to warrant preparation of a federalism assessment under Executive Order 12612.

Coordination and Consultation

Development of this Regulatory Impact Review (RIR) was coordinated with the Council's Coastal Pelagic Species Plan Development Team and staff, and NMFS scientists and managers. The options initially were identified by the Council at its March, April, and June 1998 meetings. Final action was taken at the September 1998 Council meeting in Sacramento, California.

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COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

(Amendment 8 to the Northern Anchovy Fishery Management Plan)

DECEMBER 1998

This Coastal Pelagic Species Fishery Management Plan (Amendment 8 to the Northern Anchovy Fishery Management Plan) was published by the Pacific Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award NA87FC0008.

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1.0 INTRODUCTION

Amendment 8 updates the fishery management plan (FMP) for northern anchovy to manage the entire coastal pelagic species (CPS) fishery along the West Coast of the United States, including Pacific sardine, northern anchovy, Pacific (chub) mackerel, jack mackerel, and market squid. The amendment also changes the name of the plan from the *Northern Anchovy Fishery Management Plan* to the *Coastal Pelagic Species Fishery Management Plan*. Stocks and fisheries are described in Appendix A. All options considered by the Council and analysis of those options is in Appendix B. Costs involved in this FMP are estimated in Appendix C. Essential fish habitat is described in Appendix D. References are included in Appendix E.

1.1 History of the Fishery Management Plan

The Council initiated the development of the FMP for northern anchovy in January of 1977. A final draft of the plan was approved and submitted to the U.S. Secretary of Commerce (Secretary) in June of 1978. Regulations implementing the FMP for northern anchovy were published in the *Federal Register* on September 13, 1978. Subsequently, the Council has considered seven amendments.

The first amendment changed the method of specifying the domestic annual harvest for northern anchovy and added a requirement for an estimate of domestic processing capacity and expected annual level of domestic processing. Approval for this amendment was published in the *Federal Register* on July 18, 1979.

The second amendment, which became effective on February 5, 1982, was published in the *Federal Register* on January 6, 1982. The purpose of this amendment was to increase the domestic fishing fleet's opportunity to harvest the entire optimum yield (OY) of northern anchovy from the U.S. exclusive economic zone (EEZ).

During the spring of 1982, the Council considered a third amendment that divided the quota for northern anchovy into two halves and made release of the second half conditional on the results of a mid-season review of the status of the stock. The methods proposed for the mid-season assessment were considered too complex to implement, and the amendment was not approved.

The fourth amendment, which had two parts, was published in the *Federal Register* on August 2, 1983 and became effective on August 13, 1983. The first part abolished the five-inch size limit in the commercial fishery and established a minimum mesh size of 5/8 inch for northern anchovy. The mesh size requirement did not become effective until April 1986 in order to give the fleet additional time to comply without undue economic hardship. The second part established a mid-season quota evaluation that was simpler in design than the method proposed in Amendment 3.

The fifth amendment in 1983 incorporated advances in scientific information concerning the size and potential yield of the central subpopulation of northern anchovy. In addition, the fifth amendment included changes to a variety of other management measures. Two or more alternative actions were considered in each of seven general categories (1) OY and harvest quotas; (2) season closures; (3) area closures; (4) quota allocation between areas; (5) the reduction quota reserve; (6) minimum fish size or mesh size; and (7) foreign fishing and joint venture regulations. The alternatives for the fifth amendment were reviewed by the Council during 1983. The final rule on the fifth amendment measures was published in the *Federal Register* on March 14, 1984.

The sixth amendment in 1990 implemented a definition of overfishing for northern anchovy consistent with National Standard 7 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

The Council began developing the seventh amendment as a new FMP for CPS in 1990. A complete draft was available in November of 1993, but the Council suspended further work, because NMFS withdrew support due to budget constraints. In July of 1994, the Council decided to proceed with the plan through the public comment period. NMFS agreed with the decision on the condition that the Council also consider the options of dropping or amending the anchovy FMP. Thus, four principal options were considered for managing CPS (1) drop the anchovy FMP (no federal or Council involvement in CPS); (2) continue with the existing FMP for anchovy (status quo); (3) amend the FMP for northern anchovy; and (4) implement an FMP for the entire CPS fishery. In March of 1995, after considering all four principal options, the Council decided to proceed with the FMP for CPS. Final action was postponed until June 1995 when the Council adopted a draft plan that had been revised to address comments provided by NMFS and the Scientific and Statistical Committee (SSC). Amendment 7 was submitted to the Secretary, but rejected by NMFS Southwest Region as being inconsistent with National Standard 7 of the Magnuson-Stevens Act. NMFS announced its intention to drop the FMP for northern anchovy (in addition to FMPs for other species) in the *Federal Register* on March 26, 1996, but the action was never completed.

Development of Amendment 8 began during a June 23-25, 1997 Council meeting where the Council directed the Coastal Pelagic Species Plan Development Team (CPSPDT) to amend the FMP for northern anchovy to conform to the recently revised Magnuson-Stevens Act and to expand the scope of the FMP to include the entire CPS fishery.

1.2 Fishery Management Unit

Stocks managed under this FMP include:

Common Name	Scientific Name
Pacific sardine	*Sardinops sagax*
Pacific (chub) mackerel	*Scomber japonicus*
Northern anchovy Central and northern subpopulations	*Engraulis mordax*
Market squid	*Loligo opalescens*
Jack mackerel	*Trachurus symmetricus*

Stocks may be added or removed from the management unit through the framework process described in Section 2.0.

1.3 Categories of Management

The CPS FMP includes two management categories for CPS fish stocks: “Active” management and "Monitored" management. "Active" is for stocks and fisheries with biologically significant levels of catch, or biological or socioeconomic considerations requiring relatively intense harvest management procedures. The second category, “Monitored”, is for stocks and fisheries not requiring intensive harvest management and where monitoring of landings and available abundance indices are considered sufficient to manage the stock.

The purpose of Active and Monitored management is to use available agency resources in the most efficient and effective manner while satisfying goals and objectives of the FMP. The distinction enables managers and scientists to concentrate efforts on stocks and segments of the CPS fishery that need greatest attention or where the most significant benefits might be expected.

Active management may be characterized by periodic stock assessments, and/or periodic adjustments of target harvest levels based on maximum sustainable yield (MSY) control rules. Monitored management, in contrast, involves tracking trends in landings and qualitative comparison to available abundance data, but without periodic stock assessments, or periodic adjustments to target harvest levels. Species in both categories may be subject to management measures such as catch allocation, gear regulations, closed areas, closed seasons, or other forms of Active management.

Explicit MSY control rules, definitions of overfishing and overfished stocks must be developed for all Actively managed species. Monitored management, in contrast, may use “generic” or general definitions of overfishing and overfished stocks that do not have specific fishing mortality or biomass cutoffs. Essential fish habitat (EFH) must be described for all stocks in the management unit, including Actively managed and Monitored species.

The Coastal Pelagic Species Management Team (CPSMT) will review all CPS stocks annually and make recommendations to the Council and agencies regarding appropriate management categories for each stock ("Active" or "Monitored"). Changes to the appropriate management category for each species can be made annually by the Council based on all available data, including acceptable biological catch (ABC) levels and MSY control rules, and the goals and objectives of this FMP. Changes in a management category may be accomplished according to any of the four procedures for establishing and adjusting management measures described below in Section 2.0. In addition, CPS in the Monitored management category can be reassigned to Active management on short notice under the point-of-concern framework.

1.4 Operational Definitions of Terms

Actively managed species (AMS) means CPS the Secretary has determined to require federal management by harvest guideline or quota according to the provisions of the FMP.

Coastal Pelagic Species Advisory Subpanel (CPSAS) the CPSAS is comprised of members of the fishing industry and public appointed by the Council to review proposed actions for managing the coastal pelagic species fisheries.

Biomass means the estimated amount, by weight, of a CPS population. The term biomass means total biomass (age one and above) unless stated otherwise.

Coastal pelagic species (CPS) means northern anchovy (*Engraulis mordax*), Pacific mackerel (*Scomber japonicus*), Pacific sardine (*Sardinops sagax*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*).

Coastal Pelagic Species Management Team (CPSMT) means the individuals appointed by the Council to review, analyze, and develop management measures for the CPS fishery.

Council means the Pacific Fishery Management Council, including its CPSMT, CPSAS, SSC, and any other committee established by the Council.

Finfish means northern anchovy, Pacific (chub) mackerel, Pacific sardine, and jack mackerel.

Fishery Management Area means the EEZ off the coasts of Washington, Oregon, and California between three and 200 nautical miles offshore, bounded in the north by the Provisional International Boundary between the United States and Canada, and bounded in the south by the International Boundary between the United States and Mexico.

Harvest guideline means a specified numerical harvest objective that is not a quota. Attainment of a harvest guideline does not require complete closure of a fishery.

Harvesting vessel means a vessel involved in the attempt or actual catching, taking or harvesting of fish, or any activity that can reasonably be expected to result in the catching, taking or harvesting of fish.

Limited entry fishery means the fishery comprised of vessels fishing for CPS in the CPS management zone under limited entry permits issued under this FMP.

Live bait fishery means fishing for CPS for use as live bait in other fisheries.

Monitored species (MS) means those CPS the Secretary has determined not to need management by harvest guidelines or quotas according to the provisions of the FMP.

Nonreduction fishery means fishing for CPS for use as dead bait or for processing for direct human consumption.

Owner, as used in this subpart, means a person who is identified as the current owner in the Certificate of Documentation (CG-1270) issued by the U.S. Coast Guard for a documented vessel, or in a registration certificate issued by a state or the U.S. Coast Guard for an undocumented vessel.

Person, as used in this subpart, means any individual, corporation, partnership, association or other entity (whether or not organized or existing under the laws of any state), and any federal, state, or local government, or any entity of any such government that is eligible to own a documented vessel under the terms of 46 U.S.C. 12102(a).

Processing or to process means the preparation or packaging of CPS to render the fish suitable for human consumption, pet food, industrial uses or long-term storage, including; but not limited to, cooking, canning, smoking, salting, drying, filleting, freezing, or rendering into meal or oil, but does not mean heading and gutting unless there is additional preparation.

Quota means a specified numerical harvest objective for a single species of CPS, the attainment (or expected attainment) of which causes the complete closure of the fishery for that species.

Reduction fishery means fishing for CPS for the purposes of conversion into: fish flour; fish meal; fish scrap; fertilizer; fish oil; other fishery products; or byproducts for purposes other than direct human consumption.

Regional Administrator means the Administrator, Southwest Region, NMFS, or a designee.

Reserve means a portion of the harvest guideline or quota set aside at the beginning of the year for specific purposes, such as for individual harvesting groups to ensure equitable distribution of the resource or to allow for uncertainties in preseason estimates of DAP and JVP.

Sustainable Fisheries Division (SFD) means the Assistant Regional Administrator for Sustainable Fisheries, Southwest Region, NMFS, or a designee.

Totally lost means that the vessel being replaced no longer exists in specie, or is absolutely and irretrievably sunk or otherwise beyond the possible control of the owner, or the costs of repair (including recovery) would exceed the repaired value of the vessel.

1.5 Goals and Objectives

Goals and objectives for the CPS FMP (not listed in order of priority):

1. Promote efficiency and profitability in the fishery, including stability of catch.
2. Achieve OY.
3. Encourage cooperative international and interstate management of CPS.
4. Accommodate existing fishery segments.
5. Avoid discard.
6. Provide adequate forage for dependent species.
7. Prevent overfishing.
8. Acquire biological information and develop long term research program.
9. Foster effective monitoring and enforcement.
10. Use resources spent on management of CPS efficiently.
11. Minimize gear conflicts.

2.0 FRAMEWORK MANAGEMENT

The framework approach to management of coastal pelagic species (CPS) allows changes and modifications to management procedures to be made in a timely and efficient manner without need to amend the fishery management plan (FMP). The FMP establishes two framework procedures through which the Council is able to recommend establishment and adjustment of management measures. The "point-of-concern" framework allows the Council to develop management measures in response to resource conservation and ecological issues. The "socioeconomic" framework allows the Council to develop management measures in response to social and economic issues.

Management measures may be imposed, adjusted, or removed at any time during the year. Management measures may be imposed for resource conservation, social, or economic reasons consistent with FMP procedures, goals, and objectives.

Analyses of biological, ecological, social, and economic impacts will be considered when a particular change is proposed. As a result, time required to take action will vary depending on the type of action (see below), its impacts on the fishing industry, resource, and environment, as well as review of these impacts by interested parties. Satisfaction of legal requirements for other applicable laws (e.g., the Administrative Procedure Act, Regulatory Flexibility Act, Executive Order 12866, etc.) for actions taken under this framework requires analysis and public comment before measures may be implemented by the U.S. Secretary of Commerce (Secretary).

Management measures addressing resource conservation or ecological issues must be based on the point-of-concern framework consistent with procedures and criteria listed in Section 2.1.2.

Management measures addressing social or economic issues must be based on the socioeconomic framework consistent with procedures and criteria described in Section 2.1.3.

2.1 Types of Actions and Procedures

Under the point-of-concern or the socioeconomic frameworks, there are four different types of management actions, requiring slightly different processes. Management measures may be established, adjusted, or removed using any of these four actions:

1. **Automatic Actions** may be initiated by the National Marine Fisheries Service (NMFS) Regional Administrator without prior public notice, opportunity to comment, or a Council meeting. These actions are non-discretionary and the impacts must previously have been taken into account. Examples include closure of the directed fishery when the directed portion of the harvest guideline is attained, an inseason release of geographic allocations (all species and fishery segments), or closure of the fishery when the total harvest guideline is attained. The Secretary will publish a single notice in the *Federal Register* making the action effective.

2. **"Notice" Actions** require at least one Council meeting and one *Federal Register* notice. These include all management actions other than automatic actions that are either non-discretionary or have probable impacts that have been previously analyzed.

   Notice actions are intended to have temporary effect and the expectation is that they may need frequent adjustment. They may be recommended at a single Council meeting, although the Council will provide as much advance information to the public as possible concerning the issues it will be considering. The primary examples are management actions defined as routine in Section 2.1.1. These include release of surplus incidental catch harvest guideline to the directed fishery (if necessary), and inseason changes to incidental catch allowances. In addition, annual specifications, including the total harvest guideline consisting of a directed and incidental portion, and any specifications for joint venture processing (JVP) or total allowable level of foreign fishing (TALFF) will be 'notice' actions as described in Section 4.8. Previous analysis must have been specific as to species and gear type before a management measure can be defined as routine and acted upon at a single Council meeting. If recommendations are approved, the Secretary may waive, for good cause, the requirement for prior notice and comment in the *Federal Register* and will publish a single notice in the *Federal Register* making the action effective. This category of actions presumes the Secretary will find that the extensive notice and opportunity for comment along with other information provided by the Council will serve as good cause to waive the need for additional prior notice and comment in the *Federal Register*.

3. **Abbreviated Rulemaking Actions** normally require at least two Council meetings and one *Federal Register* rule. These include all management actions intended to have permanent effect and be discretionary in nature with impacts that have not been previously analyzed. The Council will develop and analyze the proposed management actions over the span of at least two Council meetings and provide public advance notice and opportunity to comment on proposals and analysis prior to and at the second Council meeting. If the NMFS Regional Administrator approves the Council's recommendation, the Secretary may waive, for good cause, the requirement for prior notice and comment in the *Federal Register* and publish a final rule in the *Federal Register* which will remain in effect until amended. If a management measure is designated as routine by final rule under this procedure, specific adjustments of that measure can subsequently be announced in the *Federal Register* by notice as described in this FMP. The Secretary may waive the opportunity for prior notice and comment in the *Federal Register*.

   The primary purposes of the previous two categories of notice and abbreviated rulemaking procedures are (1) to accommodate the Council's meeting schedule for developing annual management recommendations; (2) to satisfy the Secretary's responsibilities under the Administrative Procedures Act; and (3) to address the need to implement management measures by a specified date each fishing year.

   The two-Council meeting process refers to two decision meetings. The first meeting to develop proposed management measures and their alternatives, and the second meeting to make a final recommendation to the Secretary. Identification of issues and the development of proposals normally will begin at a Council meeting prior to the first decision meeting.

4. **Full Rulemaking Actions** normally require at least two Council meetings and two *Federal Register* rules (Regulatory Amendment). These include any highly controversial management measure. The Council will follow the two meeting procedures described for the abbreviated rulemaking category. The Secretary will publish a proposed rule in the *Federal Register* with an appropriate period for public comment followed by publication of a final rule in the *Federal Register*.

2.1.1 Routine Management Measures

Routine management measures are those the Council determines likely to be adjusted annually or more frequently. Measures are classified as routine by the Council through either full or abbreviated rulemaking process. In order for a measure to be classified as routine, the Council will determine that the measure addresses an issue at hand and may, in the near future, require further adjustment to achieve its purpose.

Once a management measure has been classified as routine through the abbreviated or full rulemaking procedures, it may be modified thereafter through the single meeting notice procedure if (1) modification is proposed for the same purpose as the original measure; and (2) impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as routine. Analysis need not be repeated when the measure is subsequently modified if the Council determines impacts do not differ substantially from original analysis. The Council may change a routine classification for an action without following any prespecified procedure.

Any measure designated as routine for one specific species, species group, or gear type may not be treated as routine for a different species, species group, or gear type without first having been classified as routine through the rulemaking process.

To facilitate this process, the Coastal Pelagic Species Management Team (CPSMT) will make recommendations to the Council and agencies regarding assessment or management needs.

The following measures are classified as routine measures at the outset of this FMP:

1. Reallocation of surplus incidental harvest guideline to the directed fishery (all species and fishery segments).
2. Inseason changes in the incidental catch allowance.
3. Specification of annual harvest guidelines or quotas.

2.1.2 Point-of-Concern Framework

The point-of-concern process is the Council's primary tool (along with setting harvest guidelines and harvest quotas) for exercising resource stewardship responsibilities. The process is intended to foster continuous and vigilant review of Pacific Coast CPS stocks and fisheries. The process is also to prevent overfishing or any other resource damages. The CPSMT will monitor the fishery throughout the year, and account for any new information on status of each species or species group to determine if a resource conservation or ecological issue exists. Point-of-concern criteria are intended to assist the Council in determining when a focused review on a particular species is warranted and may require implementation of specific management measures. This framework provides the Council authority to act based solely on a point-of-concern. Thus, the Council may act quickly and directly to address resource conservation or ecological issues. In conducting this review, the CPSMT will utilize the most current catch, effort, abundance and other relevant data from the fishery.

In the course of the continuing review, a "point-of-concern" occurs when one or more of the following is found or expected:

1. Catch is projected to exceed the current harvest guidelines or the harvest quota.
2. Any adverse or significant change in the biological characteristics of a species (age composition, size composition, age at maturity, or recruitment) is discovered.
3. An overfishing condition appears to be imminent or likely within two years.
4. Any adverse or significant change in the availability of CPS forage for dependent species or in the status of a dependent species is discovered.
5. Developments in a foreign fishery occur that affect the likelihood of overfishing of CPS.
6. An error in data or a stock assessment is detected that significantly changes estimates of impacts due to current management.
7. Maximum sustainable yield (MSY) control rule (harvest policy) parameters or approach require modification.
8. Projected catches for a Monitored species are expected to exceed the acceptable biological catch (ABC) using either a species-specific control rule or the default control rule. This could require moving a Monitored species to the Actively managed classification.

Once a point-of-concern is identified, the CPSMT will evaluate current data to determine if a resource conservation or ecological issue exists and will provide its findings in writing at the next scheduled Council meeting. If the CPSMT determines a resource conservation or ecological issue exists, it will provide its recommendation, rationale, and analysis for appropriate management measures that will address the issue.

Direct allocation of a resource between different segments of a fishery is, in most cases, not the appropriate response to a resource conservation or ecological issue. Council recommendations to directly allocate the resource will be developed according to criteria and processes in the socioeconomic framework described in Section 2.1.3 and Section 2.1.4.

After receiving the CPSMT report, the Council will take public testimony and, if appropriate, recommend management measures to the NMFS Regional Administrator accompanied by supporting rationale and analysis of impacts. The Council analysis will include a description of (1) resource conservation or ecological issues consistent with FMP objectives; (2) likely impacts on other management measures and other fisheries; (3) socioeconomic impacts; and (4) costs and benefits to commercial and recreational segments of the CPS fishery. The recommendation will explain the urgency in implementation of the measure(s), if any.

The NMFS Regional Administrator will review the Council's recommendation and supporting information and will follow appropriate implementation processes described in this FMP, following public notice and comment. If the Council contemplates frequent adjustments to the recommended measures, it may classify them as "routine" through the appropriate process described in Section 2.1.1.

If the NMFS Regional Administrator does not concur with the Council's recommendation, he/she will notify the Council in writing of the reasons for rejection. Nothing prevents the Secretary from exercising authority to take emergency action under Section 305 (c) and (d) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). Nothing precludes or limits Council access to the point-of-concern framework.

2.1.3 The Socioeconomic Framework

Nonbiological issues may arise which require the Council to recommend management actions to address certain social or economic conditions in the fishery or to achieve FMP objectives. Resource allocation, fishing seasons, or landing limits based on market quality and timing, safety measures, and prevention of gear conflicts are examples of possible management issues with a social or economic basis. Actions that are permitted under this framework include all categories of actions authorized under the point-of-concern framework with the addition of direct resource allocation and access-limitation measures.

If the Council concludes that management action is necessary to address a social or economic issue, it will prepare a report containing the rationale supporting its conclusion. The report will include proposed management measures, a description of viable alternatives, and analyses addressing (1) achievement of FMP goals and objectives, (2) likely impacts on other fisheries and other management measures, (3) sociobiological impacts, (4) socioeconomic impacts, and (5) costs and benefits to the CPS fishery.

The Council, following review of the report, supporting data, public comment and other relevant information, may recommend management measures to the NMFS Regional Administrator accompanied by relevant background data, information, and public comment. The recommendation will explain the urgency in implementation of the measure(s), if any.

The NMFS Regional Administrator will review the Council's recommendation, supporting rationale, public comments and other relevant information and, if it is approved, will undertake the appropriate method of implementation. Rejection of the recommendation will be explained in writing.

Procedures specified in this FMP do not affect authority of the Secretary to take emergency regulatory action under Section 305(c) or (d) of the Magnuson-Stevens Act.

If conditions warrant, the Council may designate a management measure developed and recommended to address social and economic issues as a routine management measure provided that the criteria and procedures in Section 2.1.1 are followed.

2.1.4 Allocation

In addition to other requirements in this FMP, the Council will consider the following factors when considering direct allocation of the resource:

1. Present participation in and dependence on the fishery, including alternative fisheries.
2. Historical fishing practices in, and historical dependence on, the fishery.
3. Economics of the fishery.
4. Agreements or negotiated settlements between the affected participants in the fishery.
5. Potential biological impacts on any species affected by the allocation.
6. Consistency with the Magnuson-Stevens Act national standards.
7. Consistency with the goals and objectives of this FMP.

Modification of a direct allocation cannot be designated as "routine" unless the specific criteria for the modification have been established in the regulations.

2.1.5 Procedures for Specifying Maximum Sustainable Yield and Optimum Yield

As data become available, improve, or are updated, MSY control rules and OY specifications or procedures for setting MSY control rules or OY specifications may need to be modified. Changes and additions to these formulas are authorized by the FMP and may be accomplished through the point-of-concern mechanism or the socioeconomic mechanism.

2.1.6 Management Agreements with Other Nations

In the event that a management agreement between the U.S. and a foreign nation concerning CPS occurs, this FMP authorizes changes or modifications to any management measure through Council processes described herein.

2.1.7 Management Measures to Protect Noncoastal Pelagic Species

CPS fishing activities may directly impact certain non-CPS species including birds, marine mammals, and other fishes. This FMP authorizes implementation of measures to control CPS fishing to support conservation objectives identified under overfishing definitions adopted by the Council, the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), or other applicable law, while minimizing disruption of the CPS fishery. Any measures described in this FMP may be employed to control fishing impacts on non-CPS species. However, allocation may not be the primary intention of any such regulation.

The process for implementing and adjusting such measures may be initiated at any time under the point of concern or socioeconomic frameworks. In addition, measures to protect non-CPS may be designated as routine as described in Section 2.1.1, which will allow adjustment at a single meeting based on relevant information available at the time if (1) modification is proposed for the same purpose as the original measure, and (2) impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as routine.

Generally, the Council will initiate the process of establishing or adjusting management measures when a resource problem with a non-CPS is identified, and it has been determined that CPS fishing regulations will reduce the total impact on that species or stock. It is anticipated this will generally occur when a state or federal resource management agency (such as the U.S. Department of the Interior, NMFS, or a state fishery agency) presents the Council with information substantiating its concern for a particular species. The Council will review the information and refer it to the Scientific and Statistical Committee, CPSMT or other appropriate technical advisory group for evaluation. If the Council determines that management measures may be necessary to address requirements of the ESA, MMPA, international agreements, or other relevant federal law or policy, it may implement appropriate management measures in accordance with the procedures identified in Section 2.1. The intention of the measures may be to share conservation burdens while minimizing disruption of the CPS fishery, but under no circumstances may the intention be simply to provide more fish to a different user group or to achieve other allocation objectives.

2.2 Other Management Measures

2.2.1 Generic

These management measures apply to all vessels participating in the CPS fishery.

2.2.1.1 Observers

All fishing vessels operating in this management unit, including catcher/processors, at-sea processors, and vessels that harvest in Washington, Oregon, or California and land catch in another area, may be required to accommodate NMFS certified observers on board to collect scientific data. An observer program will be considered only for circumstances where other data collection methods are deemed insufficient for management of the fishery. Implementation of any observer program will be in accordance with appropriate procedures outlined under this framework.

As determined by the NMFS Regional Administrator, there may be a need for observers on at-sea processing vessels to collect data normally collected at shore-based processing plants. Processing vessels must accommodate on board observers and may be required to provide the NMFS certified observers prior to issuance of any required federal permits. Observers are required on foreign vessels operating in U.S. waters.

2.2.1.2 Essential Fish Habitat

The Magnuson-Stevens Act requires Councils to include descriptions of essential fish habitat (EFH) in all federal FMPs. In addition, the Magnuson-Stevens Act requires federal agencies to consult with NMFS on activities that may adversely affect EFH. Appendix D of this FMP includes a description of EFH for the five CPS included in this plan (northern anchovy, Pacific [chub] mackerel, jack mackerel, market squid, and Pacific sardine), fishing effects on EFH, non-fishing effects on EFH, and options to avoid or minimize adverse effects on EFH or promote conservation and enhancement of EFH.

Magnuson-Stevens Act Directives Relating to EFH

Magnuson-Stevens Act directives and NMFS guidance on implementation are addressed in greater detail in Appendix D. The Magnuson-Stevens Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." To clarify this definition, the following interpretations are made: "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers the full life cycle of a species. The definition of EFH may include habitat for an individual species or an assemblage of species, whichever is appropriate to the FMP.

The Magnuson-Stevens Act requires councils to describe in FMPs any fishing activities that may adversely affect EFH. The Magnuson-Stevens Act also requires FMPs to include management measures that minimize adverse effects on EFH from fishing, to the extent practicable.

In addition, the EFH regulations require identification of non-fishing adverse impacts on EFH. The Magnuson-Stevens Act specifies that councils may comment on and make recommendations to the Secretary and any federal or state agency concerning any activity authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken, by any state or federal agency that, in the view of the Council, may affect the habitat, including EFH, of a fishery resource under its authority. If the Secretary receives information that an activity of a state or federal agency would adversely affect EFH, the Secretary shall recommend to such agency measures that can be taken by such agency to conserve such habitat. Nonfishing impacts on EFH and corresponding potential conservation measures are included in Appendix D.

Definition of Essential Fish Habitat for CPS

The CPS fishery includes four finfish (Pacific sardine, Pacific [chub] mackerel, northern anchovy, and jack mackerel) and the invertebrate, market squid. CPS finfish are pelagic (in the water column near the surface and not associated with substrate), because they generally occur or are harvested above the thermocline in the upper mixed layer. For the purposes of EFH, the four CPS finfish are treated as a complex because of similarities in their life histories and similarities in their habitat requirements. Market squid are also treated in this same complex because they are similarly fished above spawning aggregations.

The definition of EFH for CPS finfish is based on a thermal range bordered by the geographic area where CPS occur at any life stage, where CPS have occurred historically during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by CPS. The identification of EFH for CPS accommodates the fact that the geographic range of CPS varies widely over time in response to the temperature of the upper mixed layer of the ocean.

The east-west geographic boundary of EFH for CPS is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the EEZ and above the thermocline where sea surface temperatures range between 10°C to 26°C. The southern boundary is the United States-Mexico maritime boundary. The northern boundary is more dynamic, and is defined as the position of the 10° C isotherm, which varies seasonally and annually. Appendix D provides a more detailed description of this variability.

Management Measures To Minimize Adverse Impacts on EFH from Fishing

The Council may use any of the following management measures to minimize adverse effects on EFH from fishing, if there is evidence that a fishing activity is having an identifiable adverse effect on EFH. Currently, there is not evidence that a fishing activity is having an identifiable adverse effect on CPS EFH. Such management measures shall be implemented under the point-of-concern framework as described in Section 2.1.2.

- Fishing Gear Restrictions
- Time/Area Closures
- Harvest Limits, or other applicable measures

In determining whether it is practicable to minimize an adverse effect from fishing, the Council should consider whether, and to what extent, the fishing activity is adversely impacting EFH, including the fishery; the nature and extent of the adverse effect on EFH; and whether management measures are practicable. This determination should take into consideration the long and short term costs and benefits to the fishery and EFH, along with other appropriate factors, consistent with National Standard 7 (conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication).

2.2.1.3 Vessel Safety Considerations

The Council will consider and may provide, after consultation with the U.S. Coast Guard and persons utilizing the fishery, temporary adjustments for access to the fishery by vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safety of the vessels.

2.2.1.4 Limited Entry

This FMP authorizes changes and modifications to any effort limitation programs established herein and development of additional effort limitation programs. Changes may include, but are not limited to, requirements for obtaining, maintaining, and renewing permits in any effort limitation system.

2.2.2 Domestic Commercial Management Measures

All measures, unless otherwise specified, apply to all domestic vessels regardless of whether catch is landed and processed on shore or processed at sea.

2.2.2.1 Permits

Federal permits may be required for individuals or vessels that harvest CPS, and for individuals or facilities (including vessels) that process CPS or purchase live CPS. In determining whether to require a harvesting or processing permit, and in establishing the terms and conditions for issuing a permit, the Council may consider any relevant factors including whether a permit:

1. Will enhance the collection of biological, economic, or social data.
2. Will provide better enforcement of laws and regulations, including those designed to ensure conservation and management and those designed to protect consumer health and safety.
3. Will help achieve the goals and objectives of the FMP.
4. Will help prevent or reduce overcapacity in the fishery.
5. May be transferred, and under what conditions.

Separate permits or endorsements may be required for harvesting and processing, or for vessels or facilities based on size, type of fishing gear used, species harvested or processed, or such other factors that may be appropriate. The permits and endorsements are also subject to sanctions, including revocation, as provided by Section 308 of the Magnuson-Stevens Act.

In establishing a permit requirement, the Council will follow the rulemaking procedures as described in Section 2.1.

2.2.2.2 Permit Revocation and Reinstatement

This FMP allows National Oceanic and Atmospheric Administration (NOAA), under procedures of 15 CFR Part 904, to revoke or suspend any permit issued under authority of the CPS FMP.

2.2.2.3 Catch Restrictions

This FMP authorizes the commercial and recreational harvest of CPS and provides for limiting the harvest of CPS managed under this plan. Catch restrictions may be modified under the framework provisions.

2.2.2.4 Prohibited Species

This FMP does not authorize the taking, retaining, or possessing of any species by CPS gears, if such taking or possessing is prohibited by other state or federal regulations. Species identified as prohibited must be returned to the sea as soon as practical with a minimum of injury after allowing for sampling by an observer, if any. Exceptions may be made for recovery of tagged fish.

This FMP authorizes the designation of other prohibited species in the future, or the removal of a species from this classification, consistent with other applicable law for that species.

2.2.2.5 Gear Restrictions

This FMP authorizes the use of net gear, hook-and-line, pots (traps), longlines, and any other type of gear as legal gear for the commercial harvest of CPS, unless such gear is specifically prohibited by state law. A complete listing of current state regulations in Washington, Oregon, and California is in Appendix B.

Implementation and modification of specific management measures regarding gear, such as definitions of legal gear, mesh size restrictions, gear marking, or other gear restrictions are authorized by this FMP. Gear restrictions may be established, modified, or removed under the point-of-concern or socioeconomic frameworks. Any changes in gear regulations should be scheduled to minimize costs to the fishing industry, insofar as this is consistent with achieving the goals of the change.

2.2.2.6 Closed Fishing Areas

Currently, there are certain areas closed to commercial round-haul fishing or fishing for reduction processing (Figure 1). Those areas were originally closed by the State of California to avoid commercial fishing conflicts with sport fisheries and reduce potential impacts on sport fish and salmon. This FMP authorizes the issuance of exempted fishing permits in Section 2.2.8 for fishing in closed areas consistent with the goals and objectives of the FMP.

Closed areas shall be implemented or changed through the procedures described in Section 2.1.

2.2.2.7 Reporting Requirements

This FMP authorizes domestic annual harvest (DAH) survey, exempted fishing permit (EFP) application, and foreign vessel reporting and records keeping requirements. This FMP authorizes other domestic vessel permit applications and reporting requirements in the future.

Surveys to Determine Domestic Annual Harvest

Surveys of the domestic industry will be conducted by NMFS at the appropriate time to determine amounts of fish not needed by the domestic processing industry, which then may be made available to joint venture or foreign fishing.

Other Reporting and Record Keeping Requirements

Catch, effort, biological, and other data necessary for implementation of this FMP will continue to be collected by the states of Washington, Oregon, and California under existing state data collection provisions. Federal reporting requirements, such as logbooks, will be implemented only when data collection and reporting systems operated by state agencies fail to provide the Secretary with statistical information for adequate management. Any special reporting requirement should be imposed only if it is expected to enhance the Council's and NMFS' ability to manage the CPS fishery more effectively.

Conditions may develop in the CPS fishery that make current state reporting requirements insufficient. For example, a large capacity vessel such as a factory trawler might operate within state waters but outside the area of limited entry trip limit restrictions (i.e., north of 39° N latitude), harvest substantial amounts of CPS, and either unload catch after a period of delay or outside the management area. It is possible that delays in obtaining catch data or missing catch data could affect stock assessments or other management efforts. To address these potential future problems, the FMP authorizes implementation of federal reporting requirements in addition to those of the various states. The purpose of these measures would be to enhance Council's ability to manage CPS stocks effectively. Additional reporting requirements would be developed under framework management procedures and announced in the *Federal Register*.

2.2.2.8 Vessel Identification

The FMP authorizes vessel identification requirements which may be modified as necessary to facilitate enforcement and vessel recognition.

2.2.3 Domestic Recreational

Measures described in this section apply to domestic recreational fisheries only, although most measures could be used to manage foreign recreational fisheries as well.

2.2.3.1 Permits

Washington, Oregon, and California have state laws concerning recreational licenses and permits. In the event that a federal licenses or permits become necessary, they may be required under this FMP.

2.2.3.2 Catch Restrictions

This FMP authorizes establishment of catch restrictions on the recreational fishery consistent with FMP goals and objectives and national standards established by the Magnuson-Stevens Act.

2.2.3.3 Gear Restrictions

There are no federal restrictions on legal recreational gear for CPS. Existing state regulations apply in Washington, Oregon, and California. This FMP authorizes federal recreational regulations for CPS.

2.2.4 Domestic Vessels in a Joint Venture

U.S. vessels operating in joint ventures on the West Coast are domestic vessels and traditionally have been treated the same as U.S. vessels delivering to shore facilities. However, conditions in the fishery could warrant separate treatment in the future. Although all U.S. vessels have been subject to the same regulations, joint venture catcher operations may be affected indirectly by restrictions (such as closed areas) placed on the foreign processing vessels that receive U.S. catch at sea.

2.2.5 Foreign Vessels in a Joint Venture or Foreign Fishery

These measures apply to foreign vessels that process fish taken by U.S. catcher-boats under joint venture processing or to foreign vessels that operate in a fishery directed at a species for which there is a TALFF. The CPS FMP provides authority to establish, modify or remove future regulations including, but not limited to, harvest guidelines, harvest quotas, seasons, area closures, incidental harvest restrictions, trip and landing limits, and gear restrictions.

2.2.5.1 Permits

All foreign vessels operating in this management area shall have on board a permit issued by the Secretary pursuant to the Magnuson-Stevens Act.

2.2.5.2 Target Species

A foreign nation may conduct joint venture operations only for species for which there is a JVP and only using boats with appropriate permits. Directed fishing is allowed only for species for which the foreign nation has received an allocation of TALFF.

2.2.5.3 Incidental Catch

Incidental catch refers to CPS which are unavoidably caught while fishing for another species. It is recognized that incidental harvest of domestically fully utilized CPS is unavoidable in joint venture and foreign fisheries. Minimal incidental allowances consistent with the status of the stocks and the efficiency of the joint venture or foreign fisheries will usually be allowed. These incidental allowances are not to be considered as surpluses to domestic processing needs and are allowed only to provide for full utilization of the species targeted in the joint venture or foreign fishery.

Allowances for incidental harvest in joint ventures or foreign fisheries may be percentages or some other quantity at the Council's discretion. Incidental allowances may be changed at any time during the year, but are published at least annually, concurrent with the annual specifications of JVP.

The Council may modify incidental catch allowances inseason to reflect changes in the condition of the resource and performance of the U.S. industry. The Council will consider public testimony and consider the following factors before establishing or changing incidental allowances, (1) observed catch rates in any previous joint venture or foreign fishery; (2) current estimates of relative abundance and availability of species caught incidentally; (3) ability of the foreign vessels to take the JVP or TALFF; (4) past and projected foreign and U.S. fishing effort; (5) status of stocks; (6) impacts on the domestic industry; and (7) other relevant information. Inseason changes will be made as a routine management measure.

2.2.5.4 Prohibited Species

Prohibited species means salmonids or any species of fish that a joint venture or foreign vessel is not authorized to retain. Prohibited includes fish received in excess of any authorization, landing limit, or harvest guideline. These species must be immediately returned to the sea with a minimum of injury after allowing for sampling by an observer, if any. This FMP authorizes the designation of other prohibited species in the future, or the removal of a species from this classification if consistent with the applicable law for that species.

2.2.5.5 Season and Area Restrictions

There is no season restriction unless otherwise specified according to this FMP. There is no area restriction, unless otherwise specified according to this FMP. Joint venture and foreign fisheries for CPS may not be conducted within the limited entry area south of 39° N latitude.

Season and area restrictions for foreign vessels operating in a joint venture or foreign fishery may be established, modified, or removed at any time during the year in accordance with the procedures in Sections 2.1.2 and 2.1.3 or by foreign vessel permit conditions.

2.2.5.6 Reporting and Record Keeping Requirements

Foreign nations receiving U.S. harvested fish in a joint venture or participating in a foreign fishery are required to submit detailed reports of fishing effort, location, amount, and disposition by species or species group, and transfer of fish or fish products, as needed for monitoring and management of the fishery. Reports may be required at specified time intervals. The NMFS Regional Administrator may require daily reports when a specified fraction of JVP, TALFF, or incidental allowance is reached. In addition, each country may be required to report arrival, departure, and positions of each of its vessels, as specified under the regulations and permit conditions, as needed for monitoring fleet deployment. Logbooks may be required to fulfill fishery conservation, management, and enforcement purposes of Magnuson-Stevens Act. These logs may include, but are not limited to, communications logs, transfer logs, or daily joint venture logs with haul by haul and daily receipt data, effort, and production information.

2.2.5.7 Dumping

Foreign and other vessels are prohibited from dumping pollutants and fishing gear which would degrade the environment or interfere with domestic fishing operations.

2.2.5.8 Fishery Closure

A joint venture or directed foreign fishery shall cease each year when, (1) the JVP or TALFF is reached; (2) the maximum incidental catch allowance for that nation of any species or species group is reached; (3) the overall harvest guideline or harvest quota for the allocated species is reached; (4) the applicable open season is ended; or (5) as necessary for resource conservation reasons under the point-of-concern mechanism.

2.2.5.9 Observers

Observers shall be placed on each foreign vessel while it is operating in a foreign or joint venture fishery, as provided by Title II of the Magnuson-Stevens Act. The law provides for the following exceptions to this requirement:

1. If observers are aboard motherships of a mothership/catcher vessel fleet.

2. If the vessel is in the exclusive economic zone (EEZ) for such a short time that at observer would be impractical.
3. If facilities for quartering an observer are inadequate or unsafe.
4. For reasons beyond the control of the Secretary an observer is not available.

2.2.5.10 Other Restrictions

The Secretary may impose additional requirements for the conservation and management of fishery resources covered by the vessel permit or for national defense or security reasons. These restrictions include, but are not limited to, season, area, and reporting requirements.

The highest priority of this FMP is to provide for conservation of the resource. Any restriction on the joint venture fishery may be modified under the point-of-concern mechanism for resource conservation reasons.

2.2.6 Foreign Recreational

Foreign recreational fishing refers to any fishing from a foreign vessel not operated for profit or scientific research, and not involved in the sale, barter, or trade of any part of the catch. This FMP authorizes establishment of catch restrictions on the foreign recreational fishery which are consistent with the goals and objectives of this FMP and the national standards established by the Magnuson-Stevens Act.

2.2.7 Limited Entry

Research and monitoring programs may need to be developed and implemented for the CPS fishery so that information required in a limited entry program is available. Such data should indicate the character and level of participation in the fishery, including but not limited to, (1) investment in vessel and gear; (2) the number and type of units of gear; (3) the distribution of catch; (4) the value of catch; (5) the economic returns to the participants; (6) mobility between fisheries; (7) purchase or sale prices of limited entry permits; various social and community considerations.

2.2.8 Exempted Fishing

"Exempted fishing" is defined to be fishing practices that are new to the fishery or not allowed under the FMP. Under this FMP, the NMFS Regional Administrator may authorize the targeted or incidental harvest of CPS for experimental or exploratory fishing that would otherwise be prohibited. The NMFS Regional Administrator may restrict the number of experimental permits by total catch, time, or area. The NMFS Regional Administrator may also require any level of industry-funded observer coverage for these experimental permits.

Exempted fisheries are expected to be of limited size and duration and must be authorized by an EFP issued for the participating vessel in accordance with the criteria and procedures specified in 50 CFR §600.745. The duration of EFPs will ordinarily be one year. Permits will not be renewed automatically. An application must be submitted to the Regional Administrator for each year. A fee sufficient to cover administrative expenses may be charged for EFPs. An applicant for an EFP need not be the owner or operator of the vessel(s) for which the EFP is requested as long as the proposed activity is compatible with limited entry and other management measures in the FMP.

This FMP authorizes mandatory data reporting and mandatory on-board observers with exempted fishing permits. Installation of vessel monitoring units aboard vessels with exempted fishing permits may be required.

Nothing in this FMP is intended to exclude or to limit use of CPS, markets, or processing methods as long as the process in question is compatible with measures and intentions of this FMP.

Priorities for issuing EFPs are as follows:

1. Domestic boats delivering to domestic processors and domestic factory trawlers (with equal priority).
2. Domestic catcher-boats delivering to a foreign offshore processor.

Boats already involved in developing a fishery for an underutilized species (i.e., boats with a catch history or previous EFP) should receive highest priority in applying for and renewing permits.

2.2.9 Other Fees and Permits

Nothing in this FMP is intended to exclude use of additional fees or permits in the future as long as the fee or permit is consistent with applicable law, management measures, and intent of this FMP. It may, for example, become desirable to issue permits for processing CPS in onshore plants or processing vessels offshore. It may be desirable to charge fees sufficient to cover administrative costs of issuing additional types of permits. Changes in requirements for obtaining, maintaining, and renewing permits are authorized.

2.3 Scientific Research

Nothing in this FMP is intended to inhibit or prevent any scientific research involving CPS which is acknowledged by the Secretary through procedures set out in 50 CFR §600.745.

Proposed activity is not scientific research unless it is submitted in writing to the Secretary in the form of a research proposal which addresses all of the factors below. An activity may be acknowledged as scientific research if its primary objective, purpose, or product is the acquisition of data, information, or knowledge as determined by consideration of all of the following factors:

1. The proposed program will result in information useful for scientific or management purposes.
2. The application of existing knowledge alone is insufficient to solve the scientific or management subject or problem presented by the scientific research proposal.
3. Facts/data/samples will be collected or observed and analyzed in a scientifically acceptable manner and the results will be formally prepared and available to the public.
4. Recognized scientific experts, organizations, or institutions with expertise in the field or subject matter area are conducting, sponsoring or are otherwise affiliated with the activity.

Secretarial Acknowledgement of Scientific Research

If the Secretary agrees that an activity constitutes scientific research involving CPS, a letter of acknowledgment should be issued to the applicant and operator or master of the vessel conducting the scientific research. The letter will include information on the purpose, scope, location, and schedule of the acknowledged activities. Any activities not in accordance with the letter of acknowledgment should be subject to all provisions of the Magnuson-Stevens Act and its implementing regulations. The Secretary should transmit copies of letters of acknowledgment to the Council, state or federal administrative and enforcement agencies to ensure they are aware of the research activities.

CPS taken under the scientific research exclusion may be sold to offset all or part of the cost of carrying out the research plan including costs associated with operating the research vessel.

2.4 Restrictions on Other Fisheries

For each non-CPS fishery, a reasonable limit on the incidental CPS catch may be established that is based on the best available information. The objectives of restrictions on other fisheries under this framework are to:

1. Minimize discards in the non-CPS fishery by allowing retention and sale, thereby increasing fishing income.
2. Discourage targeting on CPS by the non-CPS fleet.

Incidental limits may be imposed or adjusted in accordance with appropriate procedures described in this FMP. The Secretary may accept or reject but not substantially modify the Council's recommendations.

2.5 Procedures for Reviewing State Regulations

This FMP acknowledges that state regulations are a fundamental part of CPS management. All existing state regulations at the time of implementation of this plan are consistent with this FMP. Those regulations are listed in Section 2.2.5.2 of Appendix B.

This FMP establishes a review process by which any state may obtain a determination that its regulations are consistent with the FMP and the national standards. As necessary, the Council may also recommend to NMFS that duplicate or different federal regulations be implemented in the EEZ. While the Council retains the authority to recommend federal regulations be implemented in the EEZ, the preference is to continue to rely on state regulations in that area as long as they are consistent with the FMP.

While states are not required to submit regulations which they wish to apply in the EEZ to the Council for a consistency determination, regulations which have not received a consistency determination run the risk of being declared inconsistent and invalid if challenged in a state law enforcement proceeding. The Council invites submission of all present and future state fishery regulations relating to the harvest of species managed under this FMP which are to apply in the EEZ.

Review Procedure

Any state may propose that the Council review a particular state regulation for the purpose of determining its consistency with the FMP and the need for complementary federal regulations. Although this procedure is directed at the review of new regulations, existing regulations affecting the harvest of CPS managed by the FMP may also be reviewed under this process. The state making the proposal will include a summary of the regulation in question and concise arguments in support of consistency.

Upon receipt of a state's proposal, the Council may make an initial determination whether or not to proceed with the review. If the Council determines that the proposal has insufficient merit or little likelihood of being found consistent, it may terminate the process immediately and inform the petitioning state in writing of the reasons for its rejection.

If the Council determines sufficient merit exists to proceed with a determination, it will review the state's documentation or prepare an analysis considering, if relevant, the following factors:

1. How the proposal furthers or is not otherwise consistent with the objectives of the FMP, the Magnuson-Stevens Act, and other applicable law.
2. Likely effect on or interaction with any other regulations in force for the fisheries in the area concerned.
3. Expected impacts on the species or species group taken in the fishery sector being affected by the regulation.
4. Economic impacts of the regulation, including changes in catch, effort, revenue, fishing costs, participation, and income to different sectors being regulated as well as to sectors which might be indirectly affected.
5. Any impacts in terms of achievement of harvest guidelines or harvest quotas, maintaining year-round fisheries, maintaining stability in fisheries, prices to consumers, improved product quality, discards, joint venture operations, gear conflicts, enforcement, data collection, or other factors.

The Council will inform the public of the proposal and supporting analysis and invite public comments before and at the next scheduled Council meeting. At its next scheduled meeting, the Council will consider public testimony, public comment, advisory reports, and any further state comments or reports, and determine whether or not the state regulation is consistent with the FMP and whether or not to recommend implementation of complementary federal regulations or to endorse state regulations as consistent with the FMP without additional federal regulations.

If the Council recommends the implementation of complementary federal regulations, it will forward its recommendation to the NMFS Regional Administrator for review and approval. The NMFS Regional Administrator will publish the proposed regulation in the *Federal Register* for public comment, after which, if approved, he/she will publish final regulations as soon as practicable. If the Regional Administrator disapproves the proposed regulations, he/she will inform the Council in writing of the reasons for disapproval.

3.0 LIMITED ENTRY

This fishery management plan (FMP) establishes a limited entry program for coastal pelagic species (CPS) finfish including northern anchovy, Pacific (chub) mackerel, jack mackerel, and Pacific sardine landed south of 39° N latitude.

3.1 Problem Addressed by Limited Entry

Vessels currently participating in the CPS finfish fishery are capable of harvesting more CPS finfish than is available under current or likely future biomass conditions. Fisheries characterized by excess harvesting capacity are described as overcapitalized in terms of the number of vessels, and the amount of gear and equipment devoted to harvesting. As fisheries become overcapitalized, harvesting costs increase while catches remain the same. This situation represents an economically inefficient use of society's productive resources, and causes several problems for managers and the fishing industry when abundance declines and catches are reduced. As harvest capacity in the fisheries increases, problems arising from the need for more restrictive management measures and resolution of allocation issues become more acute. No relief from these problems will occur if harvest capacity continues to rise.

There were 640 vessels with CPS finfish landings for the period January 1, 1993 through November 5, 1997. Forty-one of these vessels, six percent, accounted for more than 95% of finfish landings for the five-year period (Appendix B, Table 3.8.7-1). Available information indicates that present participants could harvest at least as much CPS finfish as would be available under conditions of greater availability. Current capacity may be as much as 20% greater than the combined maximum sustainable yield (MSY) for anchovy, Pacific (chub) mackerel, and sardine (about 400,000 mt per year).[1/] Recent experience in the fishery and some crude calculations indicate that about 75 vessels would have sufficient harvesting capacity to take almost all of the CPS finfish likely to ever be available.

In addition to current CPS finfish participants, newcomers are likely to be attracted to the fishery, because of the expanding sardine biomass and squid fishery, and as competition in other Pacific Coast fisheries becomes more intense. In the latter instance, nearly all groundfish stocks are now fully harvested by domestic fishers in the Pacific Coast groundfish fishery. Potential participants in the CPS finfish fishery consist of fishers leaving other West Coast and North Pacific fisheries that have grown increasingly more restrictive and overcrowded relative to available harvests.

In the Pacific Coast CPS finfish fishery, excess harvest capacity is likely to result in an increasing number and complexity of regulations. Accordingly, the Council will face increased pressure to balance the conflicting need to protect the resource with the need to provide sufficient allowable catch to sustain the fishery.

Increased number and complexity of regulations have many adverse impacts in such areas as fleet costs, resource utilization, safety, enforcement costs and effectiveness. Moreover, there is a point beyond which additional regulations, which interfere with day to day vessel operations (e.g., trip limits or mesh size regulations), will not improve the Council's ability to accomplish its management goals. Pressures on industry arise not only from management measures which restrict operations, but also from increased competition for the allowable catches among larger numbers of vessels.

1/ The estimate 400,000 mt per year is the sum of estimated MSY for each stock reduced by a crude estimate of the fraction of the stock in U.S. waters. It is unlikely that all stocks would be abundant at the same time and that 400,000 mt of catch would be available in any one year.

3.2 Goals and Objectives for Finfish Limited Entry

The goals and objectives for this FMP are presented in Section 1.5. The most important of these in the context of limited entry are:

A. Promote efficiency and profitability in the fishery.
B. Achieve optimum yield (OY).
C. Accommodate existing fishery segments.
D. Use resources spent on management of CPS efficiently.

Not all these objectives are complementary. The challenge is to create a limited entry program which strikes a balance between increasing net returns from the fishery, achieving OY, accommodating participation by those with substantial investments in the fishery, and efficiently using management resources.

3.3 Achievement of Goals and Objectives and Need for Additional Measures to Reduce Capacity

The limited entry program for CPS finfish adopted under this amendment to the northern anchovy FMP will not in itself immediately accomplish the goals and objectives the Council has established for the fishery. It is a first step that may slow or prevent the worsening of conditions which impede the Council from achieving the overall goals and objectives for the fishery. The limited entry fleet size and transferability provisions represent a balance between the limited entry goals of accommodating existing fishery participants (goal C) and promoting efficiency and profitability in the fishery (goal A). Establishment of this limited entry system will provide a starting point for any future programs which may be necessary to further reduce harvest capacity.

3.4 Nature of the Interest Created

CPS limited entry permits confer a privilege to participate in the West Coast CPS finfish fishery in accordance with the limited entry system established under this FMP and implementing regulations, or any future amendment to the FMP and implementing regulations. Future amendments to the FMP may modify or even abolish the limited entry system. The permits are also subject to sanctions including revocation, as provided by the Magnuson-Stevens Act, 16 USC 1858(g) and 15 CFR part 904.

3.5 Scope of Limited Entry

3.5.1 Species within the Scope of Limited Entry

The provisions of this chapter apply only to CPS finfish, including northern anchovy, Pacific (chub) mackerel, jack mackerel, and Pacific sardine.

3.5.2 Geographic Scope of Limited Entry

The provisions of this chapter establish a CPS finfish limited entry program for the fishery south of 39° N latitude (approximately Point Arena, California). In the context of limited entry, fishing for and landing CPS finfish south of 39° N latitude is defined as landing CPS finfish. Fishing for and landing of CPS finfish north of 39° N latitude is not affected by limited entry requirements. CPS finfish fishing in the northern area would be managed as an open access fishery. This does not preclude effective management or future extension of limited entry in the north.

3.6 Limited Entry Permits

3.6.1 Initial Issuance of Limited Entry Permits

1. Each qualifying vessel will entitle the current owner to one limited entry permit.
2. A vessel qualifies for a limited entry permit by meeting the initial issuance criteria in Section 3.6.1.1.
3. A given vessel cannot receive more than one limited entry permit.

4. Fees may be charged to cover National Marine Fisheries Service (NMFS) administrative costs associated with issuance or transfer of permits.
5. Permits are assigned to one vessel at a time.
6. The vessel owner is responsible for maintaining the permit and any other documentation required on board each vessel with a permit to fish for CPS.
7. A limited entry permit may not be used with a vessel unless it is registered for use with that vessel.
8. Limited entry permits will be registered for use with a vessel and a registered vessel may be changed only according to procedures outlined in the FMP and regulations.
9. If the permit will be used with a vessel other than the one registered on the permit, a registration for use with the new vessel must be obtained from the Regional Director and placed aboard the vessel before the vessel is used to fish for CPS.

3.6.1.1 Initial Issuance Criteria

The owner of a CPS vessel will receive a limited entry permit if, during the window period of January 1, 1993 to November 5, 1997, the vessel landed or delivered a cumulative total of 100 mt of CPS finfish. No more than one limited entry permit will be issued for each qualifying vessel. The permit will be issued only to the current owner of the vessel, unless (1) the previous owner of a vessel qualifying for a permit has, by the express terms of a written contract, reserved the right to the permit, in which case the permit will be issued to the previous owner based on the catch history of the qualifying vessel; or (2) a vessel that would have qualified for a limited entry permit was totally lost before a permit was issued. In this case, the owner of the vessel at the time it was lost retains the right to the permit, unless the owner conveyed the right to another person by the express terms of a written contract.

3.6.1.2 Ownership Restriction

Only entities (human beings, corporations, etc.) qualified to own a U.S. fishing vessel may be issued or may hold (by ownership or otherwise) a limited entry permit.

3.6.1.3 Limited Entry Permit Held by Owner of Record of the Vessel

1. The vessel owner is responsible for acquiring and holding a limited entry permit for each vessel that is required to have a limited entry permit to catch CPS finfish under this limited entry section.
2. The vessel owner is responsible for maintaining NMFS required documentation of the limited entry permit on board the vessel.
3. The limited entry permit will be used with one vessel only. That vessel must be declared and registered with the NMFS issuing authority. Registration is incomplete and limited entry permits may not be used until acknowledged in writing by NMFS.
4. A vessel owner may not use a vessel, or allow a vessel to be used, to catch any Council-managed CPS finfish under the limited entry regulations unless the vessel owner holds a limited entry permit which explicitly allows such catch and the limited entry permit has been registered with NMFS for use with that vessel.

3.6.1.4 Loss of a Vessel Prior to Permit Issuance

1. A limited entry permit will be issued for a vessel which qualified for a permit but is lost before permits are issued. The vessel must be replaced within two years of the loss unless otherwise determined by the NMFS Regional Director. The replacement vessel must be of equal or less net tonnage.
2. For a vessel that would qualify an owner for a limited entry permit, in the case of a vessel's sinking or total loss, all rights to a permit from the fishing history of the vessel prior to the sinking or total loss remain with the owner unless specifically transferred.

3.6.1.5 Appeals Process

If an application for a permit is denied, the applicant may appeal the denial to the NMFS Regional Administrator. The appeal must be in writing, state the action being appealed, and reasons. The appellant may request an informal hearing before a hearing officer and the NMFS Regional Administrator will decide if a hearing is required. If required, hearings will be carried out in a timely fashion (normally within 30 days of the receipt of sufficient information).

The NMFS Regional Administrator will decide the appeal in accordance with the criteria for limited entry permits specified in this FMP and implementing regulations. The NMFS Regional Administrator will consider the information submitted by the appellant, the summary record of the hearing and hearing officer's recommendation (if any) and other relevant information.

3.6.2 Permit Renewal Procedures

1. Permits must be renewed every two calendar years in order to remain valid for the following calendar year. The renewal date for limited entry permits will be January 1 at two year intervals beginning in the year after implementation.
2. Notice of upcoming renewal periods will be sent at the appropriate time every two years to the most recent address as provided to the permit issuing authority by the permit holder. It shall be the permit holder's responsibility to provide the permit issuing authority with address changes in a timely manner.
3. An annual fee will be charged which reflects the administrative costs of maintaining the permit system.
4. Failure to renew during this period will result in expiration of the permit at the end of the calendar year.
5. Once a permit has expired because of failure to renew during the renewal period, it may not subsequently be renewed or reissued, except through a process as specified in Section 3.6.1.5.

3.6.3 Permit Transfers

Limited entry permits are affixed to the vessel. Within one year from implementation of the limited entry program, permits are transferable to another vessel one time only.

After the first year, permits become nontransferable, except in cases where:

1. The permitted vessel is stolen, lost, or no longer will participate in a federally managed commercial fishery.
2. The application for the permit transfer to a replacement vessel originates from the vessel owner who must place it on a replacement vessel of the same or less net tonnage within one year of disability of the permitted vessel.

Procedures for Transferring Permit to Replacement Vessel

After the first year of the program, and if the conditions in Section 3.6.3 (a) and (b) are met, the following procedures for transfer must be followed:

1. Limited entry permits may be transferred by the owner only if the vessel is lost, stolen, or will not participate in any federally managed fishery in the future.
2. When an owner wishes to transfer a limited entry permit to a different vessel, he or she must notify the NMFS issuing authority of the intent to change.
3. The owner will demonstrate to NMFS that the original vessel was lost or stolen, or the owner will demonstrate that the original vessel will no longer participate in a federally managed fishery. Although there is currently no way to demonstrate and or enforce that a vessel will not participate in a federally managed fishery, if a mechanism to do so is developed, this provision will be incorporated by regulation.
4. The owner will demonstrate that the replacement vessel is of equal or less net tonnage than the original vessel.
5. The NMFS will approve the transfer when the NMFS Regional Administrator determines all requirements have been met.

6. A permit transfer is not effective until the new permit has been issued.
7. Nothing in these provisions prevents a permit owner from modifying the original vessel to which the permit was issued.

3.6.4 Procedures for Issuing New Limited Entry Permits in the Future

The Council may issue new limited entry permits consistent with the parameters of a framework that may be developed in the future.

3.6.5 Coastal Pelagic Species Fishing Exempted from Limited Entry

3.6.5.1 Exempted Landings

Vessels landing small quantities of CPS finfish on a per trip basis do not require a limited entry permit. The Council will set, by regulation, a level of landings per trip that is exempt from limited entry. This level must be between one mt and five mt per trip. The level specified by the Council will remain in place until changed by rulemaking.

3.6.5.2 Recreational Fishing

Recreational fishing for CPS finfish does not require a limited entry permit. However, the Council may choose to restrict recreational harvest quotas, implement area closures or impose any other type of management measure.

3.6.5.3 Live Bait Coastal Pelagic Species Fishing

Fishing CPS species for use as live bait does not require a limited entry permit. This includes live bait harvested for use in recreational and commercial fisheries.

3.6.6 Additional Management of the Limited Entry Fishery

3.6.6.1 Trip Limit

The Council may set a trip limit, by regulation, of up to 125 mt on landings of CPS finfish. In this context, a trip is defined as any activity (e.g., catching, landing, transporting or delivering) by a vessel that harvests CPS finfish with a limited entry permit; (i.e., a possession limit that applies to harvesting operations only). Also in this context, a trip limit should not be confused with trip limits used in other fisheries (e.g., groundfish) to lengthen the season without exceeding harvest guidelines or to manage bycatch.

4.0 OPTIMUM YIELD, MAXIMUM SUSTAINABLE YIELD CONTROL RULES, AND OVERFISHING DEFINITIONS FOR THE COASTAL PELAGIC SPECIES FISHERY

This fishery management plan defines optimum yield (OY), maximum sustainable yield (MSY) control rules, and defines overfishing and overfished stocks. All aspects of harvest policies for coastal pelagic species (CPS) including the MSY control rule, definition of overfishing, definition of overfished stocks and rebuilding criteria can be modified using framework procedures described in Section 2.0.

4.1 Definition of Optimum Yield

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) defines the term "optimum", with respect to the yield from a fishery, as the amount of fish which:

(A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;
(B) is prescribed on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant social, economic, or ecological factor; and
(C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery [50 CFR §600.310(f)(1)(i)].

OY for a CPS stock is defined to be the level of harvest which is less than or equal to acceptable biological catch (ABC) estimated using a MSY control rule, consistent with the goals and objectives of this fishery management plan (FMP), and used by the Council to manage the stock. The ABC is a prudent harvest level calculated based on an MSY control rule (see below). In practice, OY will be determined with reference to ABC. In particular, OY will be set less than ABC to the degree required to prevent overfishing.

4.2 Definition of Maximum Sustainable Yield, MSY Control Rules, and Acceptable Biological Catch

For CPS, an MSY control rule is defined to be a harvest strategy that provides biomass levels at least as high as the F_{MSY} approach while also providing relatively high and relatively consistent levels of catch. According to federal regulations (50 CFR §600.310(b)(1)(ii)), an MSY control rule is "a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY." Similarly, MSY stock size "means the long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate units, that would be achieved under an MSY control rule in which the fishing mortality rate is constant." The definition of an MSY control rule for CPS is more general, because it includes the definition in National Standard 1. The definition for CPS is more conservative, because the focus for CPS is oriented primarily towards stock biomass levels at least as high as the MSY stock size. The primary focus is on biomass, rather than catch, because most CPS (Pacific sardine, northern anchovy, and market squid) are very important in the ecosystem for forage.

4.3 Definition of Overfishing

By definition, overfishing occurs in a fishery whenever fishing occurs over a period of one year or more at a rate that is high enough to jeopardize the capacity of the stock to produce MSY on a continuing basis if applied in the long term. Overfishing in the CPS fishery is "approached" whenever projections indicate overfishing will occur within two years. The definition of overfishing is in terms of a fishing mortality or exploitation rate. Depending on the exploitation rate, overfishing can occur when CPS stocks are at either high or low abundance levels. The Council must take action to eliminate overfishing when it occurs and to avoid overfishing when exploitation rates approach the overfishing level.

In operational terms, overfishing occurs in the CPS fishery whenever catch exceeds ABC and overfishing is approached whenever projections indicate that fishing mortality or exploitation rates will exceed the ABC level within two years. The definition of an overfished stock is an explicit part of the MSY control rule for CPS stocks.

4.4 Definition of an Overfished Stock

By definition, an overfished stock in the CPS fishery is a stock at a biomass level low enough to jeopardize the capacity of the stock to produce MSY on a continuing basis. An overfished condition is approached when projections indicate that stock biomass will fall below the overfished level within two years. The Council must take action to rebuild overfished stocks and to avoid overfished conditions in stocks with biomass levels approaching an overfished condition.

4.5 Rebuilding Programs

Management of overfished CPS stocks must include a rebuilding program that can, on average, be expected to result in recovery of the stock to MSY levels in ten years. It is impossible to develop a rebuilding program that would be guaranteed to restore a stock to the MSY level in ten years, because CPS stocks may remain at low biomass levels for more than ten years even with no fishing. The focus for CPS is, therefore, on the average or expected time to recovery based on realistic projections. If the expected time to stock recovery is associated with unfavorable ecosystem conditions and is greater than ten years, then the Council and the U.S. Secretary of Commerce (Secretary) may consider extending the time period as described at 50 CFR §600.310(e).

Rebuilding programs for CPS may be an integral part of the MSY control rule or may be developed or refined further in the event that biomass of a CPS stock reaches the overfished level.

4.6 Maximum Sustainable Yield Control Rules

MSY control rules in the CPS fishery may vary depending on the nature of the fishery, management goals, assessment and monitoring capabilities, and available information. Under the framework management approach used for CPS, it is not necessary to amend the CPS FMP in order to develop or modify MSY control rules or definitions of overfishing.

The use of an MSY control rule for Actively managed stocks is to provide managers with a tool for setting and adjusting harvest levels on a periodic basis while preventing overfishing and overfished stock conditions. All Actively managed stocks must have stock-specific MSY control rules, a definition of overfishing and a definition of an overfished stock.

The main use of an MSY control rule for a Monitored stock is to help gauge the need for Active management. MSY control rules and harvest policies for Monitored CPS stocks may be more generic and simple than those for Actively managed stocks with significant fisheries. Any stock supporting catches approaching the ABC or MSY levels should be Actively managed unless there is too little information available or other practical problems.

4.6.1 Default CPS MSY Control Rule

The Council may use the default MSY control rule, defined below, for Monitored species unless a better species-specific rule is available. The default MSY control rule can be modified under framework management procedures.

The default MSY control rule (intended primarily for a stocks that are Monitored) sets ABC for the entire stock (U.S., Mexico, Canada, and international fisheries) equal to 25% of the best estimate of the MSY catch level. Overfishing occurs whenever the total catch (U.S., Mexico, Canada, and international fisheries) exceeds ABC for the or whenever fishing occurs at a rate that is high enough to jeopardize the capacity of the stock to produce MSY. Overfishing of a Monitored CPS stock is "approached" whenever projections or estimates indicate that the overfishing will occur within two years.

In making decisions about Active management, Council may choose to consider ABC and catches in U.S. waters only. ABC in U.S. waters is the ABC for the entire stock prorated by an estimate of the fraction of the stock in U.S. waters. Active management may not be effective if U.S. catches are small and overfishing is occurring in Mexico, Canada, or in international waters outside the jurisdiction of federal authorities.

General MSY Control Rule for Actively Managed Species

The general form of the MSY control rule utilized for the California CPS fisheries was designed to continuously reduce the exploitation rate as biomass declines. The general formula used is :

H = (BIOMASS-CUTOFF) x FRACTION

H is the harvest target level, CUTOFF is the lowest level of estimated biomass at which directed harvest is allowed and FRACTION is the fraction of the biomass above CUTOFF that can be taken by the fishery. BIOMASS is generally the estimated biomass of fish age 1+ at the beginning the season. The purpose of CUTOFF is to protect the stock when biomass is low. The purpose of FRACTION is to specify how much of the stock is available to the fishery when BIOMASS exceeds CUTOFF. It may be useful to define any of the parameters in this general MSY control rule so that they depend on environmental conditions or stock biomass. Thus, the MSY control rule could depend explicitly on the condition of the stock or environment.

The formula generally uses the estimated biomass for the whole stock in one year (BIOMASS) to set harvest for the whole stock in the following year (H) although projections or estimates of BIOMASS, abundance index values or other data might be used instead. BIOMASS is an estimate only, it is never assumed that BIOMASS is a perfect measure of abundance. Efforts to develop a harvest formula must consider probable levels of measurement error in BIOMASS which typically have CVs of about 50% for CPS.

The general MSY control rule for CPS (depending on parameter values) is compatible with the Magnuson-Stevens Act and useful for CPS that are important as forage. If the CUTOFF is greater than zero, then the harvest rate (H/BIOMASS) declines as biomass declines. By the time BIOMASS falls as low as CUTOFF, the harvest rate is reduced to zero. The CUTOFF provides a buffer of spawning stock that is protected from fishing and available for use in rebuilding if a stock becomes overfished. The combination of a spawning biomass buffer equal to CUTOFF and reduced harvest rates at low biomass levels means that a rebuilding program for overfished stocks may be defined implicitly. Moreover, the harvest rate never increases above FRACTION. If FRACTION is approximately equal to F_{MSY}, then the MSY control rule harvest rate will not exceed F_{MSY}. In addition to the CUTOFF and FRACTION parameters, it may be advisable to define a maximum harvest level parameter (MAXCAT) so that total harvest specified by the harvest formula never exceeds MAXCAT. MAXCAT is used to guard against extremely high catch levels due to errors in estimating biomass, to reduce year to year variation in catch levels, and to avoid overcapitalization during short periods of high biomass and high harvest. MAXCAT also prevents the catch from exceeding MSY at high stock levels and spreads the catch from strong year classes over a wider range of fishing seasons.

Other general types of control rules may be useful for CPS and this FMP does not preclude their use as long as they are compatible with National Standards and the Magnuson-Stevens Act.

Transboundary Issues

Management of transboundary stocks is one of the most difficult problems in management of CPS. Ideally, transboundary CPS stocks would be managed cooperatively by the U.S., Canada, and Mexico on the basis of common policy. At present, there are no cooperative management agreements with Mexico or Canada.

In the absence of a cooperative management agreement, the default approach in the CPS FMP sets harvest levels for U.S. fisheries by prorating the total target harvest level according to the portion of the stock resident in U.S. waters or estimating the biomass in U.S. waters only. In practice, this approach is similar to managing the U.S. and Mexican portions of a stock separately since harvest for the U.S. fishery in a given year depends ultimately on the biomass in U.S. waters.

Other approaches that may be developed in the future are not precluded by this default. If the portion of the stock in U.S. waters can not be estimated or is highly variable, then other approaches may be used. It may be more practical, for example, to use of a high CUTOFF in the MSY control rule to compensate for stock biomass off Mexico or Canada.

4.6.2 MSY Control Rule for Pacific Sardine

The MSY Control Rule for Pacific sardine sets ABC for the entire sardine stock based on an estimate of biomass for the whole sardine stock, a CUTOFF equal to 150,000 mt, a FRACTION between five percent and 15% (depending on oceanographic conditions as described below), and MAXCAT of 200,000 mt. The U.S. ABC is calculated from the target harvest for the whole stock by prorating the total ABC based on proportion of total biomass in U.S. waters.

FRACTION in the MSY control rule for Pacific sardine is a proxy for F_{MSY} (i.e., the fishing mortality rate for deterministic equilibrium MSY). FRACTION depends on recent ocean temperatures because F_{MSY} and productivity of the sardine stock is higher under ocean conditions associated with warm water temperatures (Appendix B, Section 4.2.3.4). An estimate of the relationship between F_{MSY} for sardine and ocean temperatures is:

$$F_{MSY} = 0.248649805\ T^2 - 8.190043975\ T + 67.4558326$$

where T is the average three season sea surface temperature at Scripps Pier, California during the three preceding seasons. The MSY control rule for sardine sets the control rule parameter FRACTION equal to F_{MSY} except that FRACTION is never allowed to be higher than 15% or lower than five percent.

Although F_{MSY} may be greater or lesser, FRACTION can never be greater than 15% or less than five percent unless the MSY control rule for sardine is revised, because five percent and 15% are policy decisions taken by Council based on social, economic, and biological criteria. In contrast, relationships between FRACTION, F_{MSY} and environmental conditions are technical questions and estimates or approaches may be revised by technical teams to accommodate new ideas and data.

4.6.2.1 Definition for Overfished Stock for Sardine

An overfished sardine population is one with an 1+ stock biomass on July 1 of 50,000 mt or less. No directed fishing is allowed in any year or season while the stock is overfished. The Council is required to minimize fishing mortality on an overfished stock to the extent practicable and to undertake a rebuilding program which may be implicit to the MSY control rule or explicit.

4.6.2.2 Live Bait Harvest Between the Definition of Overfishing and CUTOFF

The small live bait fishery which supplies live CPS to recreational and commercial fisheries will be allowed to operate when estimated biomass falls below the CUTOFF, which is currently set at 150,000 mt (and other directed fishing is precluded) but is still above the definition of an overfished stock, currently set at 50,000 mt. This does not prevent the Council from undertaking any measure authorized under this FMP that may be necessary to manage the live bait fishery and sardine stock. The live bait fishery could, for example, be managed by harvest guideline or quota, season, or gear restrictions at any point under the framework management process.

4.6.3 Maximum Sustainable Yield Control Rule for Pacific (Chub) Mackerel

The MSY control rule for Pacific mackerel sets the CUTOFF and the definition of an overfished stock at 18,200 mt and the FRACTION at 30%. Overfishing is defined as any fishing in excess of ABC calculated using the MSY control rule. No MAXCAT is defined because the U.S. fishery appears to be limited to about 40,000 mt per year by markets. The target harvest level is defined for the entire stock in Mexico, Canada, and U.S. waters (not just the U.S. portion), and the U.S. target harvest level is prorated based on relative abundance in U.S. waters.

4.6.4 Monitored Stocks

Northern anchovy (northern and central subpopulations), jack mackerel and market squid will be monitored at the outset of the CPS FMP. The default MSY control rule and overfishing specifications will be used for Monitored stocks.

4.6.4.1 Northern Anchovy-Central Subpopulation

The central subpopulation of northern anchovy ranges from approximately San Francisco, California, to Punta Baja, Mexico. The default MSY control rule gives an ABC of 25% of the total biomass estimate. The resulting ABC would then be prorated by the portion of the stock in U.S. waters to arrive at ABC in U.S. waters.

4.6.4.2 Northern Anchovy-Northern Subpopulation

The northern subpopulation of anchovy ranges from San Francisco north to British Columbia with a major spawning center off Oregon and Washington that is associated with the Columbia River plume. The northern subpopulation supports small but locally important bait fisheries and is likely an important source of forage to local predators, including depleted and endangered salmonid stocks.

The recommended default MSY control rule gives an ABC for the entire stock equal to 25% of MSY catch but MSY catch has not been estimated. The portion of the northern subpopulation of northern anchovy resident in U.S. waters is unknown. It is likely that some biomass occurs in Canadian waters off British Columbia. ABC is U.S. waters cannot be calculated at this time.

4.6.4.3 Jack Mackerel

The ABC level for jack mackerel is calculated by age/area from mid-range potential yield values. ABC in U.S. waters will be prorated according to the portion of the stock in US waters. If jack mackerel catches increase and become significant, managers may decide to address management of different age groups and areas independently. This question does not need to be addressed at this time because catches are low (generally less than 2,000 mt per year since 1990).

4.6.4.4 Market Squid

The default MSY control rule gives an ABC for the entire stock equal to 25% of MSY catch, but MSY catch for market squid has not been estimated. The portion of the market squid stock resident in U.S. waters is unknown. It is likely that some biomass occurs in Mexican waters off Baja California and Canadian waters off British Columbia. ABC is U.S. waters cannot be calculated at this time, because basic information about life history and fisheries biology is not yet available for market squid (Appendix A, Section 1.5).

Scientific research currently underway, improvements to squid port sampling, and the moratorium on new squid permits under California state law (Appendix A, Section 1.5.5) constitute a plan for stock assessment and close monitoring of fishing effort that will make it possible to manage the market squid fishery if conditions change and Active management is required.

The Council makes decisions about Active and Monitored management for CPS annually based on socioeconomic framework management procedures (Section 2.1.3). State managers under state law and federal managers under this FMP can be expected to manage the fishery intensively when sufficient data indicate a need.

Council and state authorities will continue to monitor squid landings while research continues. If landings increase or a biological risk to the stock develops, Council can be expected to promote squid to Active management quickly under the "point-of-concern" framework management procedures (Section 2.1.2).

4.7 Stock Assessment and Fishery Evaluation Report

The Coastal Pelagic Species Management Team (CPSMT) will prepare an annual Stock Assessment and Fishery Evaluation (SAFE) report describing the status of the CPS fishery. The SAFE report provides information to the Councils for determining annual harvest levels for each stock, documenting significant trends or changes in the resource, marine ecosystems, and fishery over time, and assessing the relative success of existing state and Federal fishery management programs. This includes landings, prices, revenues, and economic, biological or environmental conditions not covered elsewhere in assessments for Actively managed species. In particular, the SAFE report shall include:

1. Current status of CPS resources.
2. A description of the maximum fishing mortality threshold and the minimum stock size threshold for each stock or stock complex, along with information by which the Council may determine:
   (a) Whether overfishing is occurring with respect to any stock or stock complex, whether any stock or stock complex is overfished, whether the rate or level of fishing mortality applied to any stock or stock complex is approaching the maximum fishing mortality threshold, and whether the size of any stock or stock complex is approaching the minimum stock size threshold.
   (b) Any management measures necessary to provide for rebuilding an overfished stock or stock complex (if any) to a level consistent with producing the MSY in such fishery.
3. The total and U.S. target levels, if calculated, along with all available information about bycatch, domestic annual harvest (DAH), domestic annual processing (DAP), joint venture processing (JVP), and total allowable level of foreign fishing (TALFF) used to specify harvest guidelines or quotas.
4. Recent and historical catch statistics (landings and value).
5. Recommendations for use of harvest guideline or quotas by species.
6. A brief history of the harvesting sector for the fishery.
7. A brief history of CPS management.
8. A summary of recent economic conditions, including information such as number of vessels and performance by gear type, including recreational and commercial fishing interests, fishing communities, and fish processing interests.
9. Safety considerations.
10. Ecosystem information.
11. Bycatch summary.
12. Any necessary expansions to previous environmental and regulatory impact documents, and ecosystem and habitat descriptions.
13. Other relevant biological, sociological, economic, and ecological information that may be useful to the Council.

The Council will make SAFE reports available to the public by such means as mailing lists and newsletters and will provide copies on request.

Monitored Species

The annual SAFE report prepared by the CPSMT will include all available information that may be used to determine if a point of concern exists (e.g., overfishing) or if a stock should be considered for Active management or for Monitored management. At a minimum, the report should contain landings' data for Monitored stocks and any available information about trends in abundance.

4.8 Annual Specifications and Announcement of Harvest Levels

Each year, the Secretary will publish in the *Federal Register* the final specifications of (1) OY for U.S. fisheries in the form of a target harvest level, (2) DAH, (3) DAP, (4) JVP, and (5) TALFF for all CPS Actively managed by the Council. The total U.S. harvest will be allocated to the various fisheries as harvest guidelines or as quotas.

In calculating harvest guidelines and quotas for each species, an estimate of the incidental catch of each species caught while fishermen are targeting other species will be taken into account. Therefore, the total harvest guideline will consist of an incidental catch portion and a directed fishery portion. This will be done to minimize the chances of exceeding the target harvest level.

If the harvest guideline for the directed fishery is reached the directed fishery will be closed by an automatic action and incidental catch will continue to be allowed under the incidental catch allowance, which is expressed in an amount of fish or a percentage of a load (Section 5.1). If the estimated incidental catch portion of the harvest guideline has been set too high, resulting in the probability of not attaining the target harvest level by the end of the fishing season, the remaining incidental catch portion may be allocated to the directed fishery through the "routine" management procedures. This reallocation of the remaining incidental catch portion of the harvest guideline to the directed fishery is not likely to be necessary unless substantial errors are discovered in calculations or estimates.

4.8.1 General Procedure for Setting Annual Specifications

The intent of the management approach under the FMP is to reassess the status of each Actively managed species at frequent intervals and preferably every year (although a full analytic stock assessment may not be necessary or possible in some cases). The general procedure for making the annual specifications for CPS is as follows:

1. The CPSMT will produce a SAFE report as specified in Section 4.7, that documents the current estimates of biomass for each coastal pelagic species assessed and status of the fishery. In the report, the CPSMT will recommend either harvest guidelines or quotas for Actively managed species, including a directed portion and an incidental portion, an initial incidental catch allowance to be used when harvest guidelines are reached together with an estimate of total incidental catch, and will make all calculations of the specifications as required by this FMP.

2. Documents will be sent to the NMFS Regional Administrator, Southwest Region, the Council, members of the Council's Scientific and Statistical Committee (SSC), members of the Coastal Pelagic Species Advisory Subpanel (CPSAS), and all interested parties for review.

3. A public meeting or meetings will be announced in the *Federal Register* and held with the CPSMT and the CPSAS to discuss the proposed annual specifications and to obtain public comments.

4. At its first opportunity, the Council will review all information compiled for the annual specifications, consult with its SSC, CPSMT, CPSAS, and hear public comments. The Council also will review any important social and economic information at that time, then make a recommendation to the NMFS Regional Administrator on the final specifications, including OY levels, harvest guidelines, quotas, allocations, and other management measures for the fishing season.

5. Following the Council meeting, the NMFS Regional Administrator will consider all comments and make a determination of the final specifications. This determination will be published in the *Federal Register* with a request for additional public comment.

6. Alternate Procedure: If assessment and season schedules warrant, the NMFS Regional Administrator may make preliminary OY, harvest guideline, and/or quota specifications quickly (without prior discussion at a Council meeting) to allow fishing to begin without delay. As soon as practicable, the Council will review all background documents contributing to the determination of the biomass estimates and make a final recommendation for the resulting target harvest level, harvest guidelines and quotas. Following the meeting of the Council, the NMFS Regional Administrator will consider all comments and make a determination of whether any changes in the final specifications are necessary. If such changes are warranted, they will be published in the *Federal Register*.

If assembling the data and producing a report would require enough time that permitting a complete public review before the beginning of the fishing season could reduce the season, then this alternate procedure should be used.

7. NMFS will monitor the fishery throughout the year, tracking incidental catch and harvest guidelines and quotas. If a harvest guideline or quota for any species is or is likely to be reached prematurely, a "point of concern" will occur, triggering a mandatory review of the status of the stock. If the directed harvest portion of a harvest guideline or quota is reached, then directed fishing will be prohibited and the prespecified incidental trip limit will be imposed as an automatic action through publication of a notice in the *Federal Register*.

The NMFS Regional Administrator would be responsible for setting the harvest guidelines based on the estimated biomass and the standards set in the FMP. This is the same process that has been used in the northern anchovy fishery and would be adapted for Actively managed CPS. The formulas used to set harvest guidelines for CPS are straightforward and provide little latitude for judgement, therefore, there is less discretion involved in setting annual specifications for CPS than for other fisheries.

Harvest guidelines for CPS are based on the current biomass estimate multiplied by a fixed harvest rate. The portion of the resource in U.S. waters may change over time, but in any one year is the best estimate available. The amount of the harvest guideline needed for incidental trip limits when the fishery is nearing closure will vary depending on when the harvest guideline is projected to be achieved, but the incidental amount and the amount harvested directly must equal the total harvest guideline.

Following the determination of the estimated biomass, a public meeting would be held between the CPSMT and CPSAS. The biomass estimate and resultant harvest guideline would be reviewed, public comments obtained, and all information forwarded to the Council. At its meeting, the Council, after hearing public comments, would either adopt the annual specifications or recommend changes, accompanied by a justification for why the change should be made.

The intention of the proposed regulations is to have public review of and a Council recommendation on the estimated biomass and harvest guidelines before the fishing season begins; however, the NMFS Regional Administrator is not precluded from announcing the harvest guidelines in the *Federal Register* before the process is completed so that fishermen can plan their activities and begin harvesting when the fishing season begins.

4.8.2 Factors Considered

The following factors will be considered when making the annual specifications:

1. The current estimated biomass and any other biological information.
2. The MSY control rule described in the FMP, which is specific for each Actively managed species.
3. Results of comments of domestic processors and joint venture operations about processing capacity and planned utilization.
4. Results of an analysis of the fishing capacity and planned utilization of recent years modified by new information and comments by the fishing industry relating to intended use.
5. Any relevant historical information on the utilization of CPS resources.

All data used to make annual specifications will be available for public inspection during normal business hours at the Southwest Regional Office of NMFS.

4.8.3 Guidelines for Choosing Between a Harvest Guideline and Quota

Quotas are specified numerical harvest objectives, the attainment of which results in automatic closure of the fishery for that species. Retention, possession, and landing of a species after attainment of its quota is prohibited. A quota is a single numerical value, not a range.

Harvest guidelines are specified numerical harvest objectives that differ from quotas in that closure of a fishery (i.e., prohibition of retention, possession, and landing) is not automatically required upon attainment of the objective. A harvest guideline may be either a range or a point estimate.

The preferred approach for managing domestic coastal pelagic resources is by harvest guideline. Foreign fisheries will normally be managed by quotas. Harvest guidelines are used for the domestic fishery because bycatch of one coastal pelagic species is common when fishing for another, and curtailing the harvest of one species may limit the harvest of another and prevent achieving target harvest levels.

Harvest guidelines will be used as long as the following conditions are met:

1. Allowing an imprecise cap on total harvest will still ensure long term productivity of the resource and the economic well-being of the fishery and dependent species.
2. Unavoidable bycatch would occur after a quota was reached and further landings prohibited, curtailing the harvest of other resources or creating discards.
3. Fishing in excess of a harvest guideline is not expected to significantly affect future yields.
4. Overfishing is not likely to occur.

Generally, a quota will not be used for domestic fisheries unless extra protection of an individual species becomes important. Foreign fishing allocations (TALFFs) will generally be quotas. Quotas should be used for domestic fisheries when:

1. A high degree of protection of one species is needed to ensure the future well-being of the fishery or dependent species.
2. Permitting bycatch after a harvest guideline is reached cannot be accepted if the objectives of the FMP are to be met.
3. Fishing in excess of a harvest guideline would significantly affect future yields.
4. Overfishing may occur and is less likely under quota management.

The choice of a numerical specification of a harvest guideline or quota is based on a balance of its social, economic, and biological effects as stated above.

4.9 Annual Assessment and Management Cycles

This FMP specifies that annual schedules for Actively managed CPS be developed based on the Council's workload and meeting schedule, opportunity for industry and technical review of biomass estimates and harvest guidelines or quotas, seasonal patterns in the fishery, collection and processing of CalCOFI data during the peak spawning season, collection of other data, time required for notification of fishers, and workload of the CPSMT and CPSAS. The FMP does not specify what those schedules will be, since they will be implemented through regulations.

The annual assessment and management cycles determine the start and close date (season) for each Actively managed fishery. These may be changed by abbreviated rulemaking as described in Section 2.1.

5.0 BYCATCH, INCIDENTAL CATCH, AND ALLOCATION

This fishery management plan (FMP) establishes incidental catch allowances for coastal pelagic species (CPS) and a geographic allocation for Pacific sardine.

5.1 Incidental Catch Allowances

"Bycatch" is defined in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) as "fish which are harvested in a fishery, but not sold or kept for personal use and includes economic discards and regulatory discards". In the CPS fisheries, fish are caught and sold incidental to catching other species, because they sometimes school together. Incidental catch allowances permit fishermen to land a certain percentage of fish that would otherwise be considered bycatch. Incidental catch allowances can be expressed as an amount or percentage of catch, landings, or deliveries.

Incidental catch allowances will be set by the Council, based on recommendation from the Coastal Pelagic Species Management Team (CPSMT), and consistent with Sections 5.1.1 through 5.1.6 of this FMP. Estimates of total incidental catch expected under the incidental catch allowances will be factored into harvest guidelines and quota recommendations. As described in Section 4.8, estimates of total incidental catch will normally be combined with the directed fishery harvest guideline to arrive at a total optimum yield (OY). The purpose of this adjustment is to ensure that overfishing does not occur due to incidental catch.

Incidental catch allowances are the primary method for managing bycatch in the CPS fishery. Other management approaches, such as fishing seasons or area restrictions, might also be required to reduce bycatch or incidental catch. The incidental catch allowances described here do not exclude the possibility of trip limits or other regulations imposed to reduce bycatch, prolong the directed fishery, or for other purposes.

5.1.1 Incidental Catch Allowances When Stocks are Overfished

When a stock is overfished according to the definition of overfishing in this FMP, incidental catch allowances for commercial fishing shall be set at zero percent to 20% of landed weight, as recommended by the Council.

5.1.2 Incidental Catch Allowances When Stocks are Not Overfished

When a stock is not overfished according to the definition of overfishing in the FMP, incidental catch allowances for commercial fishing shall be set at zero percent to 45% of landed weight, as recommended by the Council.

5.1.3 Pacific (chub) Mackerel Landed Incidentally

When the Pacific (chub) mackerel resource is not overfished, and total landings for the directed fishery established under a harvest guideline have been caught, the Council may set an allowable incidental trip limit of one mt or lower.

5.1.4 Incidental Catch Allowances for Live Bait When Stocks are Overfished

When a stock is overfished according to the definition of overfishing in the FMP, incidental catch allowances for live bait fishing shall be set to no more than 15% of landed weight, as determined by the Council.

5.1.5 Incidental Catch Allowances for Live Bait When Stocks are Not Overfished

When a stock is not overfished according to the definition of overfishing in the FMP, no restrictions are placed on live bait harvest.

5.1.6 Guidelines and Criteria For Setting Incidental Catch Allowances

In setting incidental catch allowances, Council will consider existing regulations, goals and objectives of this FMP, best available data, scientific and management advice available, guidelines given below, and other policies established by the Council. If decision by the by the NMFS Regional Administrator about incidental catch allowances is necessary due to time constraints, it will be made based on consultation with the Council Chair, Director of the California Department of Fish and Game, CPSMT, Coastal Pelagic Species Advisory Subpanel (CPSAS), other representatives appointed by the Council, and interested parties as appropriate.

5.1.6.1 Overfished Stocks

In order of priority, the Council's goals in setting incidental catch allowances for overfished stocks should be to (1) minimize fishing mortality on overfished stocks, and (2) minimize discards of overfished stocks. Incidental catch allowances for overfished stocks should approximate rates of incidental catch when fishing is conducted in a manner that minimizes catch of the overfished stock.

The Council must set incidental catch allowances for all overfished stocks. Once set, incidental catch allowances for overfished stocks remain in force until they are changed. Incidental catch allowances for overfished stocks can be revised during the fishing season if conditions warrant or new information becomes available.

5.1.6.2 Stocks Not Overfished

Incidental catch allowances for stocks that are not overfished are enforced once a the directed fishery harvest guideline has been reached, and the directed fishery has been closed. Goals in setting incidental catch allowances for stocks that are not overfished should be to (1) avoid unnecessary discard, (2) ensure that optimum yield is taken, but not exceeded, and (3) promote efficiency and profitability in the fishery. Estimates of total incidental catch (based on past or current incidental catch rates, incidental catch allowances, harvest guidelines and other conditions in the fishery) are normally considered when harvest guidelines are set. Thus, incidental catch allowances should be set at the same time and in concert with harvest guidelines.

Incidental catch allowances are meant to accommodate catches that are difficult to avoid during normal fishing directed at other species. Therefore, incidental catch allowances should be set at levels that approximate incidental catch rates during normal fishing activities.

5.2 North-South Allocation for Directed Fishery

This FMP authorizes allocations of Pacific sardine harvest guideline to participants by northern and southern areas (defined below). Nothing in this FMP precludes additional allocations based on other geographic areas or other factors developed under the authority of this FMP.

5.2.1 Definition of Northern and Southern Fishery Segments

The division between northern and southern areas for the U.S. Pacific sardine fishery is Point Piedreas Blancas (35°40' N latitude). Landings (or catches if their location is known) north of Point Piedreas Blancas and south of 39° N latitude apply to the northern area. U.S. landings (or catches if their location is known) south of Point Piedreas Blancas apply to the southern area.

5.2.2 Formulas for Allocating Pacific Sardine

The northern area allocation is 33% of the of Pacific sardine harvest guideline, and the southern area allocation is 66% of the of Pacific sardine harvest guideline. Nine months after the start of the fishing season, any uncaught portion of the harvest guideline will be totaled and reallocated with 50% of the total allocated to the northern area and 50% of the total allocated to the southern fishery area. Reallocation will be carried out by the NMFS Regional Administrator as an automatic measure as described in Section 2.1.

APPENDIX A
DESCRIPTION OF THE COASTAL PELAGICS FISHERY

Page

1.0 DESCRIPTION OF THE COASTAL PELAGICS FISHERY

The fishery for coastal pelagic species (CPS) consists of fish stocks and parties involved in their commercial harvest, commercial use, recreational harvest, and recreational use. Table 1.0-1 lists the CPS that are currently or could potentially be harvested. Not all of those species will be included under the fishery management plan (FMP) for CPS at the outset. The species to be included are northern anchovy, jack mackerel, Pacific sardine, Pacific (chub) mackerel, and market squid. Of these, only Pacific sardine and Pacific (chub) mackerel will be actively managed at the outset. Northern anchovy, jack mackerel, and market squid will be monitored only. Species included in the plan and the type of management applied to each species can be changed in the future under framework management procedures without amending the FMP.

Most CPS and the fishing they support are distributed internationally with components in the exclusive economic zones (EEZ) of Canada and Mexico as well as in international waters outside the U.S. EEZ. Individual components of the CPS fishery may include U.S. commercial fisheries; foreign catcher and processor vessels in U.S., Mexican, Canadian, and international waters; foreign vessels engaged in joint ventures (JVs) with domestic commercial vessels; party and charter boats; and anglers who target CPS or use them as bait. No tribal fisheries utilize CPS in the U.S. at this time, although a small Tribal fishery exists in British Columbia.

CPS are taken directly or as bycatch in fisheries that use many types of gear and vessels. Gears used to harvest CPS by directed fishing are primarily "round-haul" gear including purse seines, drum seines, lampara nets, and dip nets. CPS are taken incidentally with midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs.

TABLE 1.0-1. CPS, other pelagic, or midwater fish.

Pacific saury	*Cololabis saira*
northern anchovy (central subpopulation)[a/]	*Engraulis mordax*
northern anchovy (northern subpopulation)	*Engraulis mordax*
market squid[a/]	*Loligo opalescens*
Pacific bonito	*Sarda chiliensis*
Pacific herring	*Clupea harengus*
Pacific sardine[a/]	*Sardinops sagax*
Pacific (chub or blue) mackerel[a/]	*Scomber japonicus*
jack (Spanish) mackerel[a/]	*Trachurus symmetricus*

a/ Fisheries actively managed under this plan.

1.1 Northern Anchovy

Information about the biology of northern anchovy is available in Frey 1971; PFMC 1983 and 1990a; and in the references cited below.

1.1.1 Distribution and Habitat

Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia to Magdalena Bay, and Baja California, and anchovy have recently colonized the Gulf of California. The population is divided into northern, central and southern subpopulations or stocks. The northern subpopulation supports a small bait fishery (one boat to four boats) off the coasts of Oregon and Washington that is described below. The southern subpopulation is entirely within Mexican waters. The central subpopulation, which supports significant commercial fisheries in the U.S. and Mexico, ranges from approximately San Francisco, California; to Punta Baja, Baja California. The bulk of the central subpopulation is located in the Southern California Bight, a 20,000-square-nautical-mile area bounded by Point Conception, California, in the north and Point Descanso, Mexico, (about 40 miles south of the U.S.-Mexico boarder) in the south.

Northern anchovy in the central subpopulation are typically found in waters that range from 12°C to 21.5°C; however, laboratory-defined lethal temperatures occur at 7°C and 29°C (Brewer 1976). There is a great deal of regional variation in age composition and size with older and larger anchovy found farther offshore and to the north (Parrish et al. 1985). The pattern is accentuated in warm years and during the summer (Methot 1989).

1.1.2 Life History

Northern anchovy are small, short-lived fish typically found in schools near the surface. Northern anchovy rarely exceed four years of age and 18 cm total length, although individuals as old as seven years and 23 cm have been recorded. Natural mortality is thought to be M = 0.6 yr to 0.8 yr^{-1}, which means that 45% to 55% of the total stock would die each year of natural causes if no fishing occurred. Northern anchovy eat phytoplankton and zooplankton by either filter feeding or biting, depending on the size of the food.

Anchovy spawn during every month of the year, but spawning increases in late winter and early spring and peaks from February to April. Preferred spawning temperature is 14°C and eggs are most abundant at temperatures of 12°C to 16°C. Females spawn batches of eggs throughout the spawning season at intervals as short as seven days to ten days. The eggs, found near the surface, are typically ovoid and translucent and require two days to four days to hatch, depending on water temperatures. Both the eggs and larvae are found near the surface. Anchovy in the central subpopulation are all sexually mature at age two. The fraction of one-year-olds that is sexually mature in a given year depends on water temperature and has been observed to range from 47% to 100% (Methot 1989). This phenomenon affects estimates of spawning population.

Northern anchovy are subject to natural predation throughout all life stages. Eggs and larvae fall prey to an assortment of invertebrate and vertebrate planktivores. As juveniles, anchovy are vulnerable to a wide variety of predators, including many recreationally and commercially important species of fish. As adults, anchovy are fed upon by endangered salmon stocks, endangered birds (California brown pelican *Pelecanus occidentalis californicus* and least tern *Sterna albifrons browni)*, numerous fish (some of which have recreational and commercial value), mammals, and birds. Links between brown pelican breeding success and anchovy abundance have been documented (Anderson et al. 1980, 1982; Jacobson and Thomson 1989). Other species known or suspected to feed on northern anchovy are listed in Table 1.1.2-1.

TABLE 1.1.2-1. Known or suspected predators of northern anchovy, Pacific sardine, squid, and other small pelagic fish.

MARINE MAMMALS	
Callorhinus ursinus	Northern fur seal
Arctocephalus townsendi	Guadalupe fur seal
Eumetopias jubatus	Steller's sea lion
Zalophus californianus	California sea lion
Mirounga angustirostris	Northern elephant seal
Phoca vitulina	Harbor seal
Delphinus delphis bairdi	Common dolphin
Phocoena phocoena	Harbor porpoise
Phocoenoides dalli	Dall's porpoise
Lagenorhynchus obliquidens	Pacific white-sided dolphin
Tursiops truncatus	Bottlenose dolphin
Globicephala macrorhynca	Pilot whale
Balaenoptera musculus [a/]	Blue whale [a/]
Balaenoptera physalus [a/]	Fin whale [a/]
Balaenoptera borealis	Sei whale
Balaenoptera acutorostrata	Minke whale
Balaena glacialis [a/]	Pacific right whale [a/]
Megaptera novaeangliae [a/]	Humpback whale [a/]
Eschrichtius robustus [a/]	California grey whale
MARINE BIRDS	
Diomedea nigripes	Black-footed albatross
Fulmarus glacialis	Fulmar
Puffinus griseus	Sooty shearwater
Puffinus puffinus	Manx shearwater
Oceanodroma leucorhoa	Leach's petrel
Oceanodroma homochroa	Ashy petrel
Loomelania melania	Black petrel
Pelecanus occidentalis [a/]	Brown pelican [a/]
Phalacrocorax auritus	Double-crested cormorant
Phalacrocorax penicillatus	Brandt's cormorant
Phalacrocorax pelagic us	Pelagic cormorant
Lards glaucescens	Glaucous-winged gull

TABLE 1.1.2-1. Known or suspected predators of northern anchovy, Pacific sardine, squid, and other small pelagic fish.

Lards occidentalis	Western gull
Lards heermanni	Heerman's gull
Lards delawarensis	Ring-billed gull
Lards californicus	California gull
Rissa tridactyla	Black-legged kittiwake
Uria aalge	Common murre
Cepphus columba	Pigeon guillemot
Brachyramphus marmoratum	Marbled murrelet
Endomychura craveri	Craveri's murrelet
Endomychura hypoleuca	Xantu's murrelet
Synthliboramphus antiquum	Ancient murrelet
Ptychoramphus aleutica	Cassin's auklet
Cerorhinca monocerata	Rhinoceros auklet
Fratercula corniculata	Horned puffin
Lunda cirrhata	Tufted puffin
Haliaeetus leucocephalus a/	Bald eagle a/
Pandion haliaetus	Osprey
Sterna elegans	Elegant tern
Sterna caspia	Caspian tern
Sterna forsteri	Forster's tern
Sterna albifrons browni a/	Least tern a/
MARINE FISH	
Engraulis mordax	Northern anchovy
Sardinops sagax caeruleus	Pacific sardine
Merluccius productus	Pacific whiting
Alopias vulpinus	Common thresher shark
Isurus oxyrinchus	Bonito shark
Galeorhinus zyopterus	Soupfin shark
Prionace glauca	Blue shark
Torpedo californica	Pacific electric ray
Oncorhynchus kisutch	Silver (coho) salmon
Oncorhynchus tshawytscha	King (chinook) salmon
Oncorhynchus mykiss	Steelhead
Sebastes spp.	Rockfish (many species)
Roccus saxatilis	Striped bass
Paralabrax nebulifer	Barred sand bass
Paralabrax clathratus	Kelp bass
Paralabrax maculatofasciatus	Spotted sand bass
Caulolatilus princeps	Ocean whitefish
Trachurus symmetricus	Jack mackerel
Seriola dorsalis	Yellowtail
Atractoscion nobilis	White seabass
Seriphus politus	Queenfish
Menticirrhus undalatus	California corbina
Genyonemus lineatus	White croaker
Embiotocidae spp.	Surfperches (many species)
Sphyraena argentea	California barracuda
Scomber japonicus	Pacific (chub) mackerel
Sarda chiliensis	Pacific bonito
Thunnus alalunga	Albacore
Thunnus thynnus	Bluefin tuna
Xiphias gladius	Swordfish
Tetrapturus audax	Striped marlin
Onchorhynchus mykiss	Steelhead salmon
Ophiodon elongatus	Lingcod
Scorpaena guttata	Scorpionfish
Squalus acanthius	Dogfish
Stereolepis gigas	Giant seabass
Hypoglossus stenolepis	Pacific halibut
Paralichthys californicus	California halibut
INVERTEBRATES	
Loligo opalescens	Market squid
Decapoda (oegopsida)	Ocean squids

a/ An endangered species.

1.1.3 Abundance, Recruitment, and Population Dynamics

Information about changes in anchovy abundance during 1780 through 1970 is available from scale counts from sediment cores obtained from the Santa Barbara and Soledad basins off California (Soutar and Issacs 1969; 1974). These data indicate significant anchovy populations existed throughout the period and that biomass levels during the late 1960s were modest relative to levels during most of the 19th century and early 20th century. Scale counts and recent experience indicate that northern anchovy vary less over time than Pacific sardine.

Recent biomass estimates (fish age over one year) for the central subpopulation of northern anchovy from 1964 to 1995 (Jacobson et al. 1995) indicate that biomass averaged 326,000 metric tons (mt) until 1970, increased rapidly to 1,598,000 mt in 1974, and then declined to 521,000 mt in 1978 (Table 1.1.3-1). During the early 1990s biomass declined to about 150,000 mt and then increased to 388,000 mt in 1995 (Jacobson et al. 1995). No new stock assessment has been made, but available evidence indicates that the 1997 abundance is at least as high as during 1995 (Jacobson et al. 1997)

Recruitment of northern anchovy is more variable than for most clupeoid fish (Beddington and Cooke 1983; Myers et al. 1990). The standard deviation of annual log scale recruitment estimates for northern anchovy from 1964 to 1990 was 0.71 (Jacobson and Lo 1991). Strong year classes were observed in about seven years during that period (Table 1.1.3-1).

The age at which northern anchovy become vulnerable to fishing depends on location and type of fishery. They probably become vulnerable to the live bait fishery at an earlier age than to the reduction fishery. Substantial numbers of zero and one-year-old fish are taken by both fisheries in most years.

Maximum sustainable yield (MSY) for northern anchovy in the central subpopulation is estimated to be 123,000 mt per year at a total biomass level of about 733,000 mt (Conrad 1991). As for other pelagic species, MSY should be viewed as a rough indicator of stock productivity or long-term average harvest potential rather than as a management goal, because stock size and potential catches may vary dramatically from year to year (Beddington and May 1977).

1.1.4 Fishery Utilization

Northern anchovy in the central subpopulation are harvested by commercial fisheries in California and Mexico for reduction, human consumption, live bait, dead bait, other nonreduction commercial uses. Anchovy landed in Mexico are used primarily for reduction, although small amounts are probably used as bait. Small quantities of the northern subpopulation are taken off Oregon and Washington for use as bait. Anchovy catch and landings data are given in Tables 2.1.1-1, 2.1.1.3-2, and 2.1.1.4-1.

Anchovy landed by the reduction fisheries are converted to meal, oil, and soluble protein products sold mainly as protein supplements for poultry food and also as feed for pigs, farmed fish, fur-producing animals, laboratory animals, and household pets. Meal obtained from anchovy is about 65% protein (meal from other fish is 50% to 55% protein).

Anchovy harvested by the live bait fishery in California are not landed, but are kept alive for sale to anglers as bait and chum (in contrast anchovy sold as "live" bait off Oregon and Washington may be killed at time of sale). Transactions between buyers and sellers of live bait take place either at sea or at bait wells tied up at docks. Bait dealers generally supply party boats on a contract basis and receive a percentage of the fees paid by passengers. Bait is also sold by the scoop to anglers in private vessels.

Anchovy landed by the nonreduction (other than live bait) fishery are used as dead frozen bait, fresh fish for human consumption, canned fish for human consumption, animal food, and anchovy paste.

1.1.5 Current Management

As of December 31, 1992, northern anchovy were managed by the Council under the Northern Anchovy FMP. The Northern Anchovy FMP was first adopted during 1978; management before then was by the state of California. Detailed descriptions of the management of northern anchovy are given in PFMC (1983 and 1990a).

1.1.6 Northern Subpopulation

The northern subpopulation of anchovy ranges from Monterey north to British Columbia with a major spawning center off Oregon and Washington that is associated with the Columbia River plume. The northern stock supports a small (one boat to four boats in Oregon and Washington), but locally important bait fishery.

There is relatively little information available about the biology and abundance of anchovy in the northern subpopulation. Spawning biomass estimates for an area off Oregon and Washington during 1975 through 1976 based on the "Smith Larva Method" (Smith 1972) ranged from 737,000 mt to 1,005,263 mt (Richardson 1981). These estimates, based on abundance of anchovy larvae, are too high, because anchovy were erroneously assumed to spawn only once per season. Estimates of spawning biomass from the Smith Larva Method for the central subpopulation during 1964 through 1966 (Smith 1972), were about 8.6 times larger on average than more recent estimates (Lo and Methot 1989). Thus, an educated guess for spawning biomass in the northern population during 1975 through 1976, based on estimates from the Smith Larva Method and a correction factor of 8.6, is 87,000 mt to116,000 mt. Landings of anchovy in Oregon and Washington during 1981 through 1994 (less than 60 mt per year) were small relative to the revised estimates of spawning biomass.

TABLE 1.1.3-1. Total biomass (mt on February 15), spawning biomass (mt on February 15), and recruitment estimates (mt age-0 fish on July 1) for northern anchovy, 1964 to 1995. All estimates from (Jacobson et al. 1995).

Year	Total	CV	Spawning	CV	Recruits	CV
1964	636,807	39%	611,947	39%	166,216	47%
1965	378,972	30%	356,272	33%	206,829	48%
1966	261,290	28%	236,177	27%	464,458	50%
1967	274,943	31%	229,927	29%	247,758	48%
1968	214,371	30%	205,661	30%	241,230	45%
1969	186,550	29%	173,049	29%	830,351	48%
1970	330,575	33%	198,006	29%	257,794	47%
1971	221,007	30%	172,431	31%	867,978	54%
1972	360,021	38%	137,774	28%	679,802	57%
1973	390,503	37%	382,657	37%	4,348,342	47%
1974	1,597,737	36%	474,403	28%	1,495,367	76%
1975	1,245,680	35%	931,981	31%	2,651,986	75%
1976	1,325,539	35%	1,068,744	31%	990,287	59%
1977	901,543	31%	900,606	31%	495,690	56%
1978	520,683	32%	519,875	32%	654,417	55%
1979	395,165	32%	337,401	30%	1,770,193	37%
1980	673,167	24%	654,146	24%	960,584	40%
1981	513,099	20%	490,381	19%	631,225	40%
1982	356,415	22%	320,201	20%	2,050,309	25%
1983	713,707	19%	711,225	19%	221,994	42%
1984	396,595	20%	395,006	20%	1,934,712	35%
1985	822,157	22%	555,245	18%	1,115,221	60%
1986	722,768	32%	715,217	32%	303,723	41%
1987	411,576	30%	408,704	30%	216,887	42%
1988	240,711	29%	226,903	28%	1,285,251	39%
1989	440,586	29%	167,168	29%	186,449	38%
1990	245,416	30%	239,345	29%	136,300	35%
1991	153,457	29%	151,970	29%	269,658	36%
1992	172,300	27%	170,557	27%	174,301	37%
1993	145,315	28%	144,536	28%	235,177	40%
1994	155,832	31%	153,863	31%	938,190	51%
1995	392,266	38%	387,618	38%	560,523	13%

1.2 Jack Mackerel

Biological information about jack mackerel is available in MacCall et al. (1980), MacCall and Stauffer (1983), and in references cited below.

1.2.1 Distribution and Habitat

Jack mackerel are a pelagic schooling fish that ranges widely throughout the northeastern Pacific, from the Pacific coast to an offshore limit approximated by a line running from Cabo San Lucas, Baja California, to the eastern Aleutian Islands, Alaska. Much of the range lies outside the 200-mile U.S. EEZ. There is no evidence of stock structure in jack mackerel along the West Coast.

Small jack mackerel (10 cm to 30 cm fork length and up to six years of age) are most abundant in the Southern California Bight, where they are often found near the mainland coast and islands and over shallow rocky banks. Older, larger fish (50 cm to 60 cm fork length and 16 years to 30 years) range from Cabo San Lucas, Baja California, to the Gulf of Alaska, where they are generally found offshore in deep water and along the coastline to the north of Point Conception. Large fish rarely appear in southern inshore waters. Fish of intermediate lengths (30 cm to 50 cm tail length; nine years to 20 years of age) were found in considerable numbers during the spring of 1991 around the 200-mile limit of the U.S. EEZ off southern California; fish of five to nine years of age were the most numerous and fish ten to 20 years old were common (Nebenzahl 1997). Jack mackerel sampled over several years by trawl surveys off Oregon and Washington ranged from 30 cm to 62 cm and four to 36 years old. More than half of the fish sampled were greater than 20 years old, and fish greater than 30 years-old were common (Nebenzahl 1997).

Jack mackerel off southern California move inshore and offshore as well as north and south. They are more available on offshore banks in late spring, summer, and early fall than during the remainder of the year. In southern California waters, jack mackerel schools are often found over rocky banks, artificial reefs, and shallow rocky coastal areas. They remain near the bottom or under kelp canopies during daylight and venture into deeper surrounding areas at night. Young juvenile fish sometimes form small schools beneath floating kelp and debris in the open sea.

1.2.2 Life History

Jack mackerel grow to about 60 cm and live 35 years or longer. Estimates of natural mortality are uncertain, but the natural mortality rate (M) averaged over the life span of a typical fish is probably less than 0.20 to 0.25 yr^{-1}. This means that about 18% to 22% of the total stock would die each year of natural causes if no fishing occurred.

Small jack mackerel taken off southern California and northern Baja California eat large zooplankton (copepods, pteropods, and euphausiids), juvenile squid, and anchovy. Larvae feed almost entirely on copepods.

Although immature jack mackerel can be found off southern California at all times of the year, 50% or more of all females reach sexual maturity during their first year of life. Older jack mackerel, in samples taken about 200 miles offshore from Southern California, spawned about every five days, and the average female may spawn as many as 36 times per year (Macewicz and Hunter 1993).

The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July (MacCall and Prager 1988). Young spawners off southern California begin spawning later in the year than older spawners. Little is known of the maturity cycle of large fish offshore, but peak spawning appears to occur later in more northerly waters.

Large predators like tuna and billfish eat jack mackerel, but, except as young-of-the-year and yearlings, jack mackerel are probably a minor forage source for smaller predators. Older jack mackerel probably do not contribute significantly to food supplies of marine birds, because they are too large to be eaten by most bird species and school inaccessibly deep. Little information is available on predation of jack mackerel by marine mammals. Jack mackerel are not often eaten by California sea lions, *Zalophus californianus* or northern fur seals, *Callorhinus ursinus*.

1.2.3 Abundance, Recruitment, and Population Dynamics

The best current estimate of average spawning biomass for jack mackerel, based on California Cooperative Oceanic Fisheries Investigations (CalCOFI) data, is about 1.2 million mt to 2.6 million mt, with roughly 50% of the total spawning biomass found off California and Mexico. This estimate, which is based on scanty information about the distribution and reproductive biology of jack mackerel, is little more than an educated guess.

CalCOFI ichthyoplankton surveys and fish-spotter data are the only available sources of information about year-to-year changes in abundance of jack mackerel (Table 1.2.3-1). Neither CalCOFI surveys nor fish spotters cover the entire range of the population, so relationships between the indices and biomass may be obscured.

MacCall and Prager (1988) used general linear models and analysis of variance with CalCOFI data to estimate relative abundance of jack mackerel larvae from 1950 through 1980. The index of relative abundance for jack mackerel larvae shows considerable year-to-year fluctuation, but no long-term trends (Table 1.2.3-1).

Two indices of relative abundance from fish-spotter data for 1963 through 1990 are available for jack mackerel: a catch-per-unit-effort like index (Jim Squire, NMFS, Southwest Fisheries Science Center, personal communication) and an index based on lognormal linear models (N. C. H. Lo, NMFS, Southwest Fisheries Science Center, personal communication). The catch-per-unit-effort index was calculated from data collected by pilots flying at night over a "core" area where jack mackerel are naturally abundant (Squire 1972, 1983). The index based on general linear models was calculated with the model for northern anchovy described by Lo et al. (1992). Both indices (Table 1.2.3-1) indicate that abundance or availability increased dramatically during the mid-1970's, and jack mackerel biomass or availability can remain at low levels for long periods (ten or more years).

Detecting changes in jack mackerel abundance using existing CalCOFI or fish-spotter indices would probably be difficult. None of the indices appear precise, because variability in each is larger than the variability in abundance that could probably be expected for a long-lived fish like jack mackerel (MacCall and Stauffer 1983; MacCall and Prager 1988). In addition, the three indices are not well correlated.

The only information available for recruitment in jack mackerel is a rough index of year-class strength, obtained by summing the percentage contributions of a year-class to the various seasons in which it was fished (Table 1.2.3-2). An average year class will, using this measure, have a relative strength of 100%. Long-term trends cannot be detected since a year-class is effectively compared only to year-classes immediately preceding and following it (Mason 1991).

Virtual year-class strengths for 1947 through 1958 show a pattern in which strong year-classes appear every five years (Table 1.2.3-2). Recruitment was relatively low from 1959 to 1966. After 1966, strong year- classes appeared every two to three years.

The age at which jack mackerel recruit to fisheries depends on the location of the fishery. Jack mackerel begin to recruit to the southern California purse seine fishery in their first year.

MSY for jack mackerel has not been estimated, but crude estimates of potential yield (Gulland 1970; MacCall and Stauffer 1983) have been developed. Potential yield of jack mackerel is not meant to be an estimate of sustainable harvest, but rather an interim limit for catches while data sufficient for management are accumulated. Ages 0.5 through eight are harvested by the inshore fishery off southern California and have a potential yield of about 100,000 mt to 200,000 mt. The potential yield of large jack mackerel in offshore and northern regions is about 10,000 mt to 25,000 mt. The potential yield of fish ages nine years to 15 years is about 20,000 mt to 50,000 mt. The total stock has a potential yield of 130,000 mt to 275,000 mt, but larger harvests might be sustained as the nearly virgin stock is fished down.

1.2.4 Fishery Utilization

The southern California segment of the stock has been fished since the late 1940s, when jack mackerel served as a substitute for the failing sardine fishery. Landings data are given in Table 2.1.1-1. Purse seiners prefer Pacific (chub) mackerel, because jack mackerel tend to occur further from port and over rocky bottoms where there is increased risk of damage to nets. Mason (1991) describes the history of management for the jack mackerel fishery off southern California. Landings have been greatly reduced during the 1990s; 1996 landings (1,485 mt) were the lowest in more than 50 years.

Offshore, large adult jack mackerel are sometimes taken incidentally in trawls for Pacific whiting. During the 1970s, foreign trawl fisheries may have caught 1,000 mt to 2,000 mt annually, but catches by foreign and joint-venture fishers in the 1980s ranged from nil to about 100 mt.

1.2.5 Current Management

Jack mackerel was included in the Pacific Fishery Management Council's Groundfish FMP, because of foreign trawl fishery catches in the 1970s. Before 1991, an annual quota of 12,000 mt (north of 39° N latitude) was used to account for the incidental harvest while avoiding constraints on fishing for other groundfish species, particularly Pacific whiting. Beginning in 1991, in response to increased interest in fishing for jack mackerel, the Council adopted a coastwide quota of 46,500 mt for jack mackerel.

TABLE 1.2.3-1. Indices of relative abundance for jack mackerel from CalCOFI and fish-spotter data.

		Fish Spotter				Fish Spotter	
Year	CalCOFI	CPUE	Lo-GLM	Year	CalCOFI	CPUE	Lo-GLM
1952	2.41			1972	1.63	0.07	0.61
1953	0.69			1973		0.05	0.02
1954	1.19			1974		0.15	0.18
1955	0.81			1975	0.35	0.19	0.69
1956	0.35			1976		0.51	0.61
1957	1.35			1977		1.13	4.80
1958	0.35			1978	0.13	5.19	3.93
1959	0.17			1979		2.01	1.06
1960	0.30			1980		2.23	0.64
1961	1.08			1981	0.08	2.93	0.41
1962	0.81		0.28	1982		1.50	0.53
1963	0.73	0.64	1.21	1983		1.51	0.12
1964	0.17	0.84	0.77	1984		0.35	0.39
1965	0.79	0.30	0.77	1985		0.70	0.33
1966	1.25	0.21	0.24	1986		0.84	0.14
1967	1.70	0.22	0.80	1987		0.58	0.09
1968	2.60	0.21	1.27	1988		3.14	0.05
1969	1.57	0.19	0.30	1989		2.66	0.15
1970		0.07	0.15	1990		0.39	0.04
1971	0.0	0.66					

All data series were rescaled to a mean of 1.0 for years of overlap. The label "CalCOFI" is for estimates of relative abundance (number larvae per area) from a general linear model fit to CalCOFI larval data (MacCall and Prager 1988, data from Alec MacCall, NMFS, SWFSC, personal communication). The label "CPUE" is for a catch-per-unit-effort-like index from fish-spotter data (Jim Squire, NMFS, SWFSC, personal communication). The label "Lo-GLM" is for estimates from general linear models fit to fish-spotter data (N. C-H. Lo, NMFS, SWFSC, pers. comm.).

TABLE 1.2.3-2. Virtual year-class strength estimates from jack mackerel catch-at-age data for 1959 through 1966.

Year	Year-class Strength	Year	Year-class Strength
1947	1.629	1964	0.708
1948	0.382	1965	0.678
1949	0.392	1966	0.906
1950	0.355	1967	1.591
1951	0.646	1968	0.955
1952	2.366	1969	1.163
1953	1.312	1970	1.647
1954	0.468	1971	0.771
1955	0.403	1972	0.857
1956	0.414	1973	0.564
1957	0.860	1974	1.721
1958	2.039	1975	0.402
1959	1.215	1976	1.336
1960	1.125	1977	0.419
1961	0.661	1978	1.556
1962	0.512	1979	0.495
1963	0.536	1980	2.065

Source: J. Mason, NMFS, Southwest Fisheries Science Center, personal communication.

1.3 Pacific Sardine

Biological information about Pacific sardine, *Sardinops sagax caerulea*, is available in Frey (1971), Clark and Marr (1955), Ahlstrom (1960), Murphy (1966), MacCall (1979), and in the references cited below. Other common names for Pacific sardine include California pilchard, pilchard (in the northern part of its range), and sardina monterey (in the southern part of its range).

1.3.1 Distribution and Habitat

Sardines as a group of species are small pelagic schooling fish that inhabit coastal subtropical and temperate waters. The genus *Sardinops* is found in eastern boundary currents of the Atlantic and Pacific, and in western boundary currents of the Indo-Pacific oceans. Recent studies indicate that sardines in the Alguhas, Benguela, California, Kuroshio, and Peru currents, and off New Zealand and Australia are a single species (*Sardinops sagax*, Parrish et al. 1989), but stocks in different areas of the globe may be different at the subspecies level (Bowen and Grant 1997).

Pacific sardine have at times been the most abundant fish species in the California Current. When the population is large it is abundant from the tip of Baja California (23° N latitude) to southeastern Alaska (57° N latitude), and throughout the Gulf of Mexico. In the northern portion of the range, occurrence tends to be seasonal. When sardine abundance is low, as during the late 1960s and 1970s, sardine do not occur in commercial quantities north of Point Conception.

It is generally accepted that sardine off the West Coast of North America form three subpopulations or stocks. A northern subpopulation (northern Baja California to Alaska), a southern subpopulation (off Baja California), and a Gulf of California subpopulation were distinguished on the basis of serological techniques (Vrooman 1964). A recent electrophoretic study (Hedgecock et al. 1989) showed, however, no genetic variation among sardine from central and southern California, the Pacific coast of Baja California, or the Gulf of California. A fourth, far northern subpopulation, has also been postulated (Radovich 1982). Although the ranges of the northern and southern subpopulations overlap, the stocks may move north and south at similar times and not overlap significantly. The northern stock is exploited by U.S. fisheries and is included in this FMP.

Pacific sardine probably migrated extensively during historical periods when abundance was high, moving north as far as British Columbia in the summer and returning to southern California and northern Baja California in the fall. Tagging studies (Clark and Janssen 1945) indicate that the older and larger fish moved farther north. Migratory patterns were probably complex, and the timing and extent of movement were affected by oceanographic conditions (Hart 1973) and stock biomass. During the 1950s to 1970s, a period of reduced stock size and unfavorably cold sea surface temperatures apparently caused the stock to abandon the northern portion of its range. At present, the combination of increased stock size and warmer sea surface temperatures are causing the stock to reoccupy grounds off northern California, Oregon, Washington, and British Columbia. Abandonment and recolonization of the higher latitude portion of their range has been associated with changes in abundance of sardine populations around the world (Parrish et al. 1989).

1.3.2 Life History

Pacific sardine may reach 41 cm, but are seldom longer than 30 cm. They may live as long as 13 years, but individuals in historical and current California commercial catches are usually younger than five years. In contrast, the most common ages in the historical Canadian sardine fishery were six years to eight years. There is a good deal of regional variation in size at age and size at age increases from south to north (Phillips 1948). Size and age at maturity may decline with a decrease in biomass, but latitude and temperature also are important (Butler 1987). At low biomass, levels, sardine appear to be fully mature at age one, whereas at high biomass levels only some of the two-year-olds are mature (MacCall 1979).

Age-specific mortality estimates are available for the entire suite of life history stages (Butler et al. 1993). Mortality is high at the egg and yolk sac larvae stages (instantaneous rates in excess of 0.66 d^{-1}). Adult natural mortality rates has been estimated to be $M=0.4.yr^{-1}$ (Murphy 1966; MacCall 1979) and 0.51 yr^{-1} (Clark and Marr 1955). A natural mortality rate of $M=0.4\ yr^{-1}$ means that 33% of the sardine stock would die each year of natural causes if there were no fishery.

Pacific sardine spawn in loosely aggregated schools in the upper 50 meters of the water column. Spawning occurs year-round in the southern stock and peaks April through August between Point Conception and Magdalena Bay, and January through April in the Gulf of California (Allen et al. 1990). Off California, sardine eggs are most abundant at sea surface temperatures of 14°C to 16°C and larvae are most abundant at 13°C to 16°C. Temperature requirements are apparently flexible, however, because eggs are most common at 17°C to 21° C and in the Gulf of California and at 22°C to 25°C off Southern Baja (Lluch-Belda et al. 1991).

The spatial and seasonal distribution of spawning is influenced by temperature. During periods of warm water, the center of sardine spawning shifts northward and spawning extends over a longer period of time (Butler 1987; Ahlstrom 1960). Recent spawning has been concentrated in the region offshore and north of Point Conception (Lo et al. 1996). Historically, spawning may also have been fairly regular off central California. Spawning was observed off Oregon, and young fish were seen in waters off British Columbia in the early fishery (Ahlstrom 1960) and during recent years (Hargreaves et al. 1994). The main spawning area for the historical population off the U.S. was between Point Conception and San Diego, California, out to about 100 miles offshore, with evidence of spawning as far as 250 miles offshore (Hart 1973).

Sardine are oviparous multiple-batch spawners with annual fecundity that is indeterminate and highly age or size dependent. Butler et al. (1993) estimate that two-year-old sardine spawn on average six times per year whereas the oldest sardine spawn 40 times per year. Both eggs and larvae are found near the surface. Sardine eggs are spheroid, have a large perivitelline space, and require about three days to hatch at 15°C.

Sardine are planktivores that consume both phytoplankton and zooplankton. When biomass is high, Pacific sardine may consume a significant proportion of total organic production in the California Current system. Based on an energy budget for sardine developed from laboratory experiments and estimates of primary and secondary production in the California Current, Lasker (1970) estimated that annual energy requirements of the sardine population would have been about 22% of the annual primary production and 220% of the secondary production during 1932 to 1934, a period of high sardine abundance.

Pacific sardine are taken by a variety of predators throughout all life stages. Sardine eggs and larvae are consumed by an assortment of invertebrate and vertebrate planktivores. Although it has not been demonstrated in the field, anchovy predation on sardine eggs and larvae was postulated as a possible mechanism for increased larval sardine mortality from 1951 through 1967 (Butler 1987). There have been few studies about sardine as forage, but juvenile and adult sardine are consumed by a variety of predators, including commercially important fish (e.g., yellowtail, barracuda, bonito, tuna, marlin, mackerel, hake, salmon, and sharks), seabirds (pelicans, gulls, and cormorants), and marine mammals (sea lions, seals, porpoises, and whales). In all probability, sardine are fed on by the same predators (including endangered species) that utilize anchovy (Table 1.1.2-1). It is also likely that sardine will become more important as prey as their numbers increase. For example, while sardine were abundant during the 1930s, they were a major forage species for both coho and chinook salmon off Washington (Chapman 1936).

1.3.3 Abundance, Recruitment, and Population Dynamics

Extreme natural variability and susceptibility to recruitment overfishing are characteristic of clupeoid stocks like Pacific sardine (Cushing 1971). Estimates of the abundance of sardine from 1780 through 1970 have been derived from the deposition of fish scales in sediment cores from the Santa Barbara basin off southern California (Soutar and Issacs 1969, 1974; Baumgartner et al. 1992). Significant sardine populations existed throughout the period with biomass levels varying widely. Both sardine and anchovy populations tend to vary over periods of roughly 60 years, although sardine have varied more than anchovy. Sardine population declines were characterized as lasting an average of 36 years; recoveries lasted an average of 30 years. Biomass estimates of the sardine population inferred from scale-deposition rates in the 19th and 20th centuries (Soutar and Isaacs 1969; Smith 1978) indicate that the biomass peaked in 1925 at about six million mt (Table 1.3.3-1).

Sardine age-three and older were fully recruited to the historical fishery until 1953 (MacCall 1979). Recent fishery data indicate that sardine begin to recruit at age. Age-dependent availability to the fishery likely depends upon the location of the fishery; young fish are unlikely to be fully available to fisheries located in the north and old fish are unlikely to be fully available to fisheries south of Point Conception.

Sardine spawning biomass (Table 1.3.3-1) estimated from catch-at-age analysis averaged 3.5 million mt from 1932 through 1934, fluctuated between 1.2 million mt to 2.8 million mt over the next ten years, then declined steeply during 1945 through 1965, with some short-term reversals following periods of particularly successful recruitment (Murphy 1966; MacCall 1979). During the 1960s and 1970s, spawning biomass levels were thought to be less than about five thousand to ten thousand mt (Barnes et al. 1992). The sardine stock began to increase by an average rate of 27% annually in the early 1980s (Table 1.3.3-1, Barnes et al. 1992). Recent estimates (Hill et al. 1998) indicate that the total biomass of sardine age one or older had increased to about 420,000 mt to 570,000 mt by 1997.

Recruitment success in sardine is generally autocorrelated and affected by environmental processes occurring on long (decadal) time scales. Lluch-Belda et al. (1991) and Jacobson and MacCall (1995) demonstrated relationships between recruitment success in Pacific sardine and sea surface temperatures measured over relatively long periods (i.e., three years to five years). Their results suggest that equilibrium spawning biomass and potential sustained yield is highly dependent upon environmental conditions associated with elevated sea surface temperature conditions.

Recruitment of Pacific sardine is highly variable (Table 1.3.3-1). Analyses of the sardine stock recruitment relationship have been controversial, with some studies showing a density-dependent relationship (production of young sardine declines at low levels of spawning biomass) and others finding no relationship (Clark and Marr 1955; Murphy 1966; MacCall 1979). The most recent study (Jacobson and MacCall 1995) found that both density-dependent and environmental factors to be significant and important.

MacCall (1979) estimated that the average potential population growth rate of sardine was 8.5% during the historical fishery while the population was declining. He concluded that, even with no fishing mortality, the population on average was capable of little more than replacement. Jacobson and MacCall (1995) obtained similar results for cold, unproductive regimes, but also found that the stock was very productive during warmer regimes.

MSY for the historical Pacific sardine was estimated to be 250,000 mt annually (MacCall 1979; Clark 1939), which is far below the catch of sardine during the peak of the historical fishery. Jacobson and MacCall (1995) found that MSY depends on environmental conditions.

1.3.4 Fishery Utilization

The sardine fishery was first developed in response to demand for food during World War I. Landings increased from 1916 to 1936, and peaked at over 700,000 mt. The Pacific sardine supported the largest fishery in the western hemisphere during the 1930s and 1940s, with landings along the coast in British Columbia, Washington, Oregon, California, and Mexico. The fishery declined, beginning in the late 1940s and with some short-term reversals, to extremely low levels in the 1970s. There was a southward shift in the catch as the fishery decreased, with landings ceasing in the northwest in 1947 through 1948, and in San Francisco in 1951 through 1952. Sardine were primarily used for reduction to fish meal, oil, and as canned food, with small quantities taken for live bait. An extremely lucrative dead bait market developed in central California in the 1960s.

In the early 1980s, sardine began to be taken incidentally with Pacific (chub) mackerel and jack mackerel in the southern California mackerel fishery and primarily canned for pet food, although some were canned for human consumption. As sardine continued to increase in abundance, a directed purse-seine fishery was reestablished. Sardine landed in the directed sardine fisheries off southern and central California are mostly canned for human consumption and sold overseas, with minor amounts sold fresh for human consumption and animal food. Small quantities are harvested for dead bait and live bait. Sardine landed in Mexico are used primarily for reduction. Sardine landings data are given in Table 2.1.1-1.

1.3.5 Current Management

Pacific sardine are currently managed by California Department of Fish and Game (CDFG) with technical assistance and data from NMFS. State regulations allow a directed sardine fishery in years when the sardine spawning biomass exceeds 18,200 mt (20,000 short tons).

In recent years, California sardine quotas have been set using the formula Quota=(Biomass-50,000) x 20% x 59% where 20% is a target harvest rate for the entire stock and 59% is the portion of the stock available to the California fishery. One third of the total California sardine is allocated to boats operating north of San Simeon Point (San Luis Obispo County, California), and two thirds is allocated to boats operating to the south. On October 15 of each year, the total remaining state-wide quota is allocated 50-50 to the northern and southern areas. Tolerance limits for sardine (similar to bycatch allowances in this FMP) are used to manage bycatch and may be, by law, 15% to 45% by weight in each delivery. The 1998 California quota, based on a total biomass estimate of 464,000 short tons (421,000 mt), was 48,000 short tons (44,000 mt).

TABLE 1.3.3-1. Estimates of sardine biomass (1,000 mt). Data prior to 1984 are biomass of sardine age two and older and recruits in millions of age-two fish. Data beginning in 1984 are biomass of sardine age one and older and recruits in millions of age-one fish. Age-two fish prior to 1984 and age-one fish beginning in 1984 were of similar size, maturity, and biologically equivalent.[a/] Biomass estimates for recent years are for the stock available to the California fishery and likely underestimate biomass for the stock as a whole.

	Spawning Biomass					Spawning Biomass			
Year	Scale Deposition[b/]	Catch At-age[c/]	GLM[d/]	Recruits	Year	Scale Deposition[b/]	Catch At-age[c/]	GLM[d/]	Recruits
1910	1738				1955		170	166	382
1915	2444				1956		108	124	264
1920	5055				1957		90	132	588
1925	6226				1958		177	284	1586
1930	5300				1959		122	267	905
1932		3523		3981	1960		88	176	288
1933		3414		8860	1961		54	78	111
1934		3624		14202	1962		27	24	74
1935		2844		4098	1963		21	30	56
1936		1688		2821	1964		11		11
1937		1206		5383	1965		3		
1938		1201		6940		Data Not Available 1966 through 1982			
1939		1607		6763	1983		5		125
1940		1760		11808	1984		13		172
1941		2457		14442	1985		18		151
1942		2064		6152	1986		25		561
1943		1677		3268	1987		56		536
1944		1206		3720	1988		81		910

TABLE 1.3.3-1. Estimates of sardine biomass (1,000 mt). Data prior to 1984 are biomass of sardine age two and older and recruits in millions of age-two fish. Data beginning in 1984 are biomass of sardine age one and older and recruits in millions of age-one fish. Age-two fish prior to 1984 and age-one fish beginning in 1984 were of similar size, maturity, and biologically equivalent.[a/] Biomass estimates for recent years are for the stock available to the California fishery and likely underestimate biomass for the stock as a whole.

	Spawning Biomass					Spawning Biomass			
Year	Scale Deposition[b/]	Catch At-age[c/]	GLM[d/]	Recruits	Year	Scale Deposition[b/]	Catch At-age[c/]	GLM[d/]	Recruits
1945		720		2385	1989		122		708
1946		566		1625	1990		135		2754
1947		405		1667	1991		159		3235
1948		740		3875	1992		243		1984
1949		793		4261	1993		217		4732
1950		780		3690	1994		323		6818
1951		277	176	290	1995		357		5511
1952		136	101	397	1996		476		237
1953		202	6	972	1997		418		
1954		239	216	1197					

a/ For example, there were 3,532,000 mt of sardine in 1932, and the 1932 year class produced 3,981,000 age-two recruits.
b/ Estimates from scale-deposition rates converted to biomass (Smith 1978).
c/ Catch-at-age estimates of biomass and recruitment from VPA for 1932 to 1944 (Murphy 1966), VPA for 1945 through 1965 (MacCall 1979), and CANSAR/TAM for 1983 through 1997 (Hill et al. in preparation).
d/ Estimates from a general linear model (Barnes et al. 1992).

1.4 Pacific (Chub) Mackerel

Pacific (chub) mackerel (*Scomber japonicus*) found off the Pacific coast of the U.S. are often called "blue" or "chub" mackerel and are the same species as mackerel of various names found elsewhere in the Pacific, Atlantic, and Indian oceans (Collett and Nauen 1983). A synopsis of the biology of Pacific (chub) mackerel is available in Schaefer (1980) and references cited below. The northeastern Pacific stock (see below) is included in this FMP.

1.4.1 Distribution and Habitat

Pacific (chub) mackerel in the northeastern Pacific range from Banderas Bay, Mexico, to southeastern Alaska, including the Gulf of California (Hart 1973). They are common from Monterey Bay, California, to Cabo San Lucas, Baja California, but are most abundant south of Point Conception. Pacific (chub) mackerel usually occur within 20 miles of shore, but have been taken as far offshore as 250 miles (Fitch 1969; Frey 1971; Allen et al. 1990; MBC 1987).

There are three spawning stocks along the Pacific coasts of the U.S. and Mexico: one in the Gulf of California, one in the vicinity of Cabo San Lucas, and one extending along the Pacific coast north of Punta Abreojos, Baja California (Collette and Navem 1983; Allen et al. 1990; MBC 1987). The latter "northeastern Pacific" stock is harvested by fishers in the U.S. and Mexico and included in this FMP.

Pacific (chub) mackerel adults are found in water ranging from 10.0°C to 22.2°C (MBC 1987), and larvae may be found in water around 14°C (Allen et al. 1990). As adults, Pacific (chub) mackerel may move north in summer and south in winter between Tillamook, Oregon, and Magdalena Bay, Baja California: northerly movement in the summer peaks during El Niño events (MBC 1987). There is an inshore-offshore migration off California, with increased inshore abundance from July to November and increased offshore abundance from March to May (Cannon 1967; MBC 1987). Adult Pacific (chub) mackerel are commonly found near shallow banks. Juveniles are found off sandy beaches, around kelp beds, and in open bays. Adults are found from the surface to depths of 300 meters (Allen et al. 1990). Pacific (chub) mackerel often school with other pelagic species, particularly jack mackerel and Pacific sardine.

1.4.2 Life History

The largest recorded Pacific (chub) mackerel was 63 cm long and weighed 2.8 kg, but Pacific (chub) mackerel taken by commercial fishing seldom exceed 40 cm or one kilogram (Hart 1973; Roedel 1938). The oldest recorded age for a Pacific (chub) mackerel was 11 years, but most caught commercially are less than four-years-old (Fitch 1951). Some Pacific (chub) mackerel mature as one-year-olds, and all are sexually mature by age four (Prager and MacCall 1988). The annual rate of natural mortality (M) is thought to be about 0.5 yr^{-1}, which means that 39% of the stock would die each year of natural causes in the absence of fishing (Parrish and MacCall 1978).

Pacific (chub) mackerel larvae eat copepods and other zooplankton including fish larvae (Collette and Nauen 1983; MBC 1987). Juveniles and adults feed on small fish, fish larvae, squid, and pelagic crustaceans such as euphausids (Clemens and Wilby 1961; Turner and Sexsmith 1967; Fitch 1969; Fitch and Lavenberg 1971; Frey 1971; Hart 1973; Collette and Nauen 1983).

Pacific (chub) mackerel in the northeastern Pacific stock spawn from Eureka, California, south to Cabo San Lucas in Baja California (Frey 1971; MBC 1987) between three and 320 km from shore. They seldom spawn north of Point Conception (Fritzsche 1978; MBC 1987) although young-of-year mackerel have been recently reported as far north as Oregon and Washington due, perhaps, to current warm sea surface temperatures. Spawning peaks from late April to July (MacCall and Prager 1988). Like most coastal pelagic species, Pacific (chub) mackerel have indeterminate fecundity and seem to spawn whenever sufficient food is available and appropriate environmental conditions prevail. Actively spawning fish appear capable of spawning every day or every other day (Dickerson et al. 1992).

Pacific (chub) mackerel larvae are subject to predation from a number of invertebrate and vertebrate planktivores. Juveniles and adults are eaten by larger fish, marine mammals, and seabirds. Predators include porpoises, California sea lions (*Zalophus californianus*), brown pelican (*Pelecanus occidentalis*), striped marlin (*Terapturus audax*), black marlin (*Makaira indica*), sailfish (*Istiophorus platypterus*), bluefin tuna (*Thunnus thynnus*), white sea bass (*Atractoscion nobilis*, yellowtail (*Seriola dorsalis*), giant sea bass (*Stereolepis gigas*), and various sharks (MBC 1987). Although consumed in significant numbers by a wide variety of predators, Pacific (chub) mackerel are likely not as important as forage than Pacific sardine or northern anchovy which are smaller in size (i.e., available to a wider variety of predators) and often more abundant.

1.4.3 Abundance, Recruitment, and Population Dynamics

Biomass of Pacific (chub) mackerel (Table 1.4.3-1) declined from more than 200,000 mt in the early 1930s to less than 100,000 mt by 1945 and to very low levels in the late 1960s and early 1970s. Strong year- classes appeared in the late 1970s, and abundance increased dramatically after 1977. After 1982, Pacific (chub) mackerel biomass declined steadily, but remained greater than 200,000 mt until 1992. During 1993 through 1996, Pacific (chub) mackerel biomass off the Southern California Bight declined further to about 121,000 mt (Yaremko et al., In press). Analyses of scale-deposition data for Pacific (chub) mackerel (Soutar and Issacs 1974) indicate that the prolonged period of high biomass levels during the late 1970s and 1980s was an unusual event that might be expected to occur, on average, about once every 60 years (MacCall et al. 1985).

Recruitment of Pacific (chub) mackerel is variable and loosely linked to spawning biomass. Reproductive success, measured as spawning biomass divided by number of recruits, is highly variable and somewhat cyclic (MacCall et al. 1985).

MacCall et al. (1985) estimated that Pacific (chub) mackerel might sustain average yields of from 26,000 mt to 29,000 mt per year under management systems similar to that currently used to manage the stock.

1.4.4 Fishery Utilization

Pacific (chub) mackerel in the northeastern Pacific are harvested by commercial fisheries in California and Mexico; some recreational harvest also occurs. Pacific (chub) mackerel are sold as fresh fish, canned for human consumption, pet food, and reduced to fish meal and oil. Landings data are given in Table 2.1.1-1.

Pacific (chub) mackerel are often taken by anglers and in considerable numbers, though seldom as a target species (Allen et al. 1990). During 1980 through 1989, the recreational catch averaged 1,330 mt per year (Wolf 1989,) and Pacific (chub) mackerel was numerically the most important species taken in the California commercial passenger fishing boat fleet during the period of 1978 through 1989.

1.4.5 Current Management

Pacific (chub) mackerel are currently managed by the State of California. If the estimated biomass is greater than 135,000 mt, then the commercial catch is not restricted by a quota. If the biomass is between 18,000 mt and 135,000 mt, then a quota equal to 30% of the biomass above 18,000 short tons is applied. If the biomass is below 18,000 mt, commercial fishing stops. The history of Pacific (chub) mackerel fishery and management is described in Klingbeil (1983).

TABLE 1.4.3-1. Biomass estimates (1,000 mt) for Pacific (chub) mackerel from Hill et al. (In press).

Year	Biomass	Year	Biomass
1929	156	1964	27
1930	223	1965	5
1931	297	1966	3
1932	367	1967	2
1933	353	1968	2
1934	292	1969	1
1935	194	1970	0
1936	129	1971	1
1937	115	1972	1
1938	106	1973	2
1939	117	1974	4
1940	91	1975	10
1941	86	1976	12
1942	114	1977	82
1943	105	1978	142
1944	83	1979	452
1945	64	1980	594
1946	40	1981	684
1947	20	1982	1,176
1948	53	1983	1,049
1949	56	1984	902
1950	39	1985	772
1951	21	1986	692
1952	7	1987	638
1953	22	1988	526
1954	53	1989	453
1955	49	1990	371
1956	54	1991	307
1957	29	1992	202
1958	19	1993	171
1959	38	1994	146
1960	43	1995	120
1961	65	1996	124
1962	78	1997	126
1963	56		

1.5 Market Squid

Market squid (*Loligo opalescens*) along the West Coast of North America were studied during 1960-1980 (Recksiek and Frey 1978; Symposium of the 1978 CalCOFI Conference[1/]), but little research applicable to fisheries management was carried out until the 1997 CalCOFI Squid Symposium. The 1997 CalCOFI Symposium initiated an intensive research program conducted collaboratively by state, federal and academic biologists and funded by license fees for squid fishing. Results from the ongoing research program are not yet available.

1/ See papers by various authors published during 1979 in: California Cooperative Oceanic Fishing Investment Report 20: 21-71.

1.5.1 Distribution and Habitat

Adult and juvenile market squid (Dickerson and Leos 1992) are distributed throughout the California and Alaska current systems from the southern tip of Baja California, Mexico (23° N Latitude) to southeastern Alaska (55° N Latitude). They are most abundant between Punta Eugenio, Baja California and Monterey Bay, central California. Market squid are harvested near the surface and generally considered pelagic, but are actually found over the continental shelf from the surface to depths of at least 800 meters. They prefer oceanic salinities and are rarely found in bays, estuaries, or near river mouths (Jefferts 1983). Adults and juveniles are most abundant between temperatures of 10°C and 16°C (Roper et al. 1984).

Spawning squid concentrate in dense schools near spawning grounds, but habitat requirements for spawning are not well understood. Spawning occurs over a wide depth range, but the extent and significance of spawning in deep water is unknown. Known major spawning areas are shallow semi-protected near-shore areas with sandy or mud bottoms adjacent to submarine canyons where fishing occurs. In these locations, egg deposition is between five (Jefferts 1983) and 55 meters (Roper and Sweeney 1984), and most common between 20 meters and 35 meters. Off California, squid and squid eggs have been taken in bottom trawls at depths of about 800 meters near Monterey (Bob Leos, California Department of Fish and Game, personal communication) and have been observed at 180 meters near the Channel Islands (Roper and Sweeney 1984).

Attempts to differentiate squid stocks using anatomical and genetic characters have been inconclusive. Thus, the number of market squid stocks or subpopulations along the Pacific Coast is unknown.

1.5.2 Life History

Market squid are small short-lived molluscs reaching a maximum size of 30 cm total length, including arms (Roper and Sweeney 1984). Age and growth studies suggest than some individuals may live up to two years, but most mature and spawn when about one-year-old (Spratt 1979). In the laboratory squid have been reared to maturity and spawned at six months of age. Histological examination of squid testes and ovaries using electron microscopy suggests that squid spawn once over a short time period before dying (Greib 1978; Knipe 1978), although this is a topic of current research and some debate.

Spawning occurs year-round (Jefferts 1983). Peak spawning usually begins in southern California during the fall-spring. Off central California, spawning normally begins in the spring-fall. Squid spawning has been observed off Oregon during May to July. Off Washington and Canada, spawning normally begins in late summer. Year-round spawning likely reduces effects of poor temporary local conditions for survival of eggs or hatchlings. Year-round spawning suggests that stock abundance is not dependent on spawning success during a single short season or a single spawning area.

Males on spawning grounds are larger than females. Males reach 19 cm dorsal mantle length, a maximum weight of 130 g and have larger heads and thicker arms than females. Females reach 17 cm dorsal mantle length and a maximum weight of 90 g. Mating has been observed on spawning grounds just prior to spawning, but may also occur before squid move to the spawning grounds. Males deposit spermatophores into the mantle cavity of females and eggs are fertilized as they are extruded (Hurley 1977). Females produce 20 egg to 30 egg capsules and each capsule contains 200 eggs to 300 eggs that are suspended in a gelatinous matrix within the capsule. Females attach each egg capsule individually to the substrate. As spawning continues, mounds of egg capsules covering more than 100 m^2 may be formed.

Spawning is continuous and eggs of varying developmental stages may be present at one site. Eggs take three months to hatch at 7°C to 8°C, one month at 13°C, and 12 days to 23 days at 10°C (Jefferts 1983). Newly hatched squid (called "paralarvae") are about 2.5 to 3 mm in length and resemble miniature adults. Hatchlings are dispersed by currents, and their distribution after leaving the spawning areas is largely unknown.

Few organisms eat squid eggs although bat stars and sea urchins have been observed doing so (Jefferts 1983). Like northern anchovy and Pacific sardine (Table 1.1.2-1), market squid are probably important as forage to a long list of fish, birds, and mammals including threatened, endangered, and depleted species (Morejohn et al. 1978). Some of the more important squid predators are king salmon, coho salmon, lingcod, rockfish, harbor seals, California sea lion, sea otters, elephant seal, Dall's porpoise, sooty shearwater, Brandt's cormorant, rhinoceros auklet, and common murre.

Squid feed on copepods as juveniles gradually changing to euphausiids, other small crustaceans, small fish, and other squid as they grow (Karpov and Cailliet 1978).

1.5.3 Abundance, Recruitment, and Population Dynamics

Market squid population dynamics are poorly understood. Annual fluctuations in the commercial squid catch (<10,000 tons to nearly 90,000 mt) may reflect squid abundance patterns, but this idea has not been substantiated.

The best information available indicates squid have a very high natural mortality rate (approaching 100% per year) and that the adult population is composed almost entirely of new recruits. No spawner-recruit relationship has been demonstrated. Implications of these ideas are that the entire stock is replaced annually, even in the absence of fishing. Thus, the stock may be dependent on successful spawning each year coupled with good survival of recruits to adulthood. No estimates of MSY are available for market squid. No direct, statistically defendable population estimates are available.

1.5.4 Fishery Utilization

Market squid are harvested commercially primarily off southern and central California although some catch occurs throughout their range. Fishing occurs on spawning grounds and occurs during the spawning season. Peak catches occur off southern California during the winter, off Central California during the late spring and summer, and later in the summer off Oregon to Alaska.

Commercial squid fishing vessels use purse seines primarily, although scoop nets are also used in the southern California fishery. Lights are usually used to bring the squid schools up near the surface where they are more easily captured by seine or scoop net. Purse seines used for squid typically do not hang as deep as purse seines used for other species, so contact with the bottom is reduced. However, squid eggs are occasionally observed in purse seines when the seines contact the bottom. Egg mortality associated with purse seining for squid has not been quantified.

The California squid fishery accounts for most of the coast wide landings. Minor amounts of market squid are landed in Canada, Washington, and Oregon (Table 1.5.4-1). The size of the Mexican fishery is unknown, but is thought to be minor. The California annual squid catch set records of 56 thousand mt, 70 thousand mt, and 80 thousand mt during 1994 through 1996.

In California, most squid marketed for human consumption is frozen, but minor amounts are canned or sold fresh. Historically, the domestic demand for frozen squid has been relatively small, and most of the increased production from California during 1994 through 1996 was frozen and exported to Europe, Spain, and China. Squid is also frozen for bait, supplied to domestic commercial and recreational fishers, and is an important source of live bait for the California recreational fishing industry.

After decades of generally low catches, the market squid fishery increased briefly during the late 1990's because of new (primarily Asian) markets and higher prices. At one point (1997), the market squid fishery was the largest and most valuable in California. However, landings declined during the 1997/98 El Nino when squid became harder to catch and as markets collapsed due to poor economic conditions in Asia. It is not known whether markets are likely to recover and once again support a significant market squid fishery in California.

1.5.5 Current Management

The California squid fishery is perhaps the last major commercial fishery in the U.S. that is largely unregulated. Prior to the 1990s, California squid catches were relatively small (generally <20,000 tons) due to limited markets and regulations controlling the catch were thought unnecessary. Port sampling procedures for gathering biological data from catches were not developed.

In 1993, California passed legislation making it unlawful to display squid attracting lights from a vessel near Halfmoon Bay unless the vessel's primary purpose was to fish for squid.

In 1997, California passed State Assembly Bill AB 364 (the "Sher Bill") that closed areas north of Pt. Conception to squid fishing between noon Friday and noon Sunday and, in effect, expanded the existing weekend closure near Monterey. The Sher Bill established a new squid permit (fee $2,500) for squid vessels and squid light boats with a three-year moratorium on additional permits after April 1, 1998. The moratorium on additional permits is a means of monitoring and managing fishing effort in the California squid fishery. Income generated from the fishery is dedicated to squid research and management. In addition, the Sher Bill gave the California Fish and Game Commission (CDFG) management authority over the squid fishery and gave the California Department of Fish and Game Director authority to establish a squid scientific advisory board and a fishery advisory committee.

Scientific research underway, improvements to squid port sampling, and the moratorium on new squid permits under California state law constitute a plan for stock assessment and close monitoring of fishing effort that will make it possible to manage the California market squid fishery if conditions in the fishery change and active management is required. CDFG is using funds provided by industry to develop port sampling programs and to coordinate a focused and intensive three year research program involving state, federal and academic biologists. Studies underway involve port sampling, age and growth, reproductive biology, stock structure, distribution and habitat utilization, location of fishing areas, characteristics of spawning areas and means to measure and track trends in squid abundance. State law directs CDFG to develop and recommend fishery management options for the squid fishery at the end of the three year research program.

TABLE 1.5.4-1 Landings of market squid (mt per year) in Washington, Oregon, and California during 1981 through 1997. Data for 1997 are preliminary.

Year	California	Oregon	Washington	Total
1981	23,526	0	5	23,531
1982	16,319	51	2	16,373
1983	1,825	135	40	2,000
1984	564	430	13	1,007
1985	10,283	795	1	11,079
1986	21,292	12	5	21,309
1987	19,997	0	4	20,001
1988	37,257	0	1	37,259
1989	40,920	44	1	40,964
1990	28,466	0	0	28,466
1991	37,414	0	0	37,414
1992	13,119	6	1	13,126
1993	42,858	59	5	42,923
1994	55,930	106	4	56,039
1995	70,298	112	12	70,422
1996	80,374	104	5	80,483
1997	70,824	121	1	70,945

1.6 California Current Ecosystem

The California Current is one of the world's four major eastern boundary currents characterized by coastal upwelling, high nutrient levels, and high productivity. High nutrient levels in the California Current result from an influx of high-nutrient, subarctic water, plus upwelling of nutrient-rich water within the system.

1.6.1 Boundaries

The California Current ecosystem is an open system with no clearly defined boundaries and few sharp gradients. The coastlines of Canada, the U.S., and Mexico bound the ecosystem on the east, but the boundary is not distinct, because anadromous and estuarine spawning fish are significant components of the ecosystem and the region's fisheries. The northern boundary is best described by the northern limit of the West Wind Drift, near the northern end of Vancouver Island in British Columbia. The southern boundary is off southern Baja California where the California Current converges with equatorial waters. The offshore boundary of the California Current is usually given as the boundary region between the subarctic water and the eastern north Pacific central water at about 700 km offshore (435 miles; Sverdrup et al. 1942).

Pelagic fish species dominate the exploitable biomass of the California Current ecosystem, with major concentrations close to the coastline. The offshore boundary of the ecosystem for pelagic fish is rather ephemeral and best described by the mean position of the summer wind stress maximum at about 200 km from the continental margin. In the southern California region, the offshore boundary is defined by the western coasts of the Channel Islands. Thus the California Current ecosystem is essentially a region of divergence and upwelling. The offshore area of convergence and downwelling is placed in the Oceanic Pacific ecosystem; the northern area of convergence and downwelling is placed in the Gulf of Alaska ecosystem.

The California Current ecosystem is characterized by a particularly narrow continental shelf and steep continental slope. This is especially true of the area from Cape Blanco, Oregon, to Point Conception, California, where, except in the coastal bight near San Francisco, the shelf is generally narrower than 25 km, and the continental slope varies from about 20 km to 50 km. Off the Pacific Northwest, the topography is less steep, and the shelf and slope widths often exceed 50 km and 70 km. The area off southern California is a classic "continental borderland" of alternating ridges and troughs, with ridges forming islands surrounded by submerged shelves. These large-scale features are punctuated throughout the region by other dramatic features such as deep submarine canyons, steep seamounts and innumerable banks, basins, troughs, and rock piles of a wide range of sizes.

1.6.2 Physical Oceanography

The eastern limb of the North Pacific Subtropical Gyre, off the western U.S. and northern Mexico, forms the California Current. In common with other equatorward eastern boundary currents, the California Current is characterized by a generally sluggish flow with filaments, mesoscale eddies, and counterflows. The large-scale surface flow originates in the subarctic waters at the northern boundary, and subarctic characteristics (temperature and nutrient levels) persist in the northern portions of the system. Underlying the surface flow is a poleward undercurrent, and often during periods of reduced upwelling, an inshore countercurrent. Upwelling of deeper subarctic water along the continental margin helps maintain a general subarctic character in the surface layers of much of the system. The southern, tropical margin of the system has a net equatorward outflow, but a nearshore, poleward flow of subtropical water along Baja California results in a strong subtropical influence in the nearshore region south of Point Conception, California.

The ecosystem is heavily influenced by wind-induced coastal upwelling, with the most intense upwelling centered near Cape Mendocino in northern California during the spring and summer. The cool core of upwelled water near the coast is most pronounced in summer, when it occurs from near Cape Blanco along the northern and central California coasts and extends in a plumelike structure to the southwest of Point Conception. A secondary upwelling zone occurs off Baja California, with a springtime, local maximum near Punta Baja.

The Mexican and southern California sections of the California Current are characterized by nearly continuous, low-intensity upwelling that is interrupted only by brief, though often intense, atmospheric disturbances. From Point Conception to Cape Blanco, the region of maximum upwelling, upwelling is intense in spring and early summer; in winter, storms cause alternating periods of onshore and offshore transport. In winter, the typical wind systems cause a predominance of upwelling in the Point Conception area. This upwelling weakens to the north and progressively changes into a predominance of downwelling in the region north of Cape Blanco. Upwelling occurs during the summer in the region between Cape Blanco and Vancouver Island; however, the seasonal latitudinal shifts of the Pacific Basin's atmospheric pressure systems and intense winter storms result in a net annual onshore transport in this region. Offshore transport occurs only intermittently to the north of Vancouver Island.

The combined effects of the southerly surface currents and coastal upwelling result in cool sea-surface temperatures over most of the northern part of the California Current. Winter sea-surface temperatures off Vancouver Island average 8°C and increase southwards to 22°C in southern Baja California. Summer sea-surface temperatures in the region of maximum upwelling, from Cape Blanco to Point Conception, are particularly cool. July sea-surface temperatures in the nearshore areas of northern California average less than 12°C, which is slightly colder than the July sea-surface temperatures in the northernmost Gulf of Alaska. Mean summer sea-surface temperatures are above 14°C in the region between Cape Blanco and Vancouver Island.

Seasonal and interannual environmental variability within the California Current ecosystem are associated with variations in the Pacific Basin atmospheric pressure systems, which control the local winds and Ekman transport and affect flows of the equatorward California Current, the poleward undercurrent and the inshore countercurrent. Variations on time scales of several years are associated with alterations in the tropical pressure system, i.e., the El Niño/Southern Oscillation phenomenon. El Niño events markedly increase temperature and alter the flow of currents in the California Current.

1.6.3 Biology and Ecology

The California Current comprises four relatively distinct, though related, ecological components: the pelagic, the littoral, the demersal, and the anadromous. The component of most concern to the present FMP is the pelagic, which encompasses the offshore surface water layer and the species therein, including coastal pelagic fish (northern anchovy, Pacific sardine, Pacific herring, jack mackerel, Pacific (chub) mackerel, bonito, and saury), squids, seabirds, pinnipeds (sea lions and fur seals), and cetaceans (porpoises and whales). Most of the forage produced in the California Current ecosystem (i.e., phytoplankton and zooplankton) comes from the pelagic component.

The exploitable biomass of fish in the ecosystem is dominated by the pelagic component. As in the other major eastern boundary currents, anchovy, sardine, whiting, jack mackerel, and Pacific (chub) mackerel achieve the largest populations. These populations are extremely important to the trophic dynamics of the entire California Current ecosystem; anchovy and sardines are the only fish in the ecosystem that consume large quantities of primary production (phytoplankton), and all five of the species are significant consumers of zooplankton. All five species, particularly mackerels and whiting, are important predators of the early stages of other fish. The juvenile stages of all five species, and in many cases the adults, are important as forage for seabirds, pinnipeds, cetaceans, and other fish.

Trophic interactions between CPS and higher-trophic-level fish are poorly understood, and it is unknown if populations of individual predaceous fish are enhanced or hindered by large populations of CPS. It is not known if the value of CPS as forage to adult predators outweighs the negative effects of predation by CPS on predator's larvae and juveniles plus competitive removal of phytoplankton, zooplankton, and other fish.

1.6.4 Climate and Distribution of Species

Fish that dominate the pelagic component of the California Current ecosystem are all warm-temperate or subtropical species that have their centers of reproduction in the southern portion of the system. These fish are unable to complete the early stages of their development at temperatures much below 13°C, with the exception of Pacific whiting, whose minimum is about 10°C. Much of the region north of Point Conception, California, is seasonally outside the range of acceptable temperatures for early stages of CPS species. The region of maximum upwelling (Cape Blanco, Oregon, to Point Conception, California) is particularly unfavorable to early stages of CPS, because the summer winds and upwelling peak cause low temperatures and extensive offshore transport (Parrish et al. 1981). Although the region is relatively unfavorable for reproduction of the major pelagic fish, adults and subadults use the region extensively for feeding. Sardine and whiting, in particular, migrate across the region to feed in the northern section of the current system and to spawn in the Southern California Bight.

In comparison with the region of maximum upwelling, the Pacific northwest region (Vancouver Island to Cape Blanco) is more favorable for the reproduction of coastal pelagic fish, because coastal upwelling is weaker and of shorter duration; the period of favorable temperatures is longer; summer temperatures are warmer; and the Columbia River Plume provides nutrients that contribute to a favorable spawning environment. Separate stocks of Pacific whiting (Bailey et al. 1982) and anchovy (Parrish et al. 1981) occur in the region, and before its population collapse, sardine commonly spawned in the region (Walford and Mosher 1941). The present biomass of CPS stocks in the Pacific northwest is, however, considerably smaller than the biomass of CPS stocks that spawn off of southern California and northern Baja California.

This distribution and abundance of CPS could change with relatively minor climatic change. Colder sea-surface temperatures of only one or two degrees during the spring and summer could greatly reduce the biomass of the resident whiting or anchovy stocks in the Pacific northwest by lowering temperatures below the tolerance limits of the early life-history stages or by shifting the stocks southward. Conversely, warmer spring and summer temperatures could make the region a prime spawning habitat for the entire pelagic complex. There is some evidence that pelagic fish were much more abundant in the northern portion of the

California Current ecosystem during warm periods. Anchovies were very abundant in Puget Sound during the warm 1890s (Swan 1893). Pacific (chub) mackerel and jack mackerel were very abundant in the region during the 1982 through 1983 El Niño (Pearcy et al. 1985). Sardines were very abundant in Puget Sound during the warming of the 1930s (Lluch-Belda et al. 1989).

The southernmost region in the California Current ecosystem off southern Baja California contains stocks of CPS that are somewhat independent of those farther north. These southern stocks, which occur at the warm end of temperature tolerance limits, are characterized by a young age at maturity, high mortality rates, and much lower growth rates than the dominant stocks that spawn off northern Baja California and southern California.

1.6.5 Perspective on Instability of Pelagic Fish Populations and Fisheries

From a fisheries perspective, the most significant characteristic that CPS have in common is their propensity for rapid change (Lluch-Belda et al. 1989). Population size of individual stocks, biomass of some key species, and fishery yields have changed greatly since the inception of major fisheries on CPS in the 1930s. Populations of sardines and Pacific (chub) mackerel have been particularly variable, with biomass levels declining to considerably less than one percent of maximum levels.

There is evidence that CPS abundance varied considerably before the inception of modern fisheries (Soutar and Issacs 1969, 1974), and such variation is expected to depend heavily on environmental conditions. Fishing probably has exacerbated the natural variability in recent decades, because reduced stock size and loss of old fish increase the speed and magnitude of population decreases during periods of poor reproduction. In addition, the probability of stock collapse is exacerbated, because fish in a highly exploited stock may not live long enough to successfully reproduce. Fishery management approaches based on equilibrium or steady-state concepts that ignore variability in abundance have a long history of failure for CPS in many regions of the world (Troadec et al. 1980).

A second feature that will severely affect fishery yields is the geographical expansion and contraction of range associated with changes in the size of CPS populations (MacCall 1990). Geographic range typically expands when abundance increases and contracts when abundance decreases; thus, a species may become unavailable at the edge of its range during a period of low abundance. In contrast, density at the center of the distribution tends to remain rather constant, so catch rates do not decline as fast as abundance. This characteristic has been an important part of the decline of several CPS fisheries, including the fishery for Pacific sardine.

It should be realized that no management regime will produce stable yields for individual CPS species. Biomass of any species managed under this plan may decline to low levels for extended periods, and periods of low biomass will probably occur more frequently for longer periods of time and be more intense under exploitation. Consequently, managers of CPS should expect considerable interannual variation in abundance and yields, and plan to curtail fisheries during periods of low abundance to protect the reproductive capacity and long-term health of the CPS stocks.

1.7 Marine Mammal Predators

CPS are eaten by a number of marine mammals (Table 1.7-1), although their importance as forage varies from predator to predator. A great deal of information is available about the diets of marine mammals, and the total amount of CPS eaten per year has been estimated for a few. It is not currently possible, however, to estimate the total amount of CPS used as forage by all marine mammals in the California Current ecosystem, or the size of CPS populations necessary to sustain predator populations.

1.7.1 Management of Marine Mammals

Marine mammal management is based on the Marine Mammal Protection Act of (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973. Under the MMPA, marine mammals whose abundance falls below the optimum sustainable population level (the number of animals at which productivity is maximum, usually regarded as 60% of carrying capacity or maximum population size) can be listed as depleted. Under the ESA, species in danger of extinction throughout all or a significant portion of their range can be listed as endangered, and species likely to become endangered in the foreseeable future can be listed as threatened.

Populations listed as threatened or endangered under the ESA are automatically depleted under the terms of the MMPA. Fisheries that interact with species listed as depleted, endangered, or threatened may be significantly affected under the terms of the ESA and MMPA.

1.7.2 Northern Fur Seal

The California Current ecosystem is an important feeding and breeding ground for northern fur seals (*Callorhinus ursinus*). The total population of northern fur seals in 1983 was estimated to be 1.2 million (Fowler, in press). A small population of 5,000 to 7,000 breeds on San Miguel Island in the Channel Islands; the remainder breed in Alaska and Asia. Northern fur seals are found offshore, most densely along and just beyond the continental shelf from Washington through southern California. Northern fur seals that breed on San Miguel Island forage offshore over the continental shelf between San Miguel Island and Point Conception (Antonelis et al. 1980). Between December and May of each year, the resident population in California is joined by approximately 400,000 adult females from the breeding population at the Pribilof Islands in the Bering Sea.

The abundance of northern fur seals is approximately 50% as high as in the 1950s and 1960s, and northern fur seals are classified as a depleted species under the MMPA. The most useful index of population size is the number of pups born at various rookeries. On St. Paul Island in the Bering Sea, where most of the Pribilof population breeds, pup numbers declined from about 451,000 animals in 1950 to 182,000 in 1985 (Fowler, in press). Reasons suggested for the decline include harvest of adult females between 1956 to 1968 and increased natural mortality at sea beginning in the mid 1960s. Other possible causes under investigation include entanglement in man-made debris, incidental take in drift gill net fisheries, and possible competition with commercial fisheries for prey fish.

Feeding habits of northern fur seals are well known (Mead 1953; Kajimura 1984; Antonelis and Perez 1984; Loughlin and Livingston 1986; Sinclair 1988). Fur seals prey on pelagic schooling fish, squid, and, to a lesser extent, demersal fish. Fur seals probably preyed extensively on sardines when they were abundant along the Pacific coast.

Fur seals prey on CPS covered by this management plan, most heavily on anchovy, followed by jack mackerel, and Pacific (chub) mackerel. Anchovy was the most important prey (43% of the diet) for fur seals in California waters during 1984 (Antonelis and Perez 1984). About 21,000 mt of anchovy were consumed off California between January and June, with peak consumption from January through March. Off Oregon and Washington, anchovy was the third prey species in order of importance (11% of the diet) after herring and rockfish. About 4,000 mt of anchovy were consumed between January and June, with peak consumption during February through April. Northern fur seals are estimated to eat about 700 mt of jack mackerel per year (one percent of the diet) off California. Northern fur seals in Oregon and Washington did not eat jack mackerel.

1.7.3 California Sea Lion

California sea lions (*Zalophus californianus*) are found in coastal waters of the Pacific Ocean from southern Mexico to southern Canada. California sea lions breed on islands off southern California and Baja California, as well as in the Gulf of California. The U.S. population is growing at 11% a year and currently numbers about 100,000 to 114,000; the population off western Baja California is stable at 68,000 to 78,000 (Lowry, in preparation). Severe reductions in abundance of California sea lions occurred during the 19th and early 20th centuries. In 1928, Bonnot (1928) counted 1,429 in California. California sea lions are not listed as depleted, threatened or endangered.

During the summer breeding season, virtually all adults are present near rookeries. Males migrate northward in the fall, with the oldest going as far as British Columbia, then back to their rookeries in the spring. Adult females generally do not migrate away from rookery areas. Juveniles remain near rookery areas or move into waters off central California.

Diet studies indicate that California sea lions off southern California eat northern anchovy, jack mackerel, Pacific (chub) mackerel, sardine, other species of fish, and cephalopods (Antonelis et al. 1984; Lowry et al. 1990, 1991). Northern anchovy is eaten more frequently than any other prey. Jack mackerel and Pacific (chub) mackerel are also common prey. At this time, sardine is not eaten in significant quantities, but its occurrence in the diet of California sea lions increased after 1987 as sardine biomass increased (Lowry et al.

1991). The sea lions' diet in southern and central California varies seasonally and yearly depending on abundance and availability of prey (Ainley et al. 1982; Antonelis et al. 1984; Lowry et al. 1990, 1991). No estimates of consumption of individual prey species are available.

1.7.4 Northern (Steller's) Sea Lion

The northern, or Steller's, sea lion (*Eumetopias jubatus*) inhabits coastal waters from central California to the Aleutian Islands in the Bering Sea off Alaska and across the north Pacific to the Kuril Islands in the Okhotsk Sea off Japan. The center of the northern sea lion's distribution is the Gulf of Alaska and Aleutian Islands. Off California, northern sea lions breed at Año Nuevo Island, the Farallon Islands, Sugarloaf Island (Cape Mendocino), and St. George Reef (near Crescent City). Off Oregon, northern sea lions breed at Rogue Reef and Orford Reef. Northern sea lions do not breed in Washington waters, although a few hundred animals haul out along the coast year-round. Male sea lions, along with some adult females and juveniles, disperse away from rookeries after the summer breeding season; adult females with pups remain near the rookeries year-round.

Northern sea lions are listed as depleted under the MMPA and as threatened under the ESA. The population has declined over the last 30 years throughout its range, with major reductions from the Gulf of Alaska to the Kuril Islands (Merrick et al. 1987; Loughlin and Merrick 1989). Numbers of juveniles and adults in the Kuril Islands declined 74% between 1969 and 1989. Off Alaska, the number of juveniles and adults declined 80% between the late 1950s and 1990s, and as much as 91% in some areas (Merrick et al. 1987, 1991; Loughlin et al. 1990). Numbers of northern sea lions at rookeries off Oregon are stable; in California they have declined, especially in the southern part of the range. Northern sea lions no longer use San Miguel Island as a rookery; none have been observed there since 1983. Año Nuevo Island, off the central California coast, is now the southernmost rookery.

Declines in abundance of northern sea lion may be due to natural factors or human activities. Insufficient data are available to evaluate the importance of environmental factors. It is likely, however, that declines were at least partly due to commercial harvests, sea lion control programs, fisheries, and subsistence hunting. Development and expansion of commercial fisheries throughout the animals' range may have reduced or altered food supplies.

Northern sea lions in central California mostly eat Pacific whiting, rockfish, flatfish, cusk-eels, and cephalopods, as well as small quantities of anchovy and jack mackerel, and probably sardines when available.

1.7.5 Harbor Seal

Harbor seals (*Phoca vitulina*) are distributed along the coast and offshore islands from the northern region of western Baja California, Mexico, to Alaska. The population in 1986 was estimated to be at least 25,000 animals off California, and 11,000 off Oregon and Washington (Boveng 1988). Harbor seal populations are increasing in Washington and Oregon. Huber (1992) estimated that there were about 30,000 harbor seals in Washington waters during 1991 and about 7,000 in Oregon. Current abundance relative to historical levels is unknown. Harbor seals are not listed as depleted, threatened, or endangered.

Off southern California, harbor seals eat rockfish, cusk-eels, plainfin midshipman, shiner surfperch, octopus, and flatfish. Infrequently they eat jack mackerel, other fish, and squid (Stewart and Yochem 1985). Anchovies in estuaries along the coast of Oregon and Washington are one of the most important prey for harbor seals throughout the year; many other species of schooling and demersal fish are also eaten (Tracey 1985).

1.7.6 Guadalupe Fur Seal

Guadalupe fur seals (*Arctocephalus townsendi*) breed only on Guadalupe Island, Mexico. They are occasionally found at San Miguel Island, San Nicolas Island, and San Clemente Island off California and have been seen near San Francisco. During the last census conducted during the breeding season in 1984, 1,600 fur seals were counted (Seagars 1984).

Historically, Guadalupe fur seals were very abundant, but the population was reduced to a few animals by commercial sealers in the 19th century. Currently, the population at Guadalupe Island is increasing, and the animals are not listed as depleted, threatened, or endangered.

No data are available on the diet of Guadalupe fur seals, but it is assumed that they (like northern fur seals and California sea lions) eat anchovy, Pacific whiting, jack mackerel, Pacific (chub) mackerel, other small schooling fish, and squid.

1.7.7 Northern Elephant Seal

Northern elephant seals (*Mirounga angustirostris*) breed on islands off central Baja California, Mexico, north to the Farallon Islands off California and on isolated and protected beaches of central California. Major rookeries in the U.S. are located at San Miguel Island and San Nicolas Island off southern California.

The population is growing at an annual rate of 8.4%. There are an estimated 35,000 elephant seals in Mexico, 74,000 in the United States, and 109,000 in total (Barlow et al., 1997). The population was nearly extinguished in the 19th century by commercial sealers. The current population is descended from about 50 individuals that bred on Guadalupe Island (Le Boeuf and Bonnell 1980). Northern elephant seals are not listed as depleted, threatened or endangered.

Adult males forage in the Gulf of Alaska and eastern Aleutian Islands. Adult females forage off Oregon and Washington as far as 1,900 km offshore (Stewart and DeLong 1991). Northern elephant seals feed on a variety of prey including squids, fish, crustaceans, and tunicates in several oceanic habitat zones (Antonelis et al. 1987). Stomach contents of stranded juveniles in the Southern California Bight contained small quantities of anchovy (Hacker 1986).

1.7.8 Bottlenose Dolphin

Two forms of bottlenose dolphins (*Tursiops truncatus*) exist: a coastal form and an offshore form. The coastal form ranges as far north as Monterey Bay (Wells et al. 1990); the offshore form's range is unknown. The population of the coastal form from La Jolla to San Pedro, California, was estimated at 173 to 240 (Hansen 1990). The offshore form in California waters during 1991 was estimated (preliminary figures) to number 2,400 in summer and fall and 3,800 in winter and spring (Barlow et al., 1997). Bottlenose dolphins in California are not listed as depleted, threatened, or endangered.

The primary prey of coastal bottlenose dolphins in California are fish and invertebrates inhabiting the littoral and sublittoral zones. Croakers and surfperch make up the bulk of the diet, and jack mackerel is a minor component (Walker 1981). The offshore form in California was observed feeding on anchovies near San Clemente Island (Leatherwood 1975).

1.7.9 Pacific White-Sided Dolphin

Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) are found on continental slope and offshore zones of the northeastern Pacific and Gulf of Alaska from about 20° N latitude to 61° N latitude (Leatherwood and Walker 1982). Resident populations in the Southern California Bight and western Baja California, Mexico, are augmented by an influx of animals from outside the area from October through February; in summer these migrants disperse west and north. The resident population off California during 1991 (preliminary figures) was estimated at 11,000 in summer and fall and 44,000 in winter and spring (Barlow et al., 1997). Pacific white-sided dolphins in California are not listed as depleted, threatened, or endangered.

Pacific white-sided dolphins primarily eat small schooling fish and cephalopods from the epipelagic and mesopelagic zones. Northern anchovy appear to be important, but jack mackerel, Pacific (chub) mackerel, and sardines are also eaten (Walker et al. 1984).

1.7.10 Common Dolphin

Common dolphins (*Delphinus delphis*) are found from 36° N latitude to south of the equator and offshore to 132° W longitude (Leatherwood et al. 1982). Common dolphins are the most abundant cetacean in waters off California. Two forms of this species occur in California waters: the short-beaked form and the long-beaked form (Heyning and Perrin 1991). The long-beaked form inhabits coastal waters shallower than 100 fathoms and is usually found within 100 nautical miles of shore. The short-beaked form can be found from the coastline to thousands of miles offshore. Combined abundance of common dolphin off California during 1991 (preliminary figures) was estimated at 265,000 individuals during winter and spring and 450,000 individuals during summer and fall (Barlow, in preparation; Forney, in preparation). Common dolphins in California are not listed as threatened or endangered.

Common dolphins off southern California eat northern anchovy in the fall and winter and deep-sea fish in spring and summer (Leatherwood et al. 1982).

1.7.11 Harbor Porpoise

Harbor porpoise (*Phocoena phocoena*) are distributed from Point Conception, California, to Alaska (Leatherwood et al. 1982). Most are found in water no deeper than 18 m (10 fathoms) although individuals have been observed in water as deep as 183 m (100 fathoms). Harbor porpoise off California, Oregon, and Washington in 1985 were estimated to number 45,713 (Barlow 1988). Harbor porpoise in California are not listed as depleted, threatened, or endangered.

In general, harbor porpoise prey on a variety of cephalopods and fish, especially schooling fish such as anchovy, shad, herring, mackerel, sardines, pollock, and whiting (Leatherwood et al. 1982; Jones 1981). Off California they eat mostly fish such as juvenile rockfish, anchovy, Pacific whiting, and Pacific tomcod (Jones 1981). Off Washington, harbor porpoise prey on Pacific herring, smelt, and market squid (Gearin and Johnson 1991).

1.7.12 Dall's Porpoise

Dall's porpoise (*Phocoenoides dalli*) are distributed from California to Alaska. Off California, Dall's porpoise are found along the coast as far south as the Channel Islands and in water deeper than 100 fathoms (Leatherwood et al. 1982). From late October to late May, individuals move south and inshore along the coasts of California and Baja California to Cedros and Guadalupe islands. The southward movement past Point Conception is greatest in cold-water years. Abundance of Dall's porpoise off California in spring 1991 (preliminary figures) was estimated as 4,800 during winter and spring and 27,000 during summer and fall (Barlow, in preparation; Forney, in preparation). Dall's porpoise in California are not listed as depleted, threatened, or endangered.

Dall's porpoise feed on squid, crustaceans, and such fish as anchovy, myctophids, saury, whiting, herring, jack mackerel, and Pacific (chub) mackerel (Norris and Prescott 1961; Stroud et al. 1981; Leatherwood et al. 1982). In southern California, they eat anchovy, saury, whiting, and squid (Stroud et al. 1981).

1.7.13 Fin Whale

In winter, fin whales (*Balaenoptera physalus*) are distributed from central California to Cabo San Lucas, Baja California, outside the Channel Islands and farther offshore (Leatherwood et al. 1982). In summer, they range from central Baja California to the Bering Sea. The entire north Pacific population is estimated at about 16,000 (Leatherwood et al. 1982). Fin whales off California during the summer and fall of 1991 (preliminary figure) were estimated to number 800 (Barlow, in preparation). The fin whale was once very abundant, but commercial whaling reduced the population to very low numbers, and the fin whale is now listed as an endangered species.

Fin whales are known to feed on anchovy, krill, herring, pollock, capelin, lanternfish, and squid (Rice 1977; Leatherwood et al. 1982).

1.7.14 Humpback Whale

During the summer, humpback whales (*Megaptera novaeangliae*) are found over the continental slope from Point Conception to Alaska and Japan. Three stocks, defined by wintering grounds, are recognized 1) Asian, 2) Hawaiian, and 3) Mexican. The Mexican stock winters in southern Baja California, off the mainland near Manzanillo, off Islas Tres Marias, in the Gulf of California, and off the Revillagigedo Islands (Urban and Aguayo 1987). Humpback whales off California during 1991 (preliminary figures) were estimated to number 400 during winter and spring and 700 during summer and fall (Barlow, in preparation; Forney, in preparation). Another estimate for 1991, by photo-identification techniques, was 500 to 1,000 individuals (J. Calambokitis, Cascadia Research Collective, Olympia, Washington, personal communication).

There were about 15,000 humpback whales in the north pacific before 1905 (Leatherwood et al. 1982). Commercial whaling reduced the population to very low numbers, and the humpback whale is now listed as an endangered species.

Humpback whales are known to feed on anchovy, herring, juvenile rockfish, and euphausiids (Brownell 1964; Rice 1977; Dohl et al. 1983; Kieckhefer 1991). Anchovy is common in the diet of humpback whales in California (Rice 1977).

1.7.15 Sei Whale

Sei whales (*Balaenoptera borealis*) are a pelagic temperate-water species. In winter, they are sparsely distributed from central California to the Revillagigedo Islands, Mexico. In summer, they are found west of the Channel Islands, California, to the Gulf of Alaska (Leatherwood et al. 1982). Sei whales are present off central California in considerable numbers in late summer and early fall.

When sei whales were first heavily exploited by commercial whalers in 1963, there were an estimated 42,000 in the north pacific (Tillman 1977). This number was reduced to 8,600 by 1974 (20% of the original pre-exploitation estimate). The sei whale is listed as an endangered species.

Sei whales feed on anchovy, sardine, rockfish, sauries, jack mackerel, and krill (Brownell 1964; Rice 1977; Leatherwood et al. 1982). From June through August the dominant food of sei whales off California is anchovy; in September and October, their main food is krill (Rice 1977). Sardine and jack mackerel are a minor component in their diet.

1.7.16 Minke Whale

Minke whales (*Balaenoptera acutorostrata*) are sparsely distributed from the Bering and Chukchi seas to the equator (Leatherwood et al. 1982). During 1991 Minke whales (preliminary figures), were estimated to number 100 in winter and spring and 200 in summer and fall (Barlow, in preparation; Forney, in preparation). Minke whales in California are not listed as threatened or endangered.

Minke whales prey on krill, copepods, and schooling fish such as herring, anchovy, and sand lances (Leatherwood et al. 1982; Dorsey et al. 1990).

TABLE 1.7-1. References describing diets of marine mammals that eat northern anchovy, Pacific sardines, Pacific (chub) mackerel, jack mackerel, and market squid.

Marine Mammal	Anchovy	Sardine	Pacific (chub)	Jack Mackerel
CETACEANS (whales, dolphins				
Tursiops truncatus	20			18
Lagenorhynchus obliquidens	8,9,10,11	8	1,6,7,8	6,7,8,9
Delphinus delphis	4,10,19	4		
Phocoena phocoena	9	19		
Phocoenoides dalli			4,6	19
Megaptera novaeangliae	1,5,17,22			
Baleanoptera acutorostrata	19			
Balaenoptera borealis	5,17,19	5		19
Balaenoptera physalus	5			
PINNIPEDS (seals and sea lions):				
Callorhinus ursinus	3,6,7,9		3	
Arctocephalus townsendi	3		3	
Zalophus californianus	2,3,9,13,14	14	2,3,13,14	2,3,9,13,14
Eumetopias jubata	9			9,21
Mirounga angustirostris	3,23	3		
Phoca vitulina	15			16

TABLE 1.7-1 References:

1. Dohl et al. 1983
2. Antonelis et al. 1984
3. Antonelis and Fiscus 1980
4. Norris and Prescott 1961
5. Rice 1977
6. Stroud et al. 1981
7. Kajimura et al. 1980
8. Walker et al. 1984
9. Jones 1981
10. Fitch and Brownell 1968
11. Fiscus and Niggol 1965 (see also Jones 1984)
12. Hacker 1986
13. Lowry et al. 1990
14. Lowry et al. 1991
15. Beach et al. 1981
16. Stewart and Yochem 1985
17. Brownell 1964
18. Walker 1981
19. Leatherwood et al. 1982
20. Leatherwood 1975
21. Spalding 1964
22. Kieckhefer 1991

1.8 Seabird Predators

Pelagic, schooling fish are key components of marine food webs and primary prey of many seabirds. CPS are important to seabirds, because of their abundance near the sea surface (which is high relative to other sources of food), relatively small size, fusiform shape, and dense concentration. Seabird populations of the California Current system, and other eastern boundary currents, are large relative to areas not driven by large-scale coastal upwelling.

Two important groups of seabirds feed on coastal pelagic fish: year-round residents and seasonal residents that breed elsewhere, migrate long distances between areas, and seasonally tap the rich food supplies available in the California Current. The biomass of seasonally resident seabirds in the California Current greatly surpasses that of permanent residents (Briggs et al. 1987). Seasonal migrants can raise California seabird populations from about two million to seven million birds (Briggs and Chu 1987).

Food is not the only factor that affects abundance of seabirds. Eastern boundary currents, such as the California Current, have abundant fish but few small islands (Parrish et al. 1982). Thus, maximum abundance of year-round residents probably depends more on the availability of island breeding space than on food supplies (Ainley and Boekelheide 1990).

Abundance and reproductive success in seabird communities in eastern boundary current systems are sensitive to fluctuations in prey availability even though maximum abundance of permanent residents depends on breeding space. Seabirds switch from one prey species to another as availability changes seasonally or from year to year. Although anchovies, herring, and market squid are currently the primary year-round forage of seabirds off central California (Baltz and Morejohn 1977; Briggs and Chu 1987; Ainley, Point Reyes Bird Observatory, unpublished data), euphausiids and juvenile Pacific whiting are important in spring, and juvenile rockfish during the summer chick-rearing season. When juvenile rockfish are not available in summer, many seabirds switch to anchovies. When suitable forage is not available, breeding efforts fail (Ainley and Boekelheide 1990). This has occurred in the recent past only during El Niño and El Niño-like events (i.e., 1973, 1976, 1978, 1982 through 1983, and 1986) (Ainley and Boekelheide 1990).

The best example of how the availability of pelagic fish species affects reproductive success and abundance of seabird populations in eastern boundary current areas comes from the Peru and Benguela currents. The commercial importance of seabird guano in these areas led to intensive efforts to understand trophic relationships between seabirds and fish. In the Benguela region, fishing pressure on sardines and anchovies reduced their abundance and caused seabirds to switch to more abundant prey species not exploited by the fishery (Crawford and Shelton 1978). In some cases, the switch in forage changed the breeding distributions of seabirds. Later, when the initially unharvested species were also fished down, seabird populations declined.

In Peru, a well-documented case, the decline in abundance of the anchoveta and the collapse of the fishery in 1972 was accompanied by reduced seabird populations (Idyll 1973; Glantz and Thompson 1981; Tovar et al. 1987). Some seabirds later increased to the south off Chile as sardines increased there.

In the North Sea, which is not an eastern boundary area, intense fishing on herring, mackerel, and cod led to an increase in their prey (sand eels) and a subsequent increase in seabirds. After sand eels were heavily fished, seabird populations declined as well (Furness and Ainley 1984).

1.8.1 Coastal Pelagic Species as Forage for Seabirds

CPS are consumed by a large number of seabirds off the coasts of California, Oregon, and Washington (Table 1.8.1-1). One shortcoming in the available data is that most studies were conducted during the summer, when adult seabirds were feeding their young (diet data are relatively easy to collect during the feeding period). There is a paucity of diet data for other periods when CPS might be important as forage. Another shortcoming is that most of the available data were collected during the last 30 years when sardines were not abundant or available to seabirds.

Availability of anchovies is known to directly affect the breeding success of pelicans (Anderson et al. 1982), terns (Schaffner 1982), gulls (Hunt and Butler 1980; Ainley and Boekelheide 1990), and auks (Hunt and Butler 1982; Ainley and Boekelheide 1990) in the California Current region. It is likely that many predators of anchovies will also eat sardines when that population increases.

Owing to their size and occurrence near the surface, Pacific (chub) mackerel are likely to be important to seabirds, especially in southern California. Pacific (chub) mackerel have been observed in the diet of pelicans (D.W. Anderson, Department of Fisheries and Wildlife Biology, University of California, Davis, California, personal communication).

Jack mackerel are probably not important to seabirds, because of their large size and relatively deep schooling habits (MacCall et al. 1980). Studies of seabird diet during autumn, however, when small jack mackerel are nearshore and more available, may indicate their seasonal importance as forage. Baltz and Morejohn (1977) found jack mackerel in the winter diet of murres in Monterey Bay. Much of the data on seabird prey come from identification of otoliths in semidigested gut contents, but mackerel otoliths are small, fragile, and hard to detect in stomach samples. The importance of mackerel may, therefore, be underestimated.

Historically, sardines were probably important as forage for seabirds (Ainley and Lewis 1974). Recently, however, sardines have been too sparse to affect reproductive success of most seabirds. The loss of sardines during the mid 1900s shifted the breeding distribution of pelicans (MacCall 1984). As their abundance increases, sardines will probably again become important forage for marine birds. Recent increased abundance of sardines off southern California was followed by increased breeding success and abundance of brown pelicans (Ainley and Hunt 1991).

TABLE 1.8.1-1. Seabird species of the West Coast known to forage on anchovy, sardine, Pacific (chub) mackerel, or market squid. Endangered species (ES) and threatened species (TS) are indicated.

	Forage Species		
Seabird	Anchovy	Sardine	Pacific (chub)
GREBES & LOONS			
Gavia pacifica		*	
Podiceps grisegena		*	
PETRELS & ALBATROSSES			
Diomedea nigripes	*		
Fulmarus glacialis		*	
Puffinus griseus		*	*
Puffinus creatopus		*	
Puffinus tenuirostris		*	
Puffinus opisthomelas		*	

TABLE 1.8.1-1. Seabird species of the West Coast known to forage on anchovy, sardine, Pacific (chub) mackerel, or market squid. Endangered species (ES) and threatened species (TS) are indicated.

		Forage Species		
Seabird		Anchovy	Sardine	Pacific (chub)
Oceanodroma leucorhoa			*	
Oceanodroma homochroa			*	
Oceanodroma melania			*	
PELICANS & CORMORANTS				
Pelecanus occidentalis(ES)		*	*	*
Phalacrocorax auritus			*	*
Phalacrocorax penicillatus			*	
Phalacrocorax pelagicus			*	
GULLS				
Larus glaucescens			*	
Larus occidentalis			*	
Larus heermanni			*	
Larus delawarensis			*	
Larus californicus			*	
Larus canus			*	
Larus philadelphia			*	
Rissa tridactyla			*	
TERNS				
Sterna elegans			*	
Sterna caspia			*	
Sterna forsteri			*	
Sterna albifrons	(ES)		*	
AUKS				
Uria aalge			*	
Uria lomvia			*	
Cepphus columba			*	
Fratercula cirrhata			*	*
Cerorhinca monocerata			*	*
Brachyramphus marmoratus	**(TS)**		*	
Synthliboramphus antiquus			*	
Synthliboramphus craveri		*		
Synthliboramphus hypoleuca			*	
Ptychoramphus aleuticus			*	
RAPTORS				
Haleaetus leucocephalus	(ES)		*	
Pandion haliaetus			*	

2.0 FISHERY COMPONENTS

West Coast coastal pelagic species (CPS) fisheries are described in this section. The inshore component of the CPS fishery has historically been most important in harvesting CPS. This component involves both commercial and recreational fishing, but consists primarily of small commercial vessels that operate off southern California and take CPS in directed fishing with round haul gear or as bycatch with other types of gear. The following describes CPS landings trends, characterizes harvesters and processors of CPS, and describes recreational and Mexican fishery components.

2.1 Inshore Component

The inshore component includes fisheries for Pacific sardine (*Sardinops sagax*), jack mackerel (*Trachurus symmetricus*), Pacific (chub) mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), market squid (*Loligo opalescens*), and other pelagic species (jointly referred to as coastal pelagic species, or CPS). Although market squid will not be actively managed at the outset of the CPS fishery management plan (FMP), it is included in this description because (1) squid is an important source of income for many round haul vessels that also target CPS; and (2) the squid fleet includes fishers who were formerly involved in the sardine fishery, and might wish to resume participation in that fishery as it recovers. The fisheries for CPS and squid are concentrated in California. CPS fishing also occurs, however, in Oregon, Washington, and Mexico.

2.1.1 History of Landings and Regulations

Commercial landings of CPS and squid in the U.S. are monitored (as are most finfish and shellfish landings) via information from landings receipts provided by processors in the form of "fish tickets". CDFG conducts a port sampling program to estimate the species composition of mixed loads of sardine, Pacific (chub) mackerel and jack mackerel, which are otherwise reported as "unspecified mackerel" on fish tickets. Table 2.1.1-1, which describes commercial landings of CPS and squid from 1916 to 1997, is based on fish ticket data adjusted using port sampling information to more accurately reflect the species composition of mixed loads. Landings of CPS in California fluctuated widely during 1916 to 1997 (Table 2.1.1-1), in response to changes in abundance and market conditions. The CPS fisheries are currently in a period of transition. Sardines are showing signs of recovery after the fishery's collapse in the 1940s, with an apparent population increase of 30% to 40% per year over the past decade. Market squid landings have increased over the same period, reaching a record high of 80,319 mt in 1996. In contrast, market and biological conditions are contributing to declining landings of anchovy and Pacific (chub) mackerel.

2.1.1.1 Pacific Sardine

The sardine fishery developed in response to an increased demand for protein products that arose during World War I. The fishery developed rapidly and became so large that by the 1930s sardines accounted for almost 25% of all fish landed in the U.S. (Frey 1971). Coast wide landings exceeded 350,000 mt each season from 1933 through 1934 to 1945 through 1946; 83% to 99% of these landings were made in California, the remainder in British Columbia, Washington, and Oregon (Table 2.1.1.1-1).

In the late 1940s, sardine abundance and landings declined dramatically (MacCall 1979; Radovich 1981). The decline has been attributed to a combination of overfishing and environmental conditions, although the relative importance of the two factors is still open to debate (Clark and Marr 1955; Jacobson and MacCall 1995). Reduced abundance was accompanied by a southward shift in the range of the resource and landings (Radovich 1981). As a result, harvests ceased completely in British Columbia, Washington, and Oregon in the late 1940s, but significant amounts continued to be landed in California through the 1950s (Table 2.1.1.1-1). Sardine landings in Washington and Oregon have remained virtually nil.

During 1967, in response to low sardine biomass, the California legislature imposed a two-year moratorium that eliminated directed fishing for sardine, and limited the take to 15% by weight in mixed loads (primarily jack mackerel, Pacific [chub] mackerel and sardines); incidentally-taken sardines could be used for dead bait. In 1969, the legislature modified the moratorium by limiting dead bait usage to 227 mt (250 short tons). From 1967 to 1974, a lucrative fishery developed that supplied dead bait to striped bass anglers in the San Francisco Bay-Delta area. Sardine biomass remained at low levels and, in 1974, legislation was passed to permit incidentally-taken sardines to be used only for canning or reduction. The law also included a recovery plan for the sardine population, allowing a 907 mt (1,000-short ton) directed quota only when the spawning population reached 18,144 mt (20,000 short tons), with increases as the spawning stock increased further.

In the late 1970s and early 1980s, CDFG began receiving anecdotal reports about the sighting, setting, and dumping of "pure" schools of juvenile sardines, and the incidental occurrence of sardines in other fisheries, suggesting increased abundance (CDFG 1986). In 1986 the state lifted its 18-year moratorium on sardine harvest on the basis of sea-survey and other data indicating that the spawning biomass had exceeded 18,144 mt (20,000 short tons). The state also passed other legislation during the mid- and late 1980s to establish live and dead bait quotas for sardine.

In accordance with the recovery plan specified by law, the annual directed quota was 907 mt (1,000 short tons) during 1986 to 1990; it was increased to 10,886 mt (12,000 short tons) in 1991, 18,597 mt (20,500 short tons) in 1992, 18,144 mt in 1993, 9,072 mt in 1994, 47,305 mt in 1995, 34,791 mt in 1996, 48,988 mt in 1997, and 43,545 mt in 1998. Legislation passed in 1988 permitted an annual dead bait quota of 227 mt (250 short tons) when the directed quota was less than 2,268 mt (2,500 short tons) and 454 mt (500 short tons) when the directed quota exceeded 2,268 mt. In accordance with the law, the dead bait quota was 227 mt (250 short tons) during 1986 to 1990 and 454 mt (500 short tons) thereafter. A live bait quota of 68 mt (75 short tons) was established in 1984; it was increased to 136 mt (150 short tons) in 1985, 318 mt (350 short tons) in 1988, and 907 mt (1,000 short tons) thereafter.

2.1.1.2 Jack Mackerel

Before 1947, jack mackerel was marketed as fresh fish. It was taken in small amounts in loads consisting primarily of sardine and Pacific (chub) mackerel (Frey 1971; Mason 1991). The market for jack mackerel was small, since Pacific (chub) mackerel was preferred by consumers. In 1947, the industry began marketing jack mackerel as a substitute for Pacific (chub) mackerel and sardine as landings and biomass of these two species declined. In 1948, in a move that facilitated consumer acceptance of jack mackerel products, the U.S. Food and Drug Administration authorized use of the label "jack mackerel" for *Trachurus symmetricus* instead of "horse mackerel" (Frey 1971). During 1947 to 1978, jack mackerel dominated "mackerel" landings in all but three years. The general decline in jack mackerel landings after 1978 coincided with an increase in Pacific (chub) mackerel abundance and landings (Table 2.1.1-1). Since 1947, jack mackerel has been sold largely as canned products for human consumption and pet food.

Jack mackerel is also harvested in Californias' recreational fishery incidentally, as bait, and occasionally as a target species. Available information on catch indicates that anglers catch jack mackerel in small amounts.

In 1983, jack mackerel, which was taken incidentally in the expanding Pacific whiting fishery, was added to the list of species covered by the Council's Groundfish FMP. Each year from 1983 to 1990, the FMP specified an allowable biological catch (ABC) of 12,000 mt and an equivalent amount as a quota. The possibility of a joint-venture fishery for jack mackerel prompted the Council to raise the ABC to 52,600 mt and the quota to 46,500 mt in 1991. Exploratory offshore fishing for jack mackerel by factory trawlers has resulted in little success to date. There may be significant bycatch of Pacific (chub) mackerel and sardine in any offshore fishery for jack mackerel (NMFS 1991).

Current participants in the CPS fisheries do not have the capability to fully utilize jack mackerel, because older fish are difficult to take in purse seines and distributed offshore and north of current fishing grounds. Jack mackerel are not harvested in any significant quantities off Mexico. All current regulations in the FMP for groundfish apply to the fishery north of 39° N latitude; the fishery south of 39° N latitude, which includes southern California's coastal fishery, is not regulated.

2.1.1.3 Pacific (Chub) Mackerel

Before 1928, Pacific (chub) mackerel was taken incidentally with sardines and sold as fresh fish (Frey 1971). As markets developed for canned Pacific (chub) mackerel, landings increased to a high of 66,419 mt in 1935 (Table 2.1.1-1). Harvests subsequently underwent a long-term decline, reaching record low levels in the early

1970s. In 1970 the state of California imposed a moratorium on harvest, with a small allowance for incidental catch in mixed loads.

The incidental take of Pacific (chub) mackerel with jack mackerel increased dramatically in 1977 as the result of a very successful spawning in 1976 (Prager and MacCall 1988). The state responded by increasing the tolerance for Pacific (chub) mackerel in mixed loads, and establishing a directed quota. By 1979, with the advent of another strong year class in 1978, Pacific (chub) mackerel was contributing more than jack mackerel to the "mackerel" fishery (Klingbeil 1983), a pattern which continues (CDFG 1991b). Pacific (chub) mackerel is sold mostly in the form of canned products for human consumption and pet food.

Current state regulations on the commercial fishery (1) specify a quota of 30% of the population above 18,144 mt (20,000 short tons) when total biomass is between 18,144 mt and 136,079 mt (20,000 short tons to 50,000 short tons) and (2) allow unrestricted harvest when the biomass exceeds 136,079 mt.

Pacific (chub) mackerel is also harvested in California's recreational fishery as bait and incidental take and as a target species. During 1981 to 1997, the recreational harvest of Pacific (chub) mackerel in southern California averaged about 1,001 mt (2.4 million fish) per year and accounted for 11% to 19% by weight (13% to 27% by number) of the sport harvest (Table 2.1.1.3-1). Pacific (chub) mackerel is also caught by anglers in northern California but in very modest amounts. The statewide sport harvest constitutes a small fraction (two percent to three percent by weight) of total combined sport and commercial landings of Pacific (chub) mackerel.

There is no directed fishery for mackerel in Oregon or Washington. Small amounts are taken incidentally by commercial jig boats and trawlers. Incidental take (reported landings) of Pacific (chub) and jack mackerel peaked in 1997, with 1,984 mt landed in Oregon, and 157 mt landed in Washington (Table 2.1.1.3-2).

2.1.1.4 Northern Anchovy

Anchovy landings, which were relatively low during 1916 to 1946, surged in 1947, when the scarcity of Pacific sardines prompted processors to begin canning anchovies in quantity (Frey 1971). Landings for reduction were limited by restrictions imposed by the California Fish and Game Commission. Over the next two decades anchovy landings increased and then declined with changes in consumer demand for canned anchovies (Table 2.1.1.4-1).

In late 1965 the California Fish and Game Commission authorized a quota for an experimental anchovy reduction fishery. Increases in abundance and in prices for fish meal and oil raised reduction landings to record highs by the mid 1970s. Reduction landings declined somewhat in the late 1970s and early 1980s, when fishers diverted more effort to Pacific (chub) mackerel, which was increasing in abundance. Anchovy landings have been extremely low since 1983, because low exvessel prices offered by reduction processors prompted the fleet to fish for other species (Thomson 1990; Thomson et al. 1991; Jacobson and Thomson 1993). The effects of low prices have been compounded in recent years by low abundance (Jacobson et al. 1995).

Modest amounts of anchovy were harvested for live bait before World War II. Live bait harvests fell to zero during the war years and, since that time, have ranged from 3,500 mt to 7,000 mt per year. Landings for other nonreduction uses (such as dead bait and canned, fresh or frozen products for human consumption) during 1965 to 1997 ranged from about 250 mt to 5,800 mt and were almost always lower than live bait harvests (Table 2.1.1.4-1).

Small amounts of anchovy (from the northern subpopulation) are harvested by commercial albacore vessels in Oregon and Washington. Only two boats in Washington and none in Oregon are known to sell anchovy as bait to the recreational fishery, where Pacific herring is the preferred bait (Table 2.1.1.3-2).

In 1978 the Northern Anchovy FMP was drafted, and federal authorities assumed management of the anchovy fisheries. The FMP has been amended six times, most recently in 1991 (Council 1983, 1990). Current regulations specify an optimum yield (OY) for the reduction fishery of (1) zero, if the estimated spawning biomass is less than or equal to 300,000 mt, or (2) 100% of the spawning biomass above 300,000 mt, up to a limit of 200,000 mt, if the spawning biomass is greater than 300,000 mt.

The FMP imposes no numeric limit on live bait catch and provides a 7,000 mt quota for other nonreduction uses. Over fishing is defined in the FMP using a spawning biomass criterion. If the spawning biomass falls below 50,000 mt for two consecutive years, all harvests (including those for live bait and other nonreduction purposes) are disallowed until the spawning biomass exceeds 50,000 mt.

Although Mexico also harvests anchovy, there is no bilateral agreement between the U.S. and Mexico regarding anchovy management. In the absence of an agreement, the FMP for northern anchovy allocates 70% of total OY to the U.S. reduction fishery and 30% to Mexican fisheries. Similarly, 70% or 4,900 mt of the 7,000 mt quota for nonreduction uses (other than live bait) can be taken in the U.S. exclusive economic zone.

2.1.1.5 Market Squid

The squid fishery in California was established in 1863 by immigrant Chinese fishers in Monterey Bay. The method of fishing involved three skiffs: one carried a torch at its bow to attract squid while the other two encircled the school with a small purse seine. The harvest was sun-dried and exported to China. In 1905, Italian fishers introduced the more efficient lampara net, which soon became the principal gear in the squid fishery. Asian immigrants continued to dry and market squid abroad (Frey 1971).

Domestic markets for canned squid developed in 1920 and for frozen squid in 1926. These products became dominant when the Asian market declined in 1933. Squid harvests increased during World War II, peaking in 1946 as a result of demand by United States and international aid programs (Frey 1971). Landings have steadily increased since 1950, averaging 4,945 mt per year during 1950 to 1960, 7,947 mt during 1961 to 1970, 11,547 mt during 1971 to 1980, 19,609 mt during 1980 to 1990, and 52,959 mt during 1991 to 1997 (Table 2.1.1.5-1). Most of the harvest is canned or frozen for export; smaller amounts are used domestically for human consumption and as live and dead bait.

The commercial squid fishery consists of two distinct segments: a southern California fall-winter fishery and a central California (Monterey Bay) spring-summer-fall fishery. Southern California's share of statewide squid landings, which averaged 54% during 1970 to 1985, increased to about 76% during 1986 to 1997 (Table 2.1.1.5-1). Fishing in southern California is concentrated around the Channel Islands.

During the 1970s, scoop boats, using a power-assisted brail or dip net in conjunction with attracting lights, were the major harvesters in the southern California fishery (Kato and Hardwick 1975). Local purse seiners also targeted squid when CPS were not available. During the 1980s, however, purse seines became the predominant gear in southern California. Many of the scoop boats now work in partnership with the purse seiners; for a percentage of the landed value a scoop boat will use lights to attract squid, which are subsequently wrapped and landed by a seiner.

Purse seines were outlawed in Monterey Bay in 1953, and attracting lights in 1959; lampara nets have predominated in that area until very recently (Kato and Hardwick 1975). On the basis of preliminary results from a 1987 to 1988 study indicating that purse seines have no greater impact on squid spawning or egg-case mortality than lampara nets, CDFG began allowing purse seine gear in Monterey Bay in 1989. Other legislation passed that same year allowed attracting lights in the bay. Many of the Monterey lampara boats have invested in light systems and switched to half-purse drum seines, which require fewer crew members than the traditional purse seine (CDFG 1991a).

Squid are subject to natural cyclical changes in abundance. They are short-lived with a maximum life span probably about two years. There are no regulatory restrictions on squid harvest.

In 1997, the state of California passed legislation which requires possession of special permits to fish for market squid in California waters (see Appendix B, Section 2.2.5.2.3.8 for details on Californias' market squid regulations). The new law applies to both fishing and light boat vessels. A three-year moratorium on the sale of new permits was effective May 1, 1998. Approximately 270 permits were sold by the final purchase deadline of May 31, 1998. Information on the coastwide composition of permit holders is not yet available, but vessel owners from as far north as Alaska have expressed interest in Californias' squid resource. Further decline of Pacific herring off Alaska (NMFS, 1996) may lead to increased interest in the future.

2.1.2 Commercial Fisheries

This section describes the harvesting and processing sectors of the commercial fisheries as they relate to CPS and squid.

2.1.2.1 Harvesters

Tables 2.1.2-1 through 2.1.2-7 are based on vessel summaries generated from Washington, Oregon, and California fish ticket data converted to Pacific Coast Fisheries Information Network (PacFIN) format. Several points should be kept in mind in interpreting the tables:

1. The PacFIN gear category "ONT" or "Other Net" includes (a) round haul gears (encircling nets such as purse seines, drum seines and lampara nets) and (b) net gears of unspecified type. Thus, in addition to round haul gears, ONT may also include gill net, trawl and other net gears not specifically identified on fish tickets. All gears coded as ONT in the PacFIN data base are loosely referred to as "round haul" in Tables 2.1.2-1 through 2.1.2-7, although they include unspecified net gears as well as round haul gears.

2. The gear category described in Tables 2.1.2-1 through 2.1.2-7 as "Other/Unknown" includes (a) specific gears other than round haul/unspecified net, line, pot/trap, dip net, trawl or gill net (i.e., dredge and harpoon), and (b) gears that were unreadable or missing from fish tickets and, therefore, unknown. Thus, in addition to dredge and harpoon, "Other/Unknown" also includes gear types that were unidentifiable on the fish tickets.

CPS and squid are landed largely with round haul gear, and modest amounts are taken incidentally with other gears (Table 2.1.2-1). During 1981 to 1997, nearly all of the anchovy, mackerel and sardine landings were made with round haul or other/unknown gear. Other/unknown probably includes some round haul landings that were not specified as such on the fish tickets. During 1981 to 1997, nearly all of the squid landings were made with round haul, dip net or other/unknown gears.

Table 2.1.2-2 describes the number of vessels that landed any CPS or squid during 1981 to 1997, according to the vessel's principal gear. Principal gear is defined by plurality of landings (i.e., the gear with which the vessel made most of its landings during the year). The vessels are further categorized according to where (California, Oregon, or Washington) they made most of their landings. On an annual basis, about 50% to 75% of boats landed CPS but no squid; the remainder is split between boats landing both CPS and squid and boats landing squid but no CPS. In each year, most boats landing CPS or squid were round haulers; line vessels (e.g., trollers, longliners) were the second most common.

Table 2.1.2-3 distinguishes vessels that landed any CPS or squid during 1981 to 1997 on the basis of whether or not their principal gear was round haul, and on where (California, Oregon, Washington) they made most of their landings. It further categorizes the round haul vessels according to whether they landed (1) less than 50 mt of CPS+squid, (2) ≥50 mt of squid but no CPS, (3) some CPS and at least 50 mt of CPS+squid, or (4) at least 50 mt of CPS during the year.

The number of round haulers in category (1) with less than 50 mt of CPS+squid decreased from an average of 40 vessels in the early 1980s to about 25 vessels between 1986 and 1992. The number increased again in the early-1990s to mid-1990s to an average of 42 vessels (Table 2.1.2-3).

Landings categories (2) through (4) include round haul vessels that landed at least 50 mt of squid, CPS+squid or CPS annually during 1981 to 1997. The 49 vessels to 98 vessels included in these categories represent the more active participants in the fishery. Since round haul gear is customarily used to target CPS and squid, these vessels are likely to be true round haulers and not affected by the ambiguities discussed above.

Table 2.1.2-4 describes the total number of vessels in Washington, Oregon, and California that landed any CPS or squid during 1981 to 1997 and the proportion of these vessels in five categories: non-round haul vessels, and round haulers in each category described in Table 2.1.2-3. The table also describes total annual landings of CPS and squid in Washington, Oregon, and California during 1981 to 1997 and the proportion of these landings accounted for by vessels in each of the five categories. Three general patterns can be discerned from the table:

1. Although the non-round haulers and round haulers in landings category (1) together made up most of the vessels that landed any CPS or squid each year, these vessels accounted for a very small proportion of total CPS and squid landings. For instance, these vessels constituted 91.2% of all vessels that landed any CPS or squid in 1990, but accounted for only 3.7% of total CPS landings and 3.2% of squid landings in that year.

2. Round haulers in landings categories (2) and (3) harvested zero to negligible amounts of CPS, but a disproportionate amount of squid. For instance, in 1990 these vessels constituted 1.6% of all vessels that landed any CPS or squid and accounted for 0.2% of total CPS landings and 24.7% of total squid landings.

3. Category (4) round haulers landed a disproportionate amount of both CPS and squid during 1981 to 1997. For instance, while these vessels constituted 7.3% of all vessels landing any CPS or squid during 1990, they accounted for 96.1% of total CPS landings and 70.0% of total squid landings during that year.

Tables 2.1.2-5 through 2.1.2-7 describe vessels in landing categories (1) to (4) in terms of selected characteristics. The main points are:

1. Category (1) vessels are dispersed throughout southern and central California (Table 2.1.2-5). Prior to 1993, the major ports of landing for vessels in categories (2) and (3) were in the Monterey area and, to a lesser extent, in Ventura and Santa Barbara counties. From 1993 to 1997, there was a dramatic increase in the number of category (2) and (3) vessels in Ventura and Santa Barbara counties, primarily due to expansion of the market squid fishery off southern California. Category (4) vessels are geographically concentrated in Orange and Los Angeles counties (particularly San Pedro) and, to a lesser extent, in Ventura and Santa Barbara counties (Port Hueneme) and in Monterey Bay.

2. During 1981 to 1990, category (1) vessels landed about 87 mt of fish (all species, Table 2.1.2-6) with an exvessel value of about $85,300 (Table 2.1.2-7). During 1991 to 1997, category (1) vessel landings doubled to 170 mt, and average exvessel revenues increased to an average of $169,600.

3. During 1981 to 1997, vessels in categories (2) and (3) exhibited very similar patterns of fishing activity (Tables 2.1.2-6 to 2.1.2-7). For the period, both groups averaged about 591 mt per vessel per year in landings and about $239,000 per vessel per year in revenues. For both groups, squid accounted for 80% of total landings and over 60% of total revenues.

4. During 1981 to 1997, category (4) vessels averaged 2,156 mt per vessel per year with an average exvessel value of $633,000 (Tables 2.1.2-6 and 2.1.2-7). CPS finfish accounted for about 61% of their landings and 34% of their revenues, while squid accounted for abut 25% of landings and 22% of revenue activity (Tables 2.1.2-6 to 2.1.2-7).

In addition to CPS finfish and squid, round haul vessels also target Pacific bonito (*Sarda chiliensis*) and bluefin tuna (*Thunnus thynnus*) in southern California, and Pacific herring (*Clupea harengus pallasi*) in central California (Table 2.1.2-8). These three species account for most of the non-CPS and non-squid landings made by vessels in categories (2) to (4).

2.1.2.2 Markets and Exvessel Prices

Table 2.1.2-8 describes mean exvessel real prices[1/] of anchovy, mackerel, sardine, squid, bonito and bluefin tuna caught with round haul gear during 1981 to 1997. All prices are based on Washington, Oregon, and California fish ticket data converted to PacFIN format.[2/]

Prices and markets can be described as follows:

1. Anchovy is used for a variety of purposes, including reduction, live and dead bait, and human consumption. Although live bait harvest is not regulated, all other harvests are subject to separate reduction and nonreduction quotas.[3/] California Department of Fish and Game (CDFG) distinguishes between landings (without relying on the disposition code on fish tickets) by attributing landings received at known reduction plants to the reduction quota and all other landings to the nonreduction quota.

   Reduction landings, which generally receive a much lower exvessel price than nonreduction landings, have been exceedingly low since 1983 (Table 2.1.1-4-1), when the price fell below $50/mt. Nonreduction landings have increased in recent years, largely as a result of increased exports for human consumption. While still low, nonreduction landings now dominate total anchovy landings.

   The predominance of reduction landings during 1981 to 1982 is reflected in the low average prices (Table 2.1.2-8) during those years. From 1983 onward, total landings were lower (Table 2.1.1.4-1) but prices were higher (Table 2.1.2-8), reflecting the shift from reduction to higher-priced uses.

2. Commercially harvested mackerel is processed into canned products for pet food and human consumption, and a small but increasing amount is sold to fresh fish markets that cater to California's growing Asian immigrant population. Sardines landed in mixed loads with mackerel receive the same price as mackerel and are processed into the same products. Thus the mackerel prices described in Table 2.1.2-8 pertain to sardine taken incidentally with mackerel as well as to "pure" mackerel landings.

3. Because of the moratorium on sardine landings, pre-1986 landings were too low (Table 2.1.1-1) to provide any meaningful information about prices for different uses (e.g., canned or dead bait). Thus all prices in Table 2.1.2-8 are averages for all types of products. The average sardine price, which was $244/mt in 1986 when the moratorium was lifted, declined to $79/mt by 1997.

4. Squid are generally frozen or canned and exported for human consumption. Smaller amounts are sold domestically in the fresh markets and used for live and dead bait by commercial and recreational fisheries. Exvessel prices vary with the disposition of catch; landings for human consumption receive a higher price than frozen bait landings. Prices tend to be lower in southern California than in central and northern California. The general increase in landings since the early 1980s (Table 2.1.1-1) was accompanied by a steady decline in average prices until 1992 when prices increased (Table 2.1.2-8).

1/ Real prices are corrected for inflation over time thus expressing the amount in constant (1990) dollars.

2/ Since prices tend to vary significantly by disposition of catch, it would have been informative to report average prices by disposition. However, the disposition codes reported on the California fish tickets were not deemed sufficiently reliable to do this.

3/ Live bait harvests are reported on logbooks maintained by bait haulers and not on the fish tickets.

5. Bonito and bluefin tuna are important sources of income to category (4) round haulers (i.e., the 50 or so southern California purse seiners that land at least 50 mt of CPS during the year; see Tables 2.1.2-6 and 2.1.2-7). These species vary in availability both seasonally and annually and command considerably higher prices than CPS or squid.

Bonito are generally sold as canned, fresh and frozen products for human consumption. Mean annual prices ranged from \$372 to \$454/mt and averaged about \$411/mt during 1993 to 1997.

The average tuna price was extraordinarily high (\$1,455/mt) in 1988, when record-size bluefin were landed by San Pedro purse seiners and sold at premium prices in the Japanese sashimi market (Thomson et al. 1989). The average price during 1993 to 1997 was about \$785/mt.

2.1.2.3 Fish Dealers

Tables 2.1.2-9 to 2.1.2-12 provide information on west coast fish dealers who received any CPS or squid during 1981 to 1997. These tables are based on dealer summaries generated from PacFIN summary data. Several points should be kept in mind in interpreting the tables:

1. Fish sometimes pass through several dealers between the point of landing and the final market. The dealer reported on the fish ticket represents the first transaction after the fish are landed.

2. Each dealer code is specific to a particular plant belonging to a particular fish processing or distributing company. Thus a company with multiple plants would be represented by multiple dealer codes in the database.

3. Sometimes a dealer will set up receiving stations at several ports and truck the landings to the processing plant. Since the port reported on the fish tickets reflects where the landing is made and not the location of the plant, the tickets sometimes show a single dealer receiving landings in several different ports. Thus each dealer's principal landing area is defined in Tables 2.1.2-9 and 2.1.2-10 as the area in which he received most of his landings.

During 1981 to 1997, 142 to 191 California dealers purchased CPS or squid from commercial fishing vessels each year (Table 2.1.2-9). Tables 2.1.2-10 to 2.1.2-12 categorize these dealers according to whether they purchased (1) less than 500 mt of CPS+squid, (2) at least 500 mt of squid but no CPS, (3) some CPS and at least 500 mt of CPS+squid, or (4) at least 500 mt of CPS during the year. The tables can be summarized as follows:

1. During 1981 to 1997, about 45% of the category (1) dealers received most of their landings in southern California (San Diego to Santa Barbara counties); about 35% received most of their landings in central California (San Luis Obispo to San Francisco Bay); and about 20% received most of their landings in areas north of San Francisco (Table 2.1.2-10).

   California processing companies in category (1) received an average of 242 mt of fish (all species) per year during 1986 to 1997, of which about five percent consisted of CPS and three percent consisted of squid (Table 2.1.2-11). Although these processors accounted for more than 86% of all California processors who received any CPS or squid during the year, they accounted for only 2.4% of total CPS landings and less than three percent of total squid landings made in California (Table 2.1.2-12).

2. During 1981 to 1997, about 55% of category (2) and (3) dealers received most of their landings in southern California; the rest received most of their landings in central California (Table 2.1.2-10). These dealers tend to handle higher volumes of raw product and are much more dependent on squid than category (1) dealers.

   During 1986 to 1997, California processing companies in categories (2) and (3) received an average of about 2,869 mt of fish (all species) per year, about four percent of which was CPS, and about 74% squid (Table 2.1.2-11). While categories (2) and (3) made up less than five percent of all

CPS/squid processing companies in California on average, they received about 30% of total squid landings in California (Table 2.1.2-12).

3. Category (4) dealers are located predominantly in southern California; they derive most of their raw product from CPS or squid and account for most of the CPS and squid landings made in the state. From 1981 to 1997, about 82% of the category (4) dealers received most of their landings in southern California, and about 18% received most of their landings in central California.

   California processing companies in category (4) received an average of about 9,280 mt of fish (all species) per year from 1986 to 1997, about 51% of which was CPS and about 32% squid (Table 2.1.2-11). Although these processors made up only nine percent of California processors receiving any CPS or squid during the year, they accounted for about 96% of total CPS landings and about 69% of total squid landings in California (Table 2.1.2-12).

2.1.3 Recreational Fisheries

According to the Marine Recreational Fishery Statistics Survey, between 4.2 and 12.5 million marine recreational fishing trips are taken in California each year from 1980 to 1997 (Table 2.1.3-1). These figures underestimate the true level of fishing activity, because they do not include trips targeted on salmon or striped bass, or trips aboard commercial passenger fishing vessels (CPFV's)[4/] and private boats which originated in the United States but fished in Mexican waters. Annual fishing expenditures are approximately $500 million in southern California (Thomson and Crooke 1991) and $180 million in central and northern California (Thomson and Huppert 1987).

As indicated in Section 2.1.1.3, Pacific (chub) mackerel accounts for about 11% to 19% (by weight) of the total sport harvest of all species in southern California. In addition, anchovy is a major source of bait for the recreational fishery in both southern and northern California. In southern California, anchovy is used as bait on approximately 35% of beach trips, 66% of pier trips, 84% of CPFV trips and 71% of private boat trips (Table 2.1.3-2), and is more likely to be used live than dead on boat-based trips. In northern California, anchovy is used almost exclusively as dead bait.

The live bait fleet consists of approximately 18 boats that are distributed along the southern California coast to conveniently service the principal sportfishing markets. Two types of gear are used in the fishery (1) the lampara net, which is set in shallow water and cannot be used effectively in deep water offshore; and (2) the more versatile drum seine, which can be set in deep as well as shallow water and used to harvest mackerel as well as anchovy. The drum seine is of more recent origin, and about six boats in the fleet currently use this gear. The live bait boats fish for a variety of species other than anchovy, such as squid, sardine, mackerel, white croaker and queenfish. Anchovies, however, are most of the live bait catch during most years.

About 20% of the live bait harvest is sold to anglers aboard private boats for $20 per scoop. Live bait haulers sell the rest of their bait to CPFV's. The value of these sales is difficult to pinpoint, since bait haulers receive 12.5% to 16.0% of the CPFV's gross revenues rather than a fixed price.

2.1.4 Mexican Fisheries

In 1962, Mexico began harvesting anchovy, primarily for reduction. Mexico's harvesting and processing capacity increased significantly in the late 1970s, due to the addition of a number of large seiners to the fleet and the construction of a large reduction plant in Ensenada. Mexican anchovy landings reached a high of 258,745 mt in 1981, fell to 174,634 mt in 1982, and ranged from 79,495 mt to 124,482 mt per year during 1983 to 1989. Mexican anchovy landings surpassed U.S. landings during 1977 to 1989 and constituted more than 90% of total landings during 1983 to 1989. In 1990, Mexican anchovy landings fell to a record low of 99 mt and have remained generally low (Table 2.1.1.4-1). In 1991, the large reduction facility in Ensenada

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4/ CPFV's transport paying passengers to and from the fishing grounds and provide bait, food, beverage service, gear rental, and fish cleaning.

closed, although smaller plants remain open. Overfishing, changing environmental conditions and low demand have been cited as reasons for the fishery's demise.

Sardine and Pacific (chub) mackerel are harvested in Mexico as well as in the U.S. (Table 2.1.4-1). Mexican landings in recent years have been roughly equal to or greater than U.S. landings.

2.2 Take of Non-CPS in the CPS Fishery

The most important way in which CPS fishing affects non-CPS species (including endangered or threatened species) is via the food chain because many CPS (i.e. northern anchovy, Pacific sardine and market squid) are important food sources (Appendix A, tables 1.1.2-1, 1.6-1 and 1.7.1-1). Ecological effects and requirements of dependent species are important considerations in managing harvests of CPS (Appendix B, Section 4.2.1.1).

Another area of concern is "take" (incidental mortality) of birds, fish and marine mammals (especially threatened, endangered or sensitive species) during fishing for CPS. This potential problem may be exacerbated for CPS because anchovy, sardine and squid are forage for many predators (including threatened or endangered species) that may feed on CPS while fishing gear is deployed, become entangled or captured and drown. The problem is reduced somewhat by the fact that fishing gear used to harvest CPS (mostly purse seines made of small mesh) does not tend to entangle and drown predators although they may be captured within the net as the purse seines are closed.

Available information about take of birds, fish and marine mammals during CPS fishing is summarized below. Data are limited, however, because there have been no observer programs in the CPS fishery.

2.2.1 Take of Marine Mammals in the CPS Fishery

Under the terms of the Marine Mammal Protection Act, the California purse seine (CPS) fishery is "Category II." Category II fisheries are characterized by incidental mortality of marine mammals at levels less than 50% of the PBR (potential biological removal) level. Category I fisheries, in contrast, are characterized by higher (>50% of PBR) marine mammal mortality rates while Category III fisheries involve very little or no marine mammal mortality. Category II fisheries can be required to carry observers for monitoring of marine mammal mortality, however, funding limitations generally preclude observer programs in any but Category I fisheries.

Interactions between the CPS fishery and marine mammals occur when mammals contact round haul gear during fishing. Mortality occurs when marine mammals become entangled and drown or when fishers use firearms to kill marine mammals (e.g. California sea lions) interfering with a set. Use of firearms is not legal and frequency of use is unknown.

Precise estimates of mortality rates from these sources in the CPS fishery are not available but a significant amount of qualitative information exists for most marine mammal species along the west coast (Barlow et al. 1997 and Table 2.2.1-1). State and federal biologists indicate that the most significant interaction (in terms of impacts on the marine mammal stock) may be between pilot whales, which are relatively rare along the West Coast, and the squid fishery.

TABLE 2.2.1-1. Summary of information about marine mammal mortality in the CPS fishery (Barlow et al. 1997).

Marine Mammal	CPS Fishery	Average Annual Mortality for 1991-1995, as Available (Individuals / Year)
California sea lion	finfish squid	2 2.67
Harbor seals (California stock)	finfish	0.67
Risso's dolphin	squid	>0
Bottlenose dolphin	finfish	>0
Short-finned pilot whale	squid (probably)	>0

2.2.2 Take of Endangered Salmon in the CPS Fishery

A number of salmonid (salmon and trout) species along the west coast are listed under the Endangered Species Act (ESA), eat CPS, and might be taken incidentally during CPS fishing (Table 2.2.2-1). Although not listed under the ESA, Oregon Coastal Native (OCN) coho are at a low abundance level and might also be taken incidentally during CPS fishing.

No data are available concerning catch rates or mortality of salmonids during fishing for CPS although California Department of Fish and Game biologists report that some bycatch and mortality of salmon may occur off central California where salmon abundance is relatively high and CPS fishing occurs. At present, most CPS fishing occurs off southern California where salmon are not common. Salmonid bycatch may grow to be a more significant problem as the sardine stock expands its range in the north and northern fisheries develop.

TABLE 2.2.2-1. Salmonid stocks along the West Coast that are either threatened or endangered under the Endangered Species Act (ESA).

Species	Stock	Status
Chinook Salmon		
	Sacramento River Winter Run	Endangered
	Snake River Spring/summer Run	Threatened
	Snake River Fall Run	Threatened
Coho Salmon		
	Central California	Threatened
	Southern Oregon/northern ca	Threatened
	Oregon Coast	Threatened
Sockeye Salmon		
	Snake River	Endangered
Steelhead Trout		
	Upper Columbia River	Endangered
	Lower Columbia River	Threatened
	Snake River Basin	Threatened
	Central California Coast	Threatened
	South-central California Coast	Threatened
	Central Valley	Threatened
	Southern California	Endangered
Cutthroat Trout		
	Umpqua River Cutthroat	Endangered

2.2.3 Take of Endangered Birds in the CPS Fishery

Endangered and threatened birds that eat CPS and may encounter fishing gear for CPS are the least tern, marbled murrelet, and bald eagle. No hard data exist but knowledgeable sources report that take of these species in the CPS fishery is likely zero.

TABLE 2.1.1-1. Landings of northern anchovy, Pacific sardine, jack mackerel, Pacific (chub) mackerel and market squid in California (mt), 1916-1997.

Year	Northern Anchovy	Pacific Sardine	Jack Mackerel	Pacific (chub) Mackerel	Total Mackerel	Squid	Grand Total
1916	241	7,098	n.a.	n.a.	505	125	7,969
1917	240	47,221	n.a.	n.a.	1,518	199	49,178
1918	394	71,511	n.a.	n.a.	1,817	164	73,886
1919	730	69,798	n.a.	n.a.	1,204	1,677	73,409
1920	258	53,761	n.a.	n.a.	1,360	231	55,610
1921	883	26,913	n.a.	n.a.	1,322	196	29,314
1922	296	42,366	n.a.	n.a.	1,119	95	43,876
1923	139	71,741	n.a.	n.a.	1,612	535	74,027
1924	157	110,082	n.a.	n.a.	1,464	3,099	114,802
1925	42	143,017	n.a.	n.a.	1,590	858	145,507
1926	27	130,065	107	1,638	1,745	1,422	133,259
1927	167	155,255	210	2,145	2,355	2,728	160,505
1928	162	190,633	244	15,990	16,234	613	207,642
1929	174	295,642	317	26,297	26,614	2,114	324,544
1930	145	227,734	167	7,499	7,666	4,976	240,521
1931	140	165,269	255	6,466	6,721	789	172,919
1932	136	191,695	243	5,658	5,901	1,919	199,651
1933	144	284,132	459	31,577	32,036	374	316,686
1934	117	507,997	717	51,641	52,358	694	561,166
1935	81	497,033	4,529	66,419	70,948	370	568,432
1936	89	663,859	2,086	45,606	47,692	429	712,069
1937	103	486,025	2,967	27,641	30,608	228	516,964
1938	334	464,206	1,875	36,219	38,094	725	503,359
1939	974	526,533	1,706	36,700	38,406	527	566,440
1940	2,876	410,947	650	54,660	55,310	817	469,950
1941	1,862	572,657	938	35,456	36,394	649	611,562
1942	769	439,874	2,426	23,838	26,264	428	467,335
1943	713	441,019	5,760	34,117	39,877	4,157	485,766
1944	1,765	520,370	5,796	37,947	43,743	4,961	570,839
1945	733	383,318	4,097	24,366	28,463	6,906	419,420
1946	872	231,679	6,846	24,438	31,284	17,248	281,083
1947	8,591	115,900	58,536	21,082	79,618	6,596	210,705
1948	4,915	164,219	33,067	17,865	50,932	8,734	228,800
1949	1,507	287,299	23,247	22,576	45,823	3,111	337,740
1950	2,213	324,105	60,444	14,810	75,254	2,720	404,292
1951	3,155	149,188	40,750	15,204	55,954	5,617	213,914
1952	25,303	6,500	66,462	9,346	75,808	1,665	109,276
1953	38,935	4,295	25,288	3,403	28,691	4,045	75,966
1954	19,237	61,918	7,863	11,518	19,381	3,699	104,235
1955	20,272	66,047	16,218	10,574	26,792	6,474	119,585
1956	25,819	31,550	34,366	22,686	57,052	8,838	123,259
1957	18,392	20,803	37,200	28,143	65,343	5,647	110,185
1958	5,263	92,736	10,009	12,541	22,550	3,383	123,932
1959	3,254	33,733	17,013	17,056	34,069	8,914	79,970
1960	2,295	26,097	33,995	16,696	50,691	1,162	80,245
1961	3,498	19,581	44,274	20,008	64,282	4,666	92,027
1962	1,254	6,969	40,814	22,035	62,849	4,249	75,321
1963	2,073	3,235	43,292	18,254	61,546	5,244	72,098
1964	2,257	5,959	40,684	12,169	52,853	7,454	68,523
1965	2,601	873	30,240	3,198	33,438	8,446	45,358
1966	28,250	398	18,535	2,100	20,635	8,630	57,913
1967	31,575	68	17,319	529	17,848	8,891	58,382
1968	14,096	56	25,251	1,421	26,672	11,309	52,133
1969	61,362	48	24,459	1,070	25,529	9,425	96,364
1970	87,311	201	21,658	282	21,940	11,154	120,606
1971	40,690	135	27,162	71	27,233	14,296	82,354
1972	62,688	169	23,187	49	23,236	9,144	95,237
1973	120,327	69	9,351	26	9,377	5,471	135,244
1974	75,017	6	11,547	61	11,608	13,111	99,742
1975	143,799	2	16,683	130	16,813	10,715	171,329
1976	113,326	24	20,207	298	20,505	9,211	143,066
1977	101,131	5	45,508	5,420	50,928	12,811	164,875
1978	11,437	5	31,258	11,376	42,634	17,145	71,221

TABLE 2.1.1-1. Landings of northern anchovy, Pacific sardine, jack mackerel, Pacific (chub) mackerel and market squid in California (mt), 1916-1997. (Continued).

Year	Northern Anchovy	Pacific Sardine	Jack Mackerel	Pacific (chub) mackerel	Total Mackerel	Squid	Grand Total
1979	48,881	16	16,602	27,643	44,245	19,689	112,831
1980	42,946	34	20,347	29,615	49,962	15,385	108,327
1981	52,308	28	14,218	38,930	53,148	23,510	128,994
1982	42,061	132	26,408	28,372	54,780	16,308	113,281
1983	4,300	352	18,391	32,552	50,943	1,824	57,419
1984	2,956	235	10,676	42,213	52,889	564	56,644
1985	1,626	592	9,360	34,609	43,969	10,276	56,463
1986	1,910	1,164	11,076	41,280	52,356	21,277	76,707
1987	1,447	2,095	11,843	41,631	53,474	19,984	77,000
1988	1,468	3,785	10,323	42,890	53,213	37,232	95,698
1989	2,449	3,908	19,795	36,129	55,924	40,893	103,174
1990	3,201	3,125	4,667	31,794	36,461	28,447	71,234
1991	4,252	7,750	1,695	30,957	32,652	37,388	82,042
1992	1,124	17,950	1,209	18,576	19,785	13,110	51,969
1993	1,959	15,346	1,673	11,819	13,492	42,830	73,627
1994	1,789	11,644	2,704	10,008	12,712	55,892	82,037
1995	1,886	40,256	1,728	8,626	10,354	70,252	122,748
1996	4,419	32,553	2,176	9,599	11,775	80,320	129,067
1997a/	5,719	42,816	1,160	18,191	19,351	70,919	138,805

a/ Preliminary.

Sources: 1916-1968 data from CDFG 1970.
1969 data from CDFG 1986.
1970-1989 CPS data and 1970-1990 squid data from CDFG 1991a.
1981-1997 data from PacFIN vessel summaries.

TABLE 2.1.1.1-1. West Coast Pacific sardine landings (mt), 1916-1917 through 1967-1968 seasons.

Season	British Columbia	Washington	Oregon	California	Baja California	Total
1916-1917	0	0	0	24,975	0	24,975
1917-1918	73	0	0	65,844	0	65,917
1918-1919	3,302	0	0	68,529	0	71,832
1919-1920	2,976	0	0	60,809	0	63,785
1920-1921	3,992	0	0	34,882	0	38,873
1921-1922	898	0	0	33,113	0	34,011
1922-1923	925	0	0	59,067	0	59,993
1923-1924	880	0	0	76,141	0	77,021
1924-1925	1,243	0	0	156,963	0	158,206
1925-1926	14,470	0	0	124,531	0	139,000
1926-1927	43,999	0	0	138,084	0	182,083
1927-1928	62,079	0	0	169,881	0	231,960
1928-1929	73,038	0	0	230,863	0	303,901
1929-1930	78,327	0	0	294,992	0	373,319
1930-1931	68,103	0	0	167,940	0	236,043
1931-1932	66,770	0	0	149,365	0	216,134
1932-1933	40,234	0	0	227,424	0	267,659
1933-1934	3,674	0	0	347,845	0	351,519
1934-1935	39,009	0	0	539,829	0	578,839
1935-1936	41,114	9	23,796	508,480	0	573,399
1936-1937	40,325	5,951	12,882	658,735	0	717,893
1937-1938	43,618	15,513	15,114	377,904	0	452,149
1938-1939	46,965	24,023	15,440	521,897	0	608,325
1939-1940	5,008	16,112	20,258	487,405	0	528,782
1940-1941	26,100	735	2,867	417,839	0	447,541
1941-1942	54,477	15,513	14,379	532,861	0	617,230
1942-1943	59,766	526	1,769	457,825	0	519,887
1943-1944	80,504	9,471	1,651	433,756	0	525,382
1944-1945	53,633	18	0	503,407	0	557,058
1945-1946	31,117	2,096	82	366,219	0	399,513
1946-1947	3,620	5,570	3,593	212,104	0	224,886
1947-1948	445	1,234	6,287	110,080	0	118,045
1948-1949	0	45	4,826	166,675	0	171,547
1949-1950	0	0	0	307,471	0	307,471
1950-1951	0	0	0	320,319	0	320,319
1951-1952	0	0	0	117,122	14,682	131,804
1952-1953	0	0	0	5,181	8,312	13,493
1953-1954	0	0	0	4,075	12,978	17,053
1954-1955	0	0	0	62,111	11,285	73,397
1955-1956	0	0	0	67,551	3,817	71,367
1956-1957	0	0	0	30,521	12,388	42,908
1957-1958	0	0	0	20,205	9,003	29,208
1958-1959	0	0	0	94,322	20,261	114,583
1959-1960	0	0	0	33,798	19,456	53,254
1960-1961	0	0	0	26,198	18,052	44,250
1961-1962	0	0	0	23,159	19,296	42,455
1962-1963	0	0	0	3,785	13,263	17,048
1963-1964	0	0	0	2,669	16,678	19,347
1964-1965	0	0	0	5,537	24,603	30,140
1965-1966	0	0	0	652	20,182	20,835
1966-1967	0	0	0	312	17,718	18,030
1967-1968	0	0	0	64	25,090	25,155

Source: Radovich 1981.

TABLE 2.1.1.3-1. Recreational harvest of Pacific (chub) mackerel and all species in southern California. Includes fish landed in the round (type A) and fish used for bait, filleted or discarded dead (type B1), 1981-1997.

	Pacific (chub) mackerel		All Species	
Year	Thousands of Fish	Metric Tons	Thousands of Fish	Metric Tons
1981	3,029	1,233	14,000	8,152
1982	3,551	1,571	16,405	9,870
1983	3,387	1,354	12,533	8,146
1984	3,450	1,257	14,197	9,728
1985	2,587	1,053	13,812	7,785
1986	2,075	986	15,570	8,995
1987	3,402	1,320	13,766	8,891
1988	1,890	848	14,115	7,135
1989	1,669	634	10,569	5,498
1990	No Surveys		No Surveys	
1991	No Surveys		No Surveys	
1992	No Surveys		No Surveys	
1993	1,607	590	7,295	4,582
1994	2,485	994	9,185	5,238
1995	2,139	1,040	8,553	6,802
1996	1,580	678	7,755	4,174
1997[a/]	1,179	456	4,913	3,907

a/ Preliminary data.

Source: MRFSS RecFIN database.

TABLE 2.1.1.3-2. Landings of northern anchovy and mackerel (Pacific and jack) in Oregon and Washington (mt), 1981-1997.

	Oregon			Washington		
Year	Anchovy	Mackerel	Total	Anchovy	Mackerel	Total
1981	0.00	0.01	0.01	1.32	0.00	1.32
1982	0.09	0.04	0.13	5.06	0.00	5.06
1983	0.00	8.28	8.28	2.87	0.00	2.87
1984	0.00	3.05	3.05	10.09	0.12	10.21
1985	0.01	0.01	0.02	11.68	0.00	11.68
1986	0.00	0.00	0.00	22.10	0.00	22.10
1987	0.00	1.46	1.46	77.62	0.00	77.62
1988	0.01	0.64	0.65	40.35	0.00	40.35
1989	0.01	4.74	4.75	61.85	0.23	62.08
1990	0.00	10.29	10.29	50.30	0.14	50.44
1991	0.00	19.77	19.77	54.49	0.16	54.65
1992	0.00	778.80	778.80	41.66	5.86	47.52
1993	0.00	556.50	556.50	44.15	30.25	74.40
1994	0.91	454.57	455.48	69.52	33.31	102.83
1995	0.22	337.74	337.96	129.58	7.48	137.06
1996	0.00	319.15	19.15	85.64	68.08	153.72
1997	0.00	1984.06	1984.06	59.10	156.61	215.71

Source: PacFIN.

TABLE 2.1.1.4-1. Northern anchovy harvest in California, by disposition of catch, and Mexico (mt), 1916-1997.

Year	Reduction	Nonreduction[b/]	Subtotal	Live Bait	Total	Mexico	Grand Total
1916	---	---	241	0	241	0	241
1917	---	---	239	0	239	0	239
1918	---	---	394	0	394	0	394
1919	---	---	730	0	730	0	730
1920	---	---	259	0	259	0	259
1921	---	---	883	0	883	0	883
1922	---	---	296	0	296	0	296
1923	---	---	140	0	140	0	140
1924	---	---	158	0	158	0	158
1925	---	---	42	0	42	0	42
1926	---	---	27	0	27	0	27
1927	---	---	167	0	167	0	167
1928	---	---	162	0	162	0	162
1929	---	---	173	0	173	0	173
1930	---	---	145	0	145	0	145
1931	---	---	140	0	140	0	140
1932	---	---	136	0	136	0	136
1933	---	—	144	0	144	0	144
1934	---	---	117	0	117	0	117
1935	---	—	82	0	82	0	82
1936	---	---	89	0	89	0	89
1937	---	---	103	0	103	0	103
1938	---	---	334	0	334	0	334
1939	---	---	974	1,364	2,338	0	2,338
1940	---	---	2,866	1,820	4,686	0	4,686
1941	---	---	1,862	1,435	3,297	0	3,297
1942	---	---	768	234	1,002	0	1,002
1943	---	---	712	0	712	0	712
1944	---	---	1,765	0	1,765	0	1,765
1945	---	---	733	0	733	0	733
1946	---	---	872	2,493	3,365	0	3,365
1947	---	---	8,591	2,589	11,180	0	11,180
1948	---	---	4,915	3,379	8,294	0	8,294
1949	---	---	1,510	2,542	4,052	0	4,052
1950	---	---	2,213	3,469	5,682	0	5,682
1951	---	---	3,154	4,665	7,819	0	7,819
1952	---	---	25,303	6,178	31,481	0	31,481
1953	---	---	38,935	5,798	44,733	0	44,733
1954	---	---	19,237	6,066	25,303	0	25,303
1955	---	---	20,272	5,557	25,829	0	25,829
1956	---	---	25,819	5,744	31,563	0	31,563
1957	---	---	18,392	3,729	22,121	0	22,121
1958	---	---	5,263	3,843	9,106	0	9,106
1959	---	---	3,254	4,297	7,551	0	7,551
1960	---	—	2,294	4,225	6,519	0	6,519
1961	---	---	3,498	5,364	8,862	0	8,862

TABLE 2.1.1.4-1. Northern anchovy harvest in California, by disposition of catch, and Mexico (mt), 1916-1997. (Continued).

Year	Reduction	Nonreduction[b/]	Subtotal	Live Bait	Total	Mexico	Grand Total
1962	---	---	1,254	5,595	6,849	669	7,518
1963	---	---	2,073	4,030	6,103	944	7,047
1964	---	—	2,257	4,709	6,966	4,599	11,565
1965	155	2,446	2,601	5,645	8,246	9,171	17,417
1966	24,810	3,440	28,250	6,144	34,394	13,243	47,637
1967	29,346	2,229	31,575	4,898	36,473	20,104	56,577
1968	12,515	1,581	14,096	6,644	20,740	14,267	35,007
1969	59,153	2,209	61,362	4,891	66,253	3,871	70,124
1970	84,328	2,982	87,310	5,543	92,853	27,977	120,830
1971	39,601	1,089	40,690	5,794	46,484	20,079	66,563
1972	60,435	2,252	62,687	5,307	67,994	30,047	98,041
1973	118,432	1,895	120,327	5,639	125,966	15,424	141,390
1974	73,400	1,640	75,040	5,126	80,166	44,987	125,153
1975	141,586	2,214	143,800	5,577	149,377	56,877	206,254
1976	112,270	1,059	113,327	6,202	119,529	75,746	195,275
1977	99,674	1,457	101,131	6,410	107,541	142,575	250,116
1978	10,339	1,118	11,457	6,013	17,470	135,036	152,506
1979	47,408	5,836	53,244	5,364	58,608	192,476	251,084
1980	43,699	5,338	49,037	4,921	56,234	242,907	299,141
1981	51,290	246	51,536	4,698	56,234	258,745	314,979
1982	43,742	1,117	44,859	6,978	51,837	174,634	226,471
1983	2,854	1,446	4,300	4,187	8,487	87,429	95,916
1984	1,722	1,183	2,905	4,397	7,302	102,931	110,223
1985	825	1,184	2,009	3,775	5,784	117,192	122,976
1986	546	1,002	1,548	3,956	5,504	93,547	99,051
1987	149	1,154	1,303	3,572	4,875	124,482	129,357
1988	234	1,234	1,468	4,188	5,656	79,495	85,151
1989	109	2,341	2,450	4,594	7,044	81,810	88,854
1990	63	3,145	3,208	4,841	8,049	99	8,148
1991	1,037	3,215	4,252	5,039	9,291	831	10,122
1992	0	1,124	1,124	2,572	3,696	2,324	6,020
1993	0	1,959	1,959	2,521	4,480	284	4,764
1994	0	1,793	1,793	1,923	3,716	875	4,591
1995	0	1,886	1,886	na	1,886	17,772	19,658
1996	1,598	2,821	4,419	na	4,419	4,168	8,587
1997[c/]	2,230	3,489	5,718	na	5,718	1,823	7,541

a/ Separate statistics on reduction and nonreduction landings in California are available beginning in 1965, when a separate reduction quota was first established.

b/ Includes anchovy used for canning, consumption as fresh fish, freezing and dead bait.

c/ Preliminary.

Sources: 1962-1974 Mexican landings from Chavez 1977.
1975-1977 Mexican landings from L. Jacobson, NMFS, SWFSC, La Jolla, California.
1978-1997 Mexican landings from Walterio Garcia-Franco, INP-CRIP, Ensenada, Baja California.
1916-1964 California reduction landings and 1939-1964 live bait catches from Tables 3.2-2 and 3.2-3 in PFMC 1983.
1965-1990 California reduction, nonreduction and live bait catches from Thomson et al. 1991 and previous issues of the same report.
1991 California landings from E. Konno, CDFG, Long Beach.
1994-1997 California landings from PacFIN.

TABLE 2.1.1.5-1. California landings of market squid (mt), 1970-1997.

Year	Monterey	Southern California	Statewide Other	Statewide Total
1970	3,914	7,241	0	11,155
1971	7,551	6,745	0	14,296
1972	5,560	3,583	0	9,144
1973	562	4,908	0	5,470
1974	6,575	6,536	0	13,112
1975	2,263	8,451	0	10,715
1976	2,278	6,933	0	9,211
1977	2,027	10,784	0	12,810
1978	9,370	7,776	0	17,145
1979	12,867	7,114	1	19,982
1980	7,127	8,255	1	15,383
1981	12,823	10,685	2	23,510
1982	10,607	5,695	6	16,308
1983	500	862	462	1,824
1984	391	76	97	564
1985	3,813	6,386	77	10,276
1986	5,488	14,957	832	21,277
1987	5,611	14,030	343	19,984
1988	4,897	32,006	329	37,232
1989	7,140	33,724	29	40,893
1990	7,917	20,400	130	28,447
1991	6,700	29,212	1,476	37,388
1992	6,111	4,550	2,449	13,110
1993	6,040	33,736	3,053	42,829
1994	13,648	38,580	3,664	55,892
1995	2,449	66,868	934	70,251
1996	4,672	75,097	550	80,319
1997[a/]	8,283	62,427	208	70,918

a/ Preliminary.
Sources: 1970-1979 data from CDFG 1991a. 1981-1997 data from PacFIN database.

TABLE 2.1.2-1. Total Washington, Oregon, and California landings (mt) of northern anchovy, Pacific and jack mackerel, Pacific sardine, and market squid, by gear type, 1981-1997. Figures may differ from those in Table 2.1.1-1 because of differences between California and PacFIN databases.

Year	Round Haul	Trawl	Pot/Trap	Dipnet	Gill Net	Line	Other/Unkwn	Total
				Northern Anchovy				
1981	52,261.31	0.00	0.13	0.01	0.22	22.24	25.08	52,308.99
1982	41,735.13	0.00	0.00	0.00	0.34	6.99	412.73	42,155.19
1983	1,615.61	0.00	0.00	0.00	0.01	0.02	2,813.97	4,429.61
1984	2,068.36	0.00	0.00	0.00	0.05	0.05	830.42	2,898.87
1985	1,204.09	0.00	0.00	0.00	0.15	0.11	433.30	1,637.64
1986	1,113.43	0.00	0.00	0.03	0.83	0.05	443.10	1,557.42
1987	1,301.43	0.01	0.00	0.18	0.05	0.23	165.38	1,467.29
1988	1,292.10	0.04	0.16	0.41	0.83	53.96	170.72	1,518.21
1989	2,254.05	0.00	0.14	0.00	10.24	0.03	246.74	2,511.21
1990	2,670.59	0.00	0.09	0.05	0.06	35.15	552.70	3,258.65
1991	2,747.19	106.61	0.02	441.19	0.00	24.26	749.01	4,068.29
1992	1,018.47	0.09	0.00	19.33	0.00	4.39	123.31	1,165.59
1993	1,957.74	0.00	0.03	3.00	0.06	41.72	0.12	2,002.68
1994	1,847.57	0.02	0.00	0.00	0.00	7.60	4.22	1,859.42
1995	1,995.78	0.00	0.00	0.10	0.06	16.50	3.37	2,015.81
1996	4,503.62	0.00	0.00	0.93	0.00	0.02	0.00	4,504.57
1997[a/]	5,731.38	0.00	0.00	3.30	0.02	1.95	41.13	5,777.78
				Pacific (chub) mackerel				
1981	35,263.34	2.57	0.16	9.08	46.91	53.51	12.53	35,388.09
1982	35,287.61	5.35	0.26	36.72	55.81	42.81	636.05	36,064.60
1983	32,195.58	5.01	0.00	0.00	23.91	27.77	9,226.94	41,479.22
1984	39,631.74	2.88	0.02	4.10	142.85	145.89	4,156.74	44,084.22
1985	35,349.11	4.35	0.15	4.33	152.14	29.39	2,232.82	37,772.28
1986	43,146.90	0.86	0.75	21.00	63.33	63.54	4,792.85	48,089.25
1987	41,416.35	1.22	0.56	0.00	272.50	37.33	4,997.10	46,725.06
1988	48,308.30	35.25	0.76	0.23	725.47	61.08	1,732.72	50,863.82
1989	45,441.86	3.60	0.04	8.27	83.63	169.46	2,005.91	47,712.76
1990	37,357.65	11.16	0.08	253.25	59.73	39.57	2,370.36	40,091.81
1991	17,874.12	0.49	25.79	148.89	38.99	27.11	13,903.15	32,018.54
1992	15,907.93	468.56	1.85	1,919.75	23.15	69.69	653.87	19,044.80
1993	9,389.11	314.59	1.93	2,290.69	34.00	47.58	51.23	12,129.13
1994	8,579.51	287.15	0.61	1,075.24	8.86	71.29	270.60	10,293.28
1995	8,451.59	199.04	0.71	2.98	6.41	116.85	45.11	8,822.69
1996	9,427.15	143.67	0.52	20.30	21.49	91.42	25.71	9,730.27
1997[a/]	17,860.47	1,956.08	0.10	6.72	11.54	152.77	152.09	20,139.78
				Jack Mackerel				
1981	17,701.72	3.36	0.03	0.00	26.79	6.15	40.12	17,778.18
1982	19,437.03	1.11	0.00	7.99	3.42	0.33	167.51	19,617.39
1983	6,895.87	1.30	0.09	0.00	2.13	0.18	2,929.69	9,829.26
1984	6,248.60	0.05	0.00	0.00	0.65	0.03	2,899.45	9,148.78
1985	6,684.29	0.04	0.00	0.00	1.83	61.29	128.22	6,875.67
1986	4,334.68	0.04	0.00	0.00	4.57	6.47	431.56	4,777.33
1987	5,858.75	0.09	0.00	0.00	177.52	0.96	1,982.89	8,020.22
1988	4,759.30	0.15	0.00	0.00	193.28	37.64	77.15	5,067.52
1989	9,855.21	1.60	0.00	0.00	0.32	101.74	786.52	10,745.40
1990	2,999.40	1.43	0.00	32.27	2.26	1.50	185.76	3,222.61
1991	868.59	19.45	0.00	0.00	1.64	0.63	821.83	1,712.15
1992	1,129.47	319.00	0.01	47.78	4.98	0.55	24.08	1,525.87
1993	1,533.64	276.96	0.00	132.04	0.93	5.73	0.21	1,949.52
1994	2,220.91	202.47	0.00	402.29	0.40	5.22	74.92	2,906.21
1995	1,697.06	149.06	0.00	0.07	1.76	28.76	0.21	1,876.93
1996	2,153.82	256.09	0.00	0.00	0.00	22.12	0.15	2,432.18
1997[a/]	1,156.38	194.07	0.00	0.00	0.39	0.73	0.00	1,351.57

TABLE 2.1.2-1. Total Washington, Oregon, and California landings (mt) of northern anchovy, Pacific and jack mackerel, Pacific sardine, and market squid, by gear type, 1981-1997. Figures may differ from those in Table 2.1.1-1 because of differences between California and PacFIN databases. (Continued).

Year	Round Haul	Trawl	Pot/Trap	Dipnet	Gill Net	Line	Other/Unkwn	Total
				Pacific Sardine				
1981	14.75	0.00	0.00	0.00	0.02	0.00	0.00	14.77
1982	1.82	0.00	0.00	0.00	0.00	0.00	0.00	1.82
1983	0.61	0.00	0.00	0.00	0.00	0.00	0.02	0.63
1984	0.49	0.00	0.00	0.00	0.05	0.00	0.64	1.18
1985	4.84	0.00	0.00	0.00	0.02	0.00	0.98	5.84
1986	321.18	0.00	0.00	3.96	1.00	0.00	62.34	388.48
1987	345.21	0.04	0.00	0.00	7.56	0.07	86.55	439.43
1988	1,094.22	0.00	0.00	0.00	0.91	0.00	93.30	1,188.42
1989	829.54	0.00	0.00	0.00	0.43	0.03	6.71	836.71
1990	1,444.04	0.00	0.00	157.83	1.19	0.13	61.05	1,664.24
1991	4,103.45	0.00	0.00	25.52	0.78	0.23	3,457.41	7,587.39
1992	15,289.44	3.89	0.00	1,926.83	0.13	1.07	732.24	17,953.59
1993	13,715.89	0.25	0.00	1,623.28	0.37	6.56	0.34	15,346.69
1994	10,291.49	0.02	0.00	1,165.11	0.06	1.03	186.07	11,643.79
1995	39,607.75	35.61	0.00	16.75	0.00	181.43	414.07	40,255.62
1996	32,512.65	0.00	0.00	30.76	0.00	10.00	0.00	32,553.42
1997[a/]	42,652.14	0.06	0.00	2.79	0.03	17.75	143.43	42,816.20
				Market Squid				
1981	15,271.11	6.59	0.05	8,223.62	0.66	10.03	3.10	23,515.18
1982	12,491.30	6.66	51.42	3,623.89	11.51	52.14	124.67	16,361.60
1983	839.01	2.38	0.17	515.20	1.18	0.93	640.01	1,998.88
1984	536.88	3.24	0.32	70.91	0.02	0.88	394.18	1,006.42
1985	7,864.66	16.00	0.03	490.42	220.11	29.07	2,451.78	11,072.07
1986	16,690.39	6.22	2.92	63.03	36.96	0.64	4,494.33	21,294.48
1987	15,685.26	8.18	0.86	213.26	838.84	2.19	3,239.46	19,988.05
1988	31,157.77	5.06	0.12	137.34	456.68	0.30	5,476.52	37,233.80
1989	36,419.78	127.26	0.04	240.09	1.12	0.72	4,148.06	40,937.07
1990	25,791.74	2.35	1.40	45.88	0.33	50.24	2,555.29	28,447.23
1991	32,733.46	0.51	11.53	108.44	14.13	0.35	4,520.44	37,388.85
1992	12,443.08	16.79	0.86	408.33	0.09	1.70	246.18	13,117.04
1993	41,698.42	3.18	0.00	1,122.24	8.07	0.00	62.29	42,894.21
1994	54,862.54	21.40	58.69	346.02	0.00	51.12	662.11	56,001.89
1995	67,770.60	3.73	0.08	1,325.89	0.12	129.10	1,145.52	70,375.04
1996	79,668.59	2.94	0.00	757.25	0.04	0.09	0.00	80,428.90
1997[a/]	70,604.48	41.83	0.01	151.42	0.00	18.68	226.04	71,042.47

a/ Preliminary.
Source: Washington, Oregon, and California fish ticket data converted to PacFIN format. Includes unspecified net gears as well as round haul gear.

TABLE 2.1.2-2. Number of California, Oregon, and Washington vessels landing CPS or squid, by principal gear[a/], 1981-1997.

Principal Gear/Year	CPS>0, SQUID=0				CPS>0, SQUID>0				CPS=0, SQUID>0				Grand Total
	CA	OR	WA	Sum	CA	OR	WA	Sum	CA	OR	WA	Sum	
Round Haul[b/]													
1981	46	0	2	48	53	0	1	54	17	0	4	21	123
1982	54	1	1	56	54	0	0	54	12	0	3	15	125
1983	53	0	1	54	24	2	0	26	5	4	10	19	99
1984	55	0	2	57	11	2	0	13	1	8	3	12	82
1985	35	2	2	39	46	0	0	46	8	15	1	24	109
1986	20	0	2	22	45	0	0	45	9	2	1	12	79
1987	26	0	2	28	44	0	0	44	10	0	1	11	83
1988	18	1	3	22	46	0	0	46	25	0	0	25	93
1989	27	0	2	29	45	0	0	45	19	1	0	20	94
1990	20	0	2	22	49	0	0	49	14	0	0	14	85
1991	17	0	2	19	42	0	0	42	13	0	0	13	74
1992	30	0	3	33	29	0	0	29	19	0	2	21	83
1993	19	0	3	22	44	0	0	44	22	3	2	27	93
1994	27	0	2	29	42	0	1	43	26	5	4	35	107
1995	19	1	2	22	59	1	0	60	26	3	3	32	114
1996	20	0	2	22	76	0	0	76	41	3	3	47	145
1997	24	0	2	26	67	2	0	69	37	5	0	42	137
Trawl:													
1981	9	0	0	9	11	0	0	11	17	1	15	33	53
1982	14	0	0	14	6	0	0	6	20	4	12	36	56
1983	17	12	0	29	3	1	0	4	16	7	8	31	64
1984	10	1	0	11	6	0	0	6	13	3	9	25	42
1985	5	1	0	6	10	0	0	10	8	1	10	19	35
1986	3	0	0	3	3	0	0	3	11	4	19	34	40
1987	6	1	0	7	3	0	0	3	11	2	18	31	41
1988	6	2	0	8	1	0	0	1	7	1	13	21	30
1989	14	4	1	19	0	1	0	1	12	1	8	21	41
1990	8	4	1	13	2	0	0	2	12	0	3	15	30
1991	9	4	1	14	1	0	0	1	4	1	4	9	24
1992	13	9	2	24	0	10	1	11	5	6	3	14	49
1993	10	2	3	15	2	13	1	16	3	4	0	7	38
1994	12	14	3	29	1	14	6	21	6	5	3	14	64
1995	8	27	3	38	3	11	1	15	4	8	3	15	68
1996	17	23	11	51	2	15	1	18	1	6	2	9	78
1997	14	15	10	39	5	26	3	34	16	22	2	40	113
Pot/Trap:													
1981	5	0	0	5	0	0	0	0	0	0	0	0	5
1982	1	0	0	1	0	0	0	0	3	3	0	6	7
1983	0	0	0	0	0	0	0	0	5	0	1	6	6
1984	1	0	0	1	0	0	0	0	5	0	0	5	6
1985	2	0	0	2	0	0	0	0	2	0	0	2	4
1986	1	0	0	1	0	0	0	0	0	0	0	0	1
1987	4	0	0	4	2	0	0	2	8	0	0	8	14
1988	3	0	0	3	1	0	0	1	2	0	0	2	6
1989	1	0	0	1	0	0	0	0	1	0	0	1	2
1990	1	0	0	1	0	0	0	0	1	0	0	1	2
1991	3	0	0	3	0	0	0	0	2	0	0	2	5
1992	6	0	0	6	1	0	0	1	4	0	0	4	11
1993	2	0	0	2	0	0	0	0	0	0	0	0	2
1994	2	0	0	2	0	0	0	0	0	0	0	0	2
1995	1	0	0	1	0	0	0	0	0	0	0	0	1
1996	2	0	0	2	0	0	0	0	0	0	0	0	2
1997	0	0	0	0	0	0	0	0	1	1	0	2	2

TABLE 2.1.2-2. Number of California, Oregon, and Washington vessels landing CPS or squid, by principal geara/, 1981-1997. (Continued).

Principal Gear/Year	CPS>0, SQUID=0 CA	OR	WA	Sum	CPS>0, SQUID>0 CA	OR	WA	Sum	CPS=0, SQUID>0 CA	OR	WA	Sum	Grand Total
Dip Net:													
1981	0	0	1	1	9	0	0	9	42	0	2	44	54
1982	2	0	0	2	6	0	0	6	30	0	1	31	39
1983	0	0	0	0	2	0	0	2	25	1	11	37	39
1984	0	0	0	0	1	0	0	1	7	0	12	19	20
1985	1	0	0	1	4	0	0	4	24	0	1	25	30
1986	1	0	0	1	1	0	0	1	8	0	1	9	11
1987	0	0	0	0	1	0	0	1	4	0	0	4	5
1988	0	0	0	0	3	0	0	3	6	0	0	6	9
1989	0	0	0	0	3	0	0	3	5	0	0	5	8
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	1	0	0	1	1	0	0	1	2
1992	3	0	0	3	1	0	0	1	2	0	0	2	6
1993	2	0	0	2	7	0	0	7	7	0	0	7	16
1994	2	0	0	2	7	0	0	7	10	0	1	11	20
1995	1	0	0	1	6	0	0	6	15	0	4	19	26
1996	1	0	0	1	7	0	0	7	16	0	1	17	25
1997	0	0	0	0	3	0	0	3	10	0	0	10	13
Gill Net:													
1981	70	0	0	70	1	0	0	1	2	0	0	2	73
1982	70	0	0	70	1	0	0	1	2	0	0	2	73
1983	58	0	0	58	0	0	0	0	1	0	0	1	59
1984	77	0	0	77	1	0	0	1	0	0	0	0	78
1985	120	0	0	120	3	0	0	3	0	0	0	0	123
1986	106	0	0	106	5	0	0	5	1	0	0	1	112
1987	111	0	0	111	4	0	0	4	4	0	0	4	119
1988	97	0	0	97	2	0	0	2	3	0	0	3	102
1989	84	1	0	85	1	0	0	1	1	0	0	1	87
1990	87	0	0	87	4	0	0	4	1	0	0	1	92
1991	66	0	0	66	0	0	0	0	1	0	0	1	67
1992	41	0	0	41	0	0	0	0	1	0	0	1	42
1993	49	0	0	49	1	0	0	1	1	0	0	1	51
1994	21	0	0	21	0	0	0	0	0	0	0	0	21
1995	19	0	0	19	0	0	0	0	0	0	0	0	19
1996	14	0	0	14	0	0	0	0	0	0	0	0	14
1997	21	0	4	25	0	0	0	0	0	0	0	0	25
Line:													
1981	180	5	0	185	2	0	0	2	1	0	2	3	190
1982	195	3	0	198	0	0	0	0	1	0	1	2	200
1983	92	49	0	141	1	0	0	1	4	0	1	5	147
1984	51	1	0	52	0	0	0	0	1	0	0	1	53
1985	74	1	0	75	2	0	0	2	1	0	0	1	78
1986	65	1	0	66	2	0	0	2	3	0	1	4	72
1987	108	91	0	199	2	0	0	2	3	0	1	4	205
1988	152	75	0	227	2	0	0	2	2	0	0	2	231
1989	161	146	0	307	0	0	0	0	1	0	0	1	308
1990	230	159	1	390	5	0	0	5	3	0	0	3	398
1991	102	35	1	138	0	0	0	0	2	0	1	3	141
1992	303	18	5	326	3	0	0	3	4	0	0	4	333
1993	151	10	3	164	0	0	0	0	0	0	0	0	164
1994	134	1	0	135	1	0	0	1	2	0	0	2	138
1995	106	2	1	109	3	0	0	3	0	0	0	0	112
1996	96	1	0	97	3	0	0	3	0	0	0	0	100
1997	107	6	0	113	2	0	0	2	2	2	1	5	120

TABLE 2.1.2-2. Number of California, Oregon, and Washington vessels landing CPS or squid, by principal geara/, 1981-1997. (Continued).

Principal Gear/Year	CPS>0, SQUID=0 CA	OR	WA	Sum	CPS>0, SQUID>0 CA	OR	WA	Sum	CPS=0, SQUID>0 CA	OR	WA	Sum	Grand Total
Other/Unknown:													
1981	13	0	0	13	0	0	0	0	3	0	0	3	16
1982	14	0	0	14	0	0	0	0	2	0	0	2	16
1983	139	0	0	139	14	0	0	14	12	0	0	12	165
1984	179	0	0	179	17	0	0	17	11	0	0	11	207
1985	103	0	0	103	16	0	0	16	15	0	0	15	134
1986	71	0	0	71	15	0	0	15	16	0	0	16	102
1987	34	0	0	34	7	0	0	7	11	0	0	11	52
1988	29	1	0	30	13	0	0	13	18	0	0	18	61
1989	32	0	0	32	7	0	0	7	11	0	0	11	50
1990	36	0	0	36	7	0	0	7	8	0	0	8	51
1991	28	0	0	28	13	0	0	13	4	0	0	4	45
1992	29	0	0	29	2	0	0	2	6	0	0	6	37
1993	9	0	0	9	1	0	0	1	2	0	0	2	12
1994	18	1	0	19	1	0	0	1	1	0	0	1	21
1995	11	0	0	11	1	0	0	1	0	0	0	0	12
1996	14	0	0	14	1	0	0	1	0	0	0	0	15
1997	12	0	0	12	0	0	0	0	1	0	0	1	13
ALL GEARS:													
1981	323	5	3	331	76	0	1	77	82	1	23	106	514
1982	350	4	1	355	67	0	0	67	70	7	17	94	516
1983	359	61	1	421	44	3	0	47	68	12	31	111	579
1984	373	2	2	377	36	2	0	38	38	11	24	73	488
1985	340	4	2	346	81	0	0	81	58	16	12	86	513
1986	267	1	2	270	71	0	0	71	48	6	22	76	417
1987	289	92	2	383	63	0	0	63	51	2	20	73	519
1988	305	79	3	387	68	0	0	68	63	1	13	77	532
1989	319	151	3	473	56	1	0	57	50	2	8	60	590
1990	382	163	4	549	67	0	0	67	39	0	3	42	658
1991	225	39	4	268	57	0	0	57	27	1	5	33	358
1992	425	27	10	462	36	10	1	47	41	6	5	52	561
1993	242	12	9	263	55	13	1	69	35	7	2	44	376
1994	216	16	5	237	52	14	7	73	45	10	8	63	373
1995	165	30	6	201	72	12	1	85	45	11	10	66	352
1996	164	24	13	201	89	15	1	105	58	9	6	73	379
1997	178	21	16	215	77	28	3	108	67	30	3	100	423

a/ Principal gear is the gear with which a vessel made most of its landings during the year.
b/ Includes vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-3. Number of California, Oregon, and Washington vessels landing CPS or squid, by landing category, 1981-1997.

					Round Haul Vessels[a/]														
	Non-round Haulers				CPS+SQUID<50				CPS=0, SQUID>=50[b/]			0<CPS<50 CPS+SQUID>=50[b/]			CPS>=50				Grand
Year	CA	OR	WA	Sum	CA	OR	WA	Sum	CA	OR	Sum	CA	OR	Sum	CA	OR	WA	Sum	Total
1981	365	6	20	391	37	0	7	44	5	0	5	16	0	16	58	0	0	58	514
1982	367	10	14	391	34	1	4	39	4	0	4	26	0	26	56	0	0	56	516
1983	389	70	21	480	27	5	11	43	1	0	1	2	1	3	52	0	0	52	579
1984	380	5	21	406	18	7	5	30	0	2	2	0	1	1	49	0	0	49	488
1985	390	3	11	404	29	13	3	45	2	4	6	13	0	13	45	0	0	45	513
1986	312	5	21	338	16	2	3	21	2	0	2	8	0	8	48	0	0	48	417
1987	323	94	19	436	22	0	2	24	4	0	4	8	0	8	46	0	1	47	519
1988	347	79	13	439	22	1	3	26	18	0	18	7	0	7	42	0	0	42	532
1989	334	153	9	496	25	1	2	28	14	0	14	6	0	6	46	0	0	46	590
1990	405	163	5	573	25	0	2	27	5	0	5	5	0	5	48	0	0	48	658
1991	237	40	7	284	24	0	1	25	4	0	4	9	0	9	35	0	1	36	358
1992	424	43	11	478	19	0	5	24	13	0	13	10	0	10	36	0	0	36	561
1993	247	29	7	283	26	3	5	34	14	0	14	10	0	10	35	0	0	35	376
1994	218	35	13	266	36	4	6	46	18	1	19	9	0	9	32	0	1	33	373
1995	178	48	12	238	32	4	4	40	17	1	18	15	0	15	40	0	1	41	352
1996	174	45	15	234	41	2	4	47	27	1	28	22	0	22	47	0	1	48	379
1997	194	72	20	286	37	6	1	44	24	0	24	13	0	13	54	1	1	56	423

a/ Includes vessels whose principal gear is round haul or an unspecified net gear.
b/ No Washington boats in this category in any year.

Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-4. Total number of vessels landing CPS or squid in Washington, Oregon, and California and percent distribution of vessels across landings categories, 1981-1997.

			Round Haul Vessels[a/]			
Year	Total	Non-Round Haulers	CPS+Squid<50	CPS=0 Squid>=50	0<CPS<50 SQUID>=50	CPS>=50
1981	514	76.1	8.6	1.0	3.1	11.3
1982	516	75.8	7.6	0.8	5.0	10.9
1983	579	82.9	7.4	0.2	0.5	9.0
1984	488	83.2	6.1	0.4	0.2	10.0
1985	513	78.8	8.8	1.2	2.5	8.8
1986	417	81.1	5.0	0.5	1.9	11.5
1987	519	84.0	4.6	0.8	1.5	9.1
1988	532	82.5	4.9	3.4	1.3	7.9
1989	590	84.1	4.7	2.4	1.0	7.8
1990	658	87.1	4.1	0.8	0.8	7.3
1991	358	79.3	7.0	1.1	2.5	10.1
1992	561	85.2	4.3	2.3	1.8	6.4
1993	376	75.3	9.0	3.7	2.7	9.3
1994	373	71.3	12.3	5.1	2.4	8.8
1995	352	67.6	11.4	5.1	4.3	11.6
1996	379	61.7	12.4	7.4	5.8	12.7
1997	423	67.6	10.4	5.7	3.1	13.2
			CPS Landings			
1981	105,490.0	0.2	0.2	0.0	0.1	99.5
1982	97,839.0	0.2	0.2	0.0	0.3	99.4
1983	55,738.7	18.8	0.6	0.0	0.1	80.5
1984	56,133.1	10.7	0.5	0.0	0.0	88.8
1985	46,291.4	2.3	0.5	0.0	0.3	96.9
1986	54,812.5	1.9	0.3	0.0	0.2	97.6
1987	56,652.0	4.2	0.3	0.0	0.2	95.4
1988	58,638.0	2.7	0.3	0.0	0.1	96.9
1989	61,806.1	3.6	0.6	0.0	0.1	95.7
1990	48,237.3	3.1	0.6	0.0	0.2	96.1
1991	45,386.4	47.2	0.5	0.0	0.3	52.0
1992	39,689.8	2.7	0.6	0.0	0.5	96.2
1993	31,428.0	7.9	0.6	0.0	0.5	91.0
1994	26,702.7	14.2	1.1	0.0	0.4	84.3
1995	52,971.1	0.9	0.3	0.0	0.4	98.4
1996	49,220.4	1.1	0.5	0.0	0.6	97.8
1997	70,085.3	3.3	0.2	0.0	0.2	96.4
			Squid Landings			
1981	23,515.2	31.5	0.8	5.9	28.4	33.5
1982	16,361.6	22.4	0.7	4.7	45.7	26.5
1983	1,998.9	52.1	7.7	7.6	6.2	26.3
1984	1,006.4	39.8	13.9	17.5	13.3	15.6
1985	11,072.1	17.6	2.6	8.0	16.1	55.8
1986	21,294.5	8.6	0.3	2.1	10.9	78.2
1987	19,988.0	15.1	0.6	7.6	14.0	62.6
1988	37,233.8	9.8	0.5	21.4	3.0	65.4
1989	40,937.1	5.9	0.4	30.7	6.4	56.6
1990	28,447.2	4.7	0.5	14.9	9.8	70.0
1991	37,388.9	12.4	0.7	9.9	14.7	62.4
1992	13,117.0	0.2	0.9	37.8	14.8	46.3
1993	42,894.2	0.6	0.4	29.7	10.3	58.9
1994	56,001.9	1.7	0.4	26.3	20.2	51.4
1995	70,375.0	1.8	0.5	19.2	25.5	53.0
1996	80,428.9	0.8	0.9	25.4	21.4	51.5
1997	71,042.5	0.3	0.6	28.8	13.0	57.3

a/ Includes vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries from Washington, Oregon and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997.

Fishing Year and Principal Landing Area	CPS+SQUID<50	CPS=0 SQUID>=50	0<CPS<50 SQUID>=50	CPS>=50	Total
1981					
San Diego	1	0	0	0	1
Orange/LA	7	2	0	40	49
Vent/Sbarb	4	0	0	5	9
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	24	3	16	11	54
SanFran Bay Area	0	0	0	2	2
Northern California	0	0	0	0	0
Oregon	0	0	0	0	0
Washington	7	0	0	0	7
Total	44	5	16	58	123
1982					
San Diego	1	0	0	0	1
Orange/LA	9	0	0	42	51
Vent/Sbarb	2	1	0	6	9
SanLuisObispo	2	0	0	0	2
Monterey/StaCruz	17	3	26	7	53
SanFran Bay Area	3	0	0	1	4
Northern California	0	0	0	0	0
Oregon	1	0	0	0	1
Washington	4	0	0	0	4
Total	39	4	26	56	125
1983					
San Diego	1	0	0	0	1
Orange/LA	12	0	0	42	54
Vent/Sbarb	3	0	0	1	4
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	10	1	2	9	22
SanFran Bay Area	2	0	0	0	2
Northern California	0	0	0	0	0
Oregon	4	0	1	0	5
Washington	11	0	0	0	11
Total	43	1	3	52	99
1984					
San Diego	0	0	0	0	0
Orange/LA	9	0	0	39	48
Vent/Sbarb	5	0	0	1	6
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	4	0	0	9	13
SanFran Bay Area	0	0	0	0	0
Northern California	0	0	0	0	0
Oregon	7	2	1	0	10
Washington	5	0	0	0	5
Total	30	2	1	49	82

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997. (Continued).

Fishing Year and Principal Landing Area	CPS+SQUID<50	CPS=0 SQUID>=50	0<CPS<50 SQUID>=50	CPS>=50	Total
1985					
San Diego	0	0	0	0	0
Orange/LA	10	0	1	33	44
Vent/Sbarb	4	1	0	4	9
SanLuisObispo	2	0	0	0	2
Monterey/StaCruz	12	0	12	8	32
SanFran Bay Area	1	1	0	0	2
Northern California	0	0	0	0	0
Oregon	13	4	0	0	17
Washington	3	0	0	0	3
Total	45	6	13	45	109
1986					
San Diego	0	0	0	0	0
Orange/LA	5	0	1	32	38
Vent/Sbarb	4	1	0	8	13
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	6	1	6	8	21
SanFran Bay Area	0	0	1	0	1
Northern California	0	0	0	0	0
Oregon	2	0	0	0	2
Washington	3	0	0	0	3
Total	21	2	8	48	79
1987					
San Diego	1	0	0	0	1
Orange/LA	6	0	0	33	39
Vent/Sbarb	7	2	2	8	19
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	7	2	5	4	18
SanFran Bay Area	1	0	1	1	3
Northern California	0	0	0	0	0
Oregon	0	0	0	0	0
Washington	2	0	0	1	3
Total	24	4	8	47	83
1988					
San Diego	2	0	0	0	2
Orange/LA	12	2	0	30	44
Vent/Sbarb	3	9	2	8	22
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	4	6	5	3	18
SanFran Bay Area	2	1	0	1	4
Northern California	0	0	0	0	0
Oregon	0	0	0	0	0
Washington	3	0	0	0	3
Total	26	18	7	42	93

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997. (Continued).

Fishing Year and Principal Landing Area	CPS+SQUID<50	CPS=0 SQUID>=50	0<CPS<50 SQUID>=50	CPS>=50	Total
1989					
San Diego	2	0	0	0	2
Orange/LA	11	3	0	30	44
Vent/Sbarb	5	6	1	9	21
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	6	5	5	6	22
SanFran Bay Area	1	0	0	1	2
Northern California	0	0	0	0	0
Oregon	1	0	0	0	1
Washington	2	0	0	0	2
Total	28	14	6	46	94
1990					
San Diego	4	0	0	0	4
Orange/LA	10	0	0	30	40
Vent/Sbarb	3	1	2	6	12
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	8	4	3	11	26
SanFran Bay Area	0	0	0	1	1
Northern California	0	0	0	0	0
Oregon	0	0	0	0	0
Washington	2	0	0	0	2
Total	27	5	5	48	85
1991					
San Diego	3	0	0	2	5
Orange/LA	8	0	0	17	25
Vent/Sbarb	6	1	5	7	19
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	6	2	4	8	20
SanFran Bay Area	1	1	0	1	3
Northern California	0	0	0	0	0
Oregon	0	0	0	0	0
Washington	1	0	0	1	2
Total	25	4	9	36	74
1992					
San Diego	2	0	0	1	3
Orange/LA	7	0	0	29	36
Vent/Sbarb	4	4	0	0	8
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	3	7	10	5	25
SanFran Bay Area	3	2	0	1	6
Northern California	0	0	0	0	0
Oregon	0	0	0	0	0
Washington	5	0	0	0	5
Total	24	13	10	36	83

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997. (Continued).

Fishing Year and Principal Landing Area	CPS+SQUID<50	CPS=0 SQUID>=50	0<CPS<50 SQUID>=50	CPS>=50	Total
1993					
San Diego	1	0	0	0	1
Orange/LA	11	0	1	24	36
Vent/Sbarb	3	10	2	6	21
SanLuisObispo	2	0	0	0	2
Monterey/StaCruz	7	4	7	4	22
SanFran Bay Area	2	0	0	1	3
Northern California	0	0	0	0	0
Oregon	3	0	0	0	3
Washington	5	0	0	0	5
Total	34	14	10	35	93
1994					
San Diego	1	0	0	0	1
Orange/LA	14	0	1	19	34
Vent/Sbarb	8	9	6	4	27
SanLuisObispo	2	0	0	0	2
Monterey/StaCruz	11	9	2	6	28
SanFran Bay Area	0	0	0	3	3
Northern California	1	0	0	0	1
Oregon	4	1	0	0	5
Washington	5	0	0	1	6
Total	46	19	9	33	107
1995					
San Diego	1	0	0	0	1
Orange/LA	14	1	2	22	39
Vent/Sbarb	7	15	11	8	41
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	6	1	2	9	18
SanFran Bay Area	3	0	0	1	4
Northern California	1	0	0	0	1
Oregon	4	1	0	0	5
Washington	4	0	0	1	5
Total	40	18	15	41	114
1996					
San Diego	1	0	0	1	2
Orange/LA	12	1	6	23	42
Vent/Sbarb	17	23	15	12	67
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	10	3	1	10	24
SanFran Bay Area	0	0	0	1	1
Northern California	1	0	0	0	1
Oregon	2	1	0	0	3
Washington	4	0	0	1	5
Total	47	28	22	48	145

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997. (Continued).

Fishing Year and Principal Landing Area	CPS+SQUID<50	CPS=0 SQUID>=50	0<CPS<50 SQUID>=50	CPS>=50	Total
1997					
San Diego	1	0	0	0	1
Orange/LA	19	0	2	28	49
Vent/Sbarb	5	20	10	12	47
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	8	4	1	14	27
SanFran Bay Area	3	0	0	1	4
Northern California	0	0	0	0	0
Oregon	6	0	0	0	6
Washington	1	0	0	1	2
Total	44	24	13	56	137

a/ Vessels whose principal gear is round haul or an unspecified net gear.

Principal landing area is the area in which the vessel made most of its landings during the year.
Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data in PacFIN format.

TABLE 2.1.2-6. Average landings (mt) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1997.

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS+SQUID<50 mt:									
1981	8.6	5.0	0.0	7.0	19.0	0.7	6.8	9.4	56.5
1982	8.0	4.4	0.1	6.4	8.9	1.4	8.6	3.3	41.0
1983	10.5	11.1	0.0	6.2	22.2	0.9	57.0	63.0	170.9
1984	20.1	10.4	0.1	10.8	19.8	1.0	3.0	35.3	100.4
1985	8.9	5.2	0.2	11.4	16.7	3.0	1.7	57.9	105.1
1986	18.5	6.5	0.4	5.4	15.1	0.7	20.1	11.5	78.2
1987	10.9	4.2	0.1	9.0	13.5	0.3	0.0	15.0	53.2
1988	8.5	5.9	1.9	14.6	25.0	0.1	6.8	10.5	73.4
1989	21.6	8.7	0.1	17.9	7.3	0.1	0.0	70.2	125.8
1990	22.5	6.9	0.8	10.7	19.9	0.7	0.1	2.5	64.1
1991	17.2	0.7	0.6	17.7	11.2	0.1	0.0	9.1	56.7
1992	16.0	10.9	4.6	15.2	19.3	0.1	25.1	78.7	170.0
1993	9.5	4.0	6.3	10.5	16.0	0.1	324.3	16.7	387.4
1994	4.9	6.0	6.3	9.9	7.6	3.1	37.0	55.3	130.2
1995	6.5	4.0	3.1	14.4	24.9	0.0	37.8	13.8	104.5
1996	12.5	4.1	4.9	23.2	17.1	0.1	18.8	10.4	91.0
1997	6.4	4.2	2.2	14.6	57.3	5.5	106.8	53.4	250.5
1981	0.0	0.0	0.0	275.6	16.3	0.0	40.9	6.1	338.8
1982	0.0	0.0	0.0	192.4	20.4	0.0	23.6	20.5	256.9
1983	0.0	0.0	0.0	151.9	0.0	0.0	1.8	2.7	156.4
1984	0.0	0.0	0.0	87.8	20.9	0.0	0.8	36.4	146.0
1985	0.0	0.0	0.0	147.1	25.1	0.0	7.9	115.6	295.7
1986	0.0	0.0	0.0	227.0	27.6	0.0	0.1	25.0	279.8
1987	0.0	0.0	0.0	381.6	43.9	21.5	0.0	18.0	465.1
1988	0.0	0.0	0.0	441.9	52.8	0.1	18.2	25.8	538.8
1989	0.0	0.0	0.0	898.0	65.2	0.0	25.8	22.4	1011.5
1990	0.0	0.0	0.0	848.4	36.0	0.0	0.0	3.0	887.4
1991	0.0	0.0	0.0	923.9	61.4	0.0	0.0	9.4	994.7
1992	0.0	0.0	0.0	381.7	52.5	0.0	1.0	16.2	451.5
1993	0.0	0.0	0.0	911.1	34.2	0.0	3.4	20.6	969.3
1994	0.0	0.0	0.0	774.6	32.4	1.7	0.0	16.8	825.5
1995	0.0	0.0	0.0	749.2	28.2	7.8	0.0	72.0	857.2
1996	0.0	0.0	0.0	729.5	37.5	26.3	0.2	8.8	802.4
1997	0.0	0.0	0.0	852.1	106.6	0.0	0.3	17.5	976.5
1981	1.4	8.1	0.0	416.9	29.4	0.0	25.1	5.8	486.7
1982	4.8	10.3	0.0	287.5	45.9	0.0	0.9	9.6	359.0
1983	9.2	15.9	0.0	41.5	74.1	0.1	0.9	16.4	158.2
1984	0.3	0.0	0.0	133.5	0.0	0.0	6.9	81.3	222.0
1985	13.0	6.7	0.0	136.8	41.7	0.0	1.5	5.3	204.9
1986	15.2	7.3	0.9	289.8	40.8	0.0	0.0	4.1	358.0
1987	0.0	10.9	1.3	350.0	54.6	0.5	0.0	19.4	436.6
1988	6.4	10.2	2.8	157.0	46.2	0.0	0.8	4.3	227.7
1989	19.9	10.1	0.0	439.9	48.5	0.1	2.9	6.8	528.2
1990	0.0	27.8	1.4	559.0	0.0	0.0	0.0	37.8	625.9
1991	8.5	7.2	8.9	612.8	41.3	0.0	247.5	248.2	1174.3
1992	18.3	11.9	8.7	194.2	61.8	0.0	0.0	0.7	295.5
1993	5.6	8.3	9.7	443.1	25.9	0.0	0.0	6.4	499.0
1994	0.0	7.3	10.7	1258.8	0.0	32.2	13.1	4.5	1326.6
1995	0.2	8.0	12.6	1197.4	45.2	1.6	0.0	0.8	1266.0
1996	17.2	5.8	11.5	780.8	0.0	7.7	0.7	10.7	834.4
1997	7.3	7.1	5.1	710.1	95.4	0.0	0.2	4.9	830.1

TABLE 2.1.2-6. Average landings (mt) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1997. (Continued).

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS>=50 mt:									
1981	1135.3	959.5	1.0	291.9	52.1	133.1	89.3	3.2	2665.2
1982	1168.6	1040.7	0.5	206.8	105.4	65.0	68.7	5.3	2661.1
1983	74.6	847.1	0.3	32.9	70.0	81.9	82.3	6.6	1195.7
1984	172.7	995.1	0.2	17.4	28.3	78.9	170.6	101.3	1564.5
1985	117.4	992.8	1.3	237.7	41.8	105.2	71.9	5.2	1573.3
1986	93.3	1088.7	27.4	462.3	31.8	15.4	226.5	79.8	2025.2
1987	154.1	1165.6	26.1	431.5	42.2	131.3	116.7	10.2	2077.6
1988	145.1	1359.2	53.4	737.6	54.7	148.7	94.4	8.8	2601.9
1989	176.1	1222.0	37.6	643.1	52.6	38.5	57.8	176.4	2404.3
1990	165.1	887.7	44.8	510.7	48.7	156.5	127.4	162.5	2103.5
1991	174.7	598.0	152.1	842.6	46.7	10.3	27.8	3.6	1856.0
1992	87.6	592.8	521.4	319.4	17.4	69.0	104.2	3.2	1715.1
1993	124.8	372.0	466.5	870.6	39.9	25.3	140.1	6.0	2045.1
1994	98.9	408.4	337.0	1028.5	22.3	17.6	189.6	11.0	2113.2
1995	84.5	326.9	1001.8	1037.0	49.1	9.6	288.3	9.5	2806.6
1996	160.3	302.0	735.3	964.0	62.1	26.4	337.3	11.1	2598.4
1997	178.5	414.9	791.5	904.8	109.8	23.9	165.7	63.8	2652.8
All Round Haul Vessels:									
1981	917.7	582.4	1.0	214.9	32.8	109.2	68.1	6.2	1932.4
1982	878.2	544.4	0.4	184.1	47.2	58.8	57.0	6.1	1776.1
1983	42.4	583.3	0.3	21.3	40.2	62.0	67.8	38.2	855.5
1984	106.3	772.8	0.1	24.2	25.6	72.4	141.3	67.9	1210.6
1985	45.5	609.0	1.0	130.4	31.9	88.6	45.2	41.6	993.1
1986	57.2	844.4	18.5	341.6	29.4	13.4	193.6	45.4	1543.6
1987	78.3	796.9	18.4	308.5	39.6	102.0	104.4	13.5	1461.6
1988	59.5	939.7	43.5	473.0	47.9	128.9	73.2	12.3	1778.1
1989	92.8	894.7	34.4	592.7	48.5	34.7	51.3	105.6	1854.7
1990	117.6	686.9	40.5	430.3	42.1	130.6	114.7	93.4	1656.0
1991	103.7	385.9	125.0	601.0	46.6	7.4	96.4	43.6	1409.6
1992	47.4	437.8	371.4	261.9	40.9	60.9	89.7	21.5	1331.5
1993	66.7	238.1	331.1	600.3	29.5	22.2	163.2	13.5	1464.6
1994	53.1	215.4	194.0	705.9	22.5	14.8	156.2	32.6	1394.5
1995	57.6	197.0	628.9	751.2	38.3	6.4	254.9	23.2	1957.4
1996	112.6	166.2	478.7	648.4	35.3	20.0	211.3	10.3	1682.7
1997	137.6	282.3	586.5	638.0	98.1	19.0	130.9	49.3	1941.6

a/ Vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-7. Average exvessel revenues ($1,000's; base year=1990) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1997.

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS+SQUID<50 mt:									
1981	3.3	1.6	0.0	3.1	25.1	0.5	18.7	17.5	69.8
1982	4.0	1.3	0.1	2.5	13.2	0.7	22.4	8.0	52.3
1983	4.3	3.0	0.0	4.6	37.6	0.8	79.6	86.5	216.4
1984	7.9	2.2	0.1	6.6	13.5	0.6	5.2	44.0	80.1
1985	3.8	1.5	0.2	5.6	34.7	0.7	3.1	60.6	110.2
1986	7.9	0.9	0.1	1.5	10.3	0.4	28.4	31.0	80.4
1987	4.7	0.9	0.1	3.0	9.9	0.2	0.1	26.6	45.5
1988	4.5	1.2	0.5	3.4	18.7	0.1	9.8	17.1	55.3
1989	21.7	1.1	0.0	3.5	8.3	0.1	0.0	64.0	98.7
1990	13.5	1.0	0.1	1.8	21.9	0.6	0.3	5.6	44.7
1991	4.7	0.4	0.1	2.9	11.8	0.1	0.0	22.4	42.5
1992	5.1	2.5	0.4	2.9	28.7	0.1	54.7	95.5	189.9
1993	3.9	1.1	0.7	3.6	9.2	0.1	282.3	36.7	337.7
1994	1.7	1.6	0.6	2.9	7.3	1.2	57.0	66.2	138.5
1995	4.6	1.2	0.6	4.3	41.3	0.0	57.3	27.9	137.1
1996	5.1	0.9	0.3	6.8	46.3	0.1	29.0	26.0	114.5
1997	3.0	0.7	0.3	4.0	65.3	2.4	90.3	61.1	227.1
CPS=0, SQUID>=50 mt:									
1981	0.0	0.0	0.0	86.2	24.8	0.0	113.0	24.7	248.8
1982	0.0	0.0	0.0	53.4	38.5	0.0	48.7	11.3	151.9
1983	0.0	0.0	0.0	85.4	0.0	0.0	2.8	34.4	122.6
1984	0.0	0.0	0.0	48.1	14.2	0.0	1.0	70.1	133.4
1985	0.0	0.0	0.0	64.1	32.1	0.1	10.5	218.6	325.4
1986	0.0	0.0	0.0	61.8	27.6	0.0	0.3	26.3	116.0
1987	0.0	0.0	0.0	79.0	27.4	10.9	0.0	43.5	160.7
1988	0.0	0.0	0.0	104.2	21.5	0.1	36.7	56.0	218.4
1989	0.0	0.0	0.0	157.1	14.0	0.0	36.4	21.8	229.3
1990	0.0	0.0	0.0	229.8	23.9	0.0	0.0	5.5	259.1
1991	0.0	0.0	0.0	183.1	43.6	0.0	0.0	26.6	253.3
1992	0.0	0.0	0.0	69.9	49.0	0.0	2.3	45.0	166.2
1993	0.0	0.0	0.0	202.6	18.5	0.0	4.1	42.5	267.7
1994	0.0	0.0	0.0	230.3	24.3	0.3	0.0	106.1	360.9
1995	0.0	0.0	0.0	227.1	49.1	1.8	0.0	70.8	348.8
1996	0.0	0.0	0.0	259.2	77.5	6.1	0.3	29.2	372.4
1997	0.0	0.0	0.0	202.5	110.0	0.0	0.4	26.1	339.0
0<CPS<50, SQUID>=50 mt:									
1981	0.1	1.8	0.0	178.6	31.0	0.0	68.8	3.4	283.7
1982	1.1	2.7	0.0	107.7	36.1	0.0	2.2	8.4	158.4
1983	2.0	5.9	0.0	26.1	111.4	0.1	1.4	35.1	182.0
1984	0.1	0.0	0.0	79.1	0.0	0.0	9.5	327.4	416.0
1985	3.3	1.5	0.0	77.7	46.4	0.0	1.7	8.4	138.9
1986	3.5	1.6	0.3	89.1	29.2	0.0	0.0	16.2	140.0
1987	0.0	2.0	0.3	83.9	35.1	0.4	0.0	46.6	168.3
1988	1.5	1.2	0.6	38.8	18.4	0.0	13.1	6.6	80.2
1989	3.4	1.7	0.0	91.1	20.8	0.1	4.3	18.9	140.2
1990	0.0	4.9	0.1	88.2	0.0	0.0	0.0	54.9	148.1
1991	1.3	1.6	1.0	99.0	29.9	0.0	199.3	278.1	610.2
1992	1.9	2.6	1.9	39.2	60.6	0.0	0.0	0.8	107.1
1993	1.3	1.9	0.8	102.2	13.3	0.0	0.0	2.0	121.5
1994	0.0	1.0	1.0	350.1	0.0	13.5	10.6	21.3	397.4
1995	0.2	1.7	1.0	319.0	62.9	0.3	0.0	2.8	387.8
1996	4.5	1.5	1.1	246.8	0.0	1.8	1.3	14.9	271.9
1997	3.3	0.6	1.8	173.9	109.1	0.0	0.4	6.6	295.4

TABLE 2.1.2-7. Average exvessel revenues ($1,000's; base year=1990) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1997. (Continued).

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS>=50 mt:									
1981	100.2	279.2	0.3	102.4	30.0	113.3	181.1	4.1	810.6
1982	79.4	280.0	0.2	53.2	49.4	39.8	112.3	3.5	617.7
1983	14.5	210.8	0.1	16.7	95.4	41.3	118.1	3.1	500.1
1984	20.4	229.6	0.1	10.8	12.5	29.8	252.2	281.3	836.8
1985	11.7	209.1	0.3	80.1	33.5	26.4	76.9	9.0	447.1
1986	19.6	210.4	6.7	108.6	28.3	5.0	258.1	140.2	776.9
1987	34.8	189.4	4.3	93.7	29.8	69.5	237.5	13.7	672.6
1988	37.8	244.4	6.7	167.5	28.2	67.8	265.8	11.1	829.2
1989	63.0	190.7	8.8	111.6	23.5	17.3	76.5	174.1	665.5
1990	26.9	117.5	5.3	74.9	62.3	69.0	138.3	175.3	669.5
1991	25.9	108.8	18.7	130.9	60.6	4.2	25.7	4.4	379.2
1992	14.4	116.4	49.4	53.1	34.0	26.1	66.6	0.7	360.6
1993	26.5	42.8	42.0	183.5	22.3	7.9	94.7	2.3	421.9
1994	25.9	44.7	48.7	285.0	22.5	8.0	153.9	18.7	607.5
1995	14.2	35.9	79.6	289.2	69.7	4.2	187.8	27.9	708.5
1996	28.0	31.9	59.0	332.1	49.9	10.9	218.8	24.6	755.2
1997	20.6	52.1	62.3	247.0	113.8	10.9	135.5	60.1	702.2
All Round Haul Vessels:									
1981	81.5	169.4	0.3	81.8	28.7	93.0	141.7	9.9	606.3
1982	60.4	146.4	0.1	60.6	33.4	36.0	94.5	6.7	438.1
1983	9.2	145.3	0.1	12.2	60.2	31.4	96.7	51.2	406.2
1984	14.7	178.3	0.1	14.3	12.9	27.4	208.9	165.0	621.6
1985	6.4	128.4	0.3	51.7	37.8	22.3	48.7	53.8	349.4
1986	13.1	163.2	4.5	83.5	23.9	4.4	221.4	84.1	598.1
1987	18.9	129.6	3.0	68.1	26.8	54.0	212.5	24.1	537.0
1988	16.7	168.9	5.5	108.7	22.5	58.7	204.2	22.0	607.3
1989	39.3	139.6	8.0	104.5	18.4	15.6	68.1	103.9	497.5
1990	22.4	91.0	4.8	72.0	49.2	57.6	124.5	102.6	524.2
1991	16.1	70.3	15.4	96.9	49.4	3.0	79.3	54.5	384.8
1992	8.7	86.0	35.4	46.6	45.1	23.1	61.7	27.7	334.3
1993	14.9	27.7	29.8	130.2	16.1	6.9	120.9	25.2	371.8
1994	14.1	23.9	27.9	199.6	18.5	6.5	131.1	54.7	476.4
1995	10.8	21.9	50.0	210.7	57.2	2.5	170.4	34.3	557.9
1996	20.5	17.9	38.4	220.9	50.5	7.4	140.4	24.9	521.0
1997	16.4	35.4	46.4	165.3	104.3	8.6	108.0	52.5	536.9

a/ Vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-8. Mean exvessel price ($/mt; base year=1990) of fish caught by Washington, Oregon, and California round haul gear, 1981-1997.

Year	Anchovy	Mackerel	Sardine	Squid	Bonito	Tuna	All Else
1981	$89	$291	$289	$394	$863	$1,756	$2,266
1982	$69	$269	$393	$331	$614	$1,489	$3,077
1983	$191	$250	$339	$575	$500	$1,229	$1,559
1984	$135	$232	$821	$570	$382	$1,220	$2,973
1985	$129	$209	$291	$380	$254	$957	$1,657
1986	$231	$191	$244	$239	$318	$964	$3,028
1987	$239	$161	$163	$219	$530	$1,142	$3,159
1988	$309	$179	$125	$227	$454	$1,455	$3,874
1989	$437	$156	$229	$175	$450	$1,092	$2,213
1990	$187	$133	$123	$167	$441	$995	$2,971
1991	$177	$177	$123	$160	$384	$842	$1,153
1992	$186	$206	$96	$177	$379	$829	$1,731
1993	$220	$115	$90	$217	$372	$794	$1,197
1994	$264	$113	$143	$283	$448	$862	$2,086
1995	$187	$111	$80	$282	$401	$724	$656
1996	$182	$107	$80	$341	$382	$719	$913
1997	$119	$125	$79	$259	$454	$827	$982

Round haul gear refers to unspecified net gears as well as round haul gear. Sardine prices apply to directed landings only. Mackerel prices apply to sardines landed in mixed loads with mackerel (which receive the same price as mackerel) as well as "pure" loads of mackerel.

Source: Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-9. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997.

	County	CPS>0, SQUID=0	CPS>0, SQUID>0	CPS=0, SQUID>0	Total
1981					
	San Diego	16	5	1	22
	Orange/LA	26	18	0	44
	Vent/Sbarb	8	6	1	15
	SanLuisObispo	5	6	0	11
	Monterey/StaCruz	8	12	9	29
	SanFran Bay Area	6	0	1	7
	Northern California	1	1	6	8
	Oregon	0	0	1	1
	Washington	2	1	11	14
	Unknown	1	0	0	1
	Total	73	49	30	152
1982					
	San Diego	16	1	0	17
	Orange/LA	29	13	1	43
	Vent/Sbarb	5	8	1	14
	SanLuisObispo	2	3	1	6
	Monterey/StaCruz	19	16	8	43
	SanFran Bay Area	12	0	2	14
	Northern California	1	3	2	6
	Oregon	4	0	5	9
	Washington	1	0	9	10
	Unknown	0	0	0	0
	Total	89	44	29	162
1983					
	San Diego	14	3	1	18
	Orange/LA	23	12	1	36
	Vent/Sbarb	6	10	2	18
	SanLuisObispo	3	2	1	6
	Monterey/StaCruz	15	11	1	27
	SanFran Bay Area	21	5	7	33
	Northern California	7	1	1	9
	Oregon	5	6	9	20
	Washington	1	0	23	24
	Unknown	0	0	0	0
	Total	95	50	46	191
1984					
	San Diego	19	1	0	20
	Orange/LA	23	6	0	29
	Vent/Sbarb	5	10	3	18
	SanLuisObispo	1	2	1	4
	Monterey/StaCruz	22	14	1	37
	SanFran Bay Area	27	3	3	33
	Northern California	3	0	1	4
	Oregon	2	2	5	9
	Washington	1	1	12	14
	Unknown	0	0	0	0
	Total	103	39	26	168
1985					
	San Diego	16	0	1	17
	Orange/LA	18	12	2	32
	Vent/Sbarb	7	13	1	21
	SanLuisObispo	5	2	0	7
	Monterey/StaCruz	13	18	5	36
	SanFran Bay Area	24	3	3	30
	Northern California	0	0	1	1
	Oregon	4	0	9	13
	Washington	2	0	6	8
	Unknown	0	0	0	0
	Total	89	48	28	165

TABLE 2.1.2-9. Number of fish dealers[a] who received any CPS or squid, by principal landing area, 1981-1997. (Continued).

	County	CPS>0, SQUID=0	CPS>0, SQUID>0	CPS=0, SQUID>0	Total
1986					
	San Diego	17	2	0	19
	Orange/LA	20	12	2	34
	Vent/Sbarb	3	10	9	22
	SanLuisObispo	5	2	1	8
	Monterey/StaCruz	16	15	4	35
	SanFran Bay Area	19	3	3	25
	Northern California	1	0	2	3
	Oregon	1	0	4	5
	Washington	2	0	11	13
	Unknown	0	0	0	0
	Total	84	44	36	164
1987					
	San Diego	14	5	1	20
	Orange/LA	23	10	2	35
	Vent/Sbarb	4	16	4	24
	SanLuisObispo	6	2	1	9
	Monterey/StaCruz	11	14	9	34
	SanFran Bay Area	20	6	1	27
	Northern California	3	0	1	4
	Oregon	8	0	2	10
	Washington	3	0	9	12
	Unknown	2	0	0	2
	Total	94	53	30	177
1988					
	San Diego	11	6	1	18
	Orange/LA	23	13	1	37
	Vent/Sbarb	10	11	6	27
	SanLuisObispo	3	2	1	6
	Monterey/StaCruz	7	10	5	22
	SanFran Bay Area	18	4	2	24
	Northern California	2	0	2	4
	Oregon	10	1	0	11
	Washington	3	0	6	9
	Unknown	1	0	0	1
	Total	88	47	24	159
1989					
	San Diego	17	3	0	20
	Orange/LA	27	16	1	44
	Vent/Sbarb	10	10	7	27
	SanLuisObispo	7	3	0	10
	Monterey/StaCruz	11	9	7	27
	SanFran Bay Area	20	1	2	23
	Northern California	3	0	2	5
	Oregon	12	3	0	15
	Washington	3	0	5	8
	Unknown	3	0	0	3
	Total	113	45	24	182
1990					
	San Diego	18	6	2	26
	Orange/LA	28	16	1	45
	Vent/Sbarb	10	8	3	21
	SanLuisObispo	2	4	0	6
	Monterey/StaCruz	12	12	5	29
	SanFran Bay Area	25	4	1	30
	Northern California	4	0	2	6
	Oregon	14	0	0	14
	Washington	6	0	2	8
	Unknown	2	0	0	2
	Total	121	50	16	187

TABLE 2.1.2-9. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. (Continued).

	County	CPS>0, SQUID=0	CPS>0, SQUID>0	CPS=0, SQUID>0	Total
1991					
	San Diego	19	0	0	19
	Orange/LA	27	11	3	41
	Vent/Sbarb	7	7	3	17
	SanLuisObispo	3	1	1	5
	Monterey/StaCruz	19	7	1	27
	SanFran Bay Area	8	4	3	15
	Northern California	1	0	2	3
	Oregon	6	1	0	7
	Washington	3	0	4	7
	Unknown	1	0	0	1
	Total	94	31	17	142
1992					
	San Diego	21	0	0	21
	Orange/LA	30	7	0	37
	Vent/Sbarb	7	2	4	13
	SanLuisObispo	2	4	0	6
	Monterey/StaCruz	20	12	1	33
	SanFran Bay Area	20	10	4	34
	Northern California	4	0	2	6
	Oregon	9	4	1	14
	Washington	4	0	6	10
	Unknown	1	0	0	1
	Total	118	39	18	175
1993					
	San Diego	14	0	0	14
	Orange/LA	27	12	3	42
	Vent/Sbarb	12	6	3	21
	SanLuisObispo	2	4	2	8
	Monterey/StaCruz	15	6	1	22
	SanFran Bay Area	12	3	3	18
	Northern California	3	0	0	3
	Oregon	2	6	4	12
	Washington	6	0	4	10
	Unknown	1	0	0	1
	Total	94	37	20	151
1994					
	San Diego	16	3	1	20
	Orange/LA	26	15	0	41
	Vent/Sbarb	6	9	13	28
	SanLuisObispo	1	1	3	5
	Monterey/StaCruz	16	10	4	30
	SanFran Bay Area	13	2	3	18
	Northern California	6	1	1	8
	Oregon	3	9	2	14
	Washington	3	2	7	12
	Unknown	1	0	0	1
	Total	91	52	34	177
1995					
	San Diego	13	2	0	15
	Orange/LA	25	16	1	42
	Vent/Sbarb	13	15	13	41
	SanLuisObispo	0	1	1	2
	Monterey/StaCruz	10	4	1	15
	SanFran Bay Area	15	1	3	19
	Northern California	2	0	1	3
	Oregon	8	6	1	15
	Washington	4	1	11	16
	Unknown	0	0	0	0
	Total	90	46	32	168

TABLE 2.1.2-9. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. (Continued).

	County	CPS>0, SQUID=0	CPS>0, SQUID>0	CPS=0, SQUID>0	Total
1996					
	San Diego	14	3	1	18
	Orange/LA	21	14	4	39
	Vent/Sbarb	11	15	7	33
	SanLuisObispo	0	0	0	0
	Monterey/StaCruz	8	6	0	14
	SanFran Bay Area	18	2	1	21
	Northern California	4	0	0	4
	Oregon	6	5	2	13
	Washington	5	1	6	12
	Unknown	0	0	0	0
	Total	87	46	21	154
1997					
	San Diego	12	3	0	15
	Orange/LA	22	13	4	39
	Vent/Sbarb	8	15	7	30
	SanLuisObispo	1	0	3	4
	Monterey/StaCruz	13	5	1	19
	SanFran Bay Area	25	3	1	29
	Northern California	1	4	4	9
	Oregon	6	8	3	17
	Washington	8	2	1	11
	Unknown	0	0	0	0
	Total	96	53	24	173

a/ Dealers include parent processing plants and associated buying stations.
Principal landing area is the area from which a dealer received the most landings.
Source: PacFIN summary data.

TABLE 2.1.2-10. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons.

	County	CPS+SQUID<500	CPS=0 SQUID>=500	0<CPS<500 CPS+SQUID>=500	CPS>=500	Total
1981						
	San Diego	22	0	0	0	22
	Orange/LA	35	0	2	7	44
	Vent/Sbarb	14	0	0	1	15
	SanLuisObispo	11	0	0	0	11
	Monterey/StaCruz	20	2	5	2	29
	SanFran Bay Area	7	0	0	0	7
	Northern California	8	0	0	0	8
	Oregon	1	0	0	0	1
	Washington	14	0	0	0	14
	Unknown	1	0	0	0	1
	Total	133	2	7	10	152
1982						
	San Diego	17	0	0	0	17
	Orange/LA	35	0	0	8	43
	Vent/Sbarb	12	0	0	2	14
	SanLuisObispo	6	0	0	0	6
	Monterey/StaCruz	34	1	6	2	43
	SanFran Bay Area	14	0	0	0	14
	Northern California	6	0	0	0	6
	Oregon	9	0	0	0	9
	Washington	10	0	0	0	10
	Unknown	0	0	0	0	0
	Total	143	1	6	12	162
1983						
	San Diego	18	0	0	0	18
	Orange/LA	28	0	0	8	36
	Vent/Sbarb	16	0	0	2	18
	SanLuisObispo	6	0	0	0	6
	Monterey/StaCruz	24	0	0	3	27
	SanFran Bay Area	33	0	0	0	33
	Northern California	9	0	0	0	9
	Oregon	20	0	0	0	20
	Washington	24	0	0	0	24
	Unknown	0	0	0	0	0
	Total	178	0	0	13	191
1984						
	San Diego	20	0	0	0	20
	Orange/LA	22	0	0	7	29
	Vent/Sbarb	17	0	0	1	18
	SanLuisObispo	4	0	0	0	4
	Monterey/StaCruz	32	0	0	5	37
	SanFran Bay Area	32	0	0	1	33
	Northern California	4	0	0	0	4
	Oregon	9	0	0	0	9
	Washington	14	0	0	0	14
	Unknown	0	0	0	0	0
	Total	154	0	0	14	168

TABLE 2.1.2-10. Number of fish dealers[a] who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons. (Continued).

	County	CPS+SQUID<500	CPS=0 SQUID>=500	0<CPS<500 CPS+SQUID>=500	CPS>=500	Total
1985						
	San Diego	17	0	0	0	17
	Orange/LA	25	0	0	7	32
	Vent/Sbarb	19	0	0	2	21
	SanLuisObispo	7	0	0	0	7
	Monterey/StaCruz	31	0	2	3	36
	SanFran Bay Area	30	0	0	0	30
	Northern California	1	0	0	0	1
	Oregon	13	0	0	0	13
	Washington	8	0	0	0	8
	Unknown	0	0	0	0	0
	Total	151	0	2	12	165
1986						
	San Diego	19	0	0	0	19
	Orange/LA	26	0	2	6	34
	Vent/Sbarb	18	1	0	3	22
	SanLuisObispo	8	0	0	0	8
	Monterey/StaCruz	31	0	2	2	35
	SanFran Bay Area	24	1	0	0	25
	Northern California	3	0	0	0	3
	Oregon	5	0	0	0	5
	Washington	13	0	0	0	13
	Unknown	0	0	0	0	0
	Total	147	2	4	11	164
1987						
	San Diego	20	0	0	0	20
	Orange/LA	24	0	1	10	35
	Vent/Sbarb	20	0	0	4	24
	SanLuisObispo	9	0	0	0	9
	Monterey/StaCruz	28	3	2	1	34
	SanFran Bay Area	27	0	0	0	27
	Northern California	4	0	0	0	4
	Oregon	10	0	0	0	10
	Washington	12	0	0	0	12
	Unknown	2	0	0	0	2
	Total	156	3	3	15	177
1988						
	San Diego	18	0	0	0	18
	Orange/LA	25	0	1	11	37
	Vent/Sbarb	22	2	0	3	27
	SanLuisObispo	6	0	0	0	6
	Monterey/StaCruz	20	1	0	1	22
	SanFran Bay Area	24	0	0	0	24
	Northern California	4	0	0	0	4
	Oregon	11	0	0	0	11
	Washington	9	0	0	0	9
	Unknown	1	0	0	0	1
	Total	140	3	1	15	159

TABLE 2.1.2-10. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons. (Continued).

	County	CPS+SQUID<500	CPS=0 SQUID>=500	0<CPS<500 CPS+SQUID>=500	CPS>=500	Total
1989						
	San Diego	20	0	0	0	20
	Orange/LA	32	0	2	10	44
	Vent/Sbarb	22	2	1	2	27
	SanLuisObispo	10	0	0	0	10
	Monterey/StaCruz	23	1	2	1	27
	SanFran Bay Area	22	0	0	1	23
	Northern California	5	0	0	0	5
	Oregon	15	0	0	0	15
	Washington	8	0	0	0	8
	Unknown	3	0	0	0	3
	Total	160	3	5	14	182
1990						
	San Diego	26	0	0	0	26
	Orange/LA	36	0	1	8	45
	Vent/Sbarb	18	0	2	1	21
	SanLuisObispo	6	0	0	0	6
	Monterey/StaCruz	23	1	3	2	29
	SanFran Bay Area	29	0	0	1	30
	Northern California	6	0	0	0	6
	Oregon	14	0	0	0	14
	Washington	8	0	0	0	8
	Unknown	2	0	0	0	2
	Total	168	1	6	12	187
1991						
	San Diego	19	0	0	0	19
	Orange/LA	34	0	0	7	41
	Vent/Sbarb	12	1	2	2	17
	SanLuisObispo	5	0	0	0	5
	Monterey/StaCruz	24	0	2	1	27
	SanFran Bay Area	14	1	0	0	15
	Northern California	3	0	0	0	3
	Oregon	7	0	0	0	7
	Washington	7	0	0	0	7
	Unknown	1	0	0	0	1
	Total	126	2	4	10	142
1992						
	San Diego	21	0	0	0	21
	Orange/LA	29	0	0	8	37
	Vent/Sbarb	12	1	0	0	13
	SanLuisObispo	6	0	0	0	6
	Monterey/StaCruz	28	0	3	2	33
	SanFran Bay Area	32	0	2	0	34
	Northern California	6	0	0	0	6
	Oregon	14	0	0	0	14
	Washington	10	0	0	0	10
	Unknown	1	0	0	0	1
	Total	159	1	5	10	175

TABLE 2.1.2-10. Number of fish dealers[a] who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons. (Continued).

	County	CPS+SQUID<500	CPS=0 SQUID>=500	0<CPS<500 CPS+SQUID>=500	CPS>=500	Total
1993						
	San Diego	14	0	0	0	14
	Orange/LA	34	0	0	8	42
	Vent/Sbarb	16	2	2	1	21
	SanLuisObispo	8	0	0	0	8
	Monterey/StaCruz	18	1	2	1	22
	SanFran Bay Area	18	0	0	0	18
	Northern California	3	0	0	0	3
	Oregon	12	0	0	0	12
	Washington	10	0	0	0	10
	Unknown	1	0	0	0	1
	Total	134	3	4	10	151
1994						
	San Diego	20	0	0	0	20
	Orange/LA	33	0	1	7	41
	Vent/Sbarb	19	4	5	0	28
	SanLuisObispo	5	0	0	0	5
	Monterey/StaCruz	26	1	2	1	30
	SanFran Bay Area	18	0	0	0	18
	Northern California	8	0	0	0	8
	Oregon	14	0	0	0	14
	Washington	12	0	0	0	12
	Unknown	1	0	0	0	1
	Total	156	5	8	8	177
1995						
	San Diego	15	0	0	0	15
	Orange/LA	34	0	1	7	42
	Vent/Sbarb	32	2	5	2	41
	SanLuisObispo	2	0	0	0	2
	Monterey/StaCruz	15	0	0	0	15
	SanFran Bay Area	19	0	0	0	19
	Northern California	3	0	0	0	3
	Oregon	15	0	0	0	15
	Washington	16	0	0	0	16
	Unknown	0	0	0	0	0
	Total	151	2	6	9	168
1996						
	San Diego	18	0	0	0	18
	Orange/LA	31	0	0	8	39
	Vent/Sbarb	22	3	5	3	33
	SanLuisObispo	0	0	0	0	0
	Monterey/StaCruz	11	0	1	2	14
	SanFran Bay Area	21	0	0	0	21
	Northern California	4	0	0	0	4
	Oregon	13	0	0	0	13
	Washington	12	0	0	0	12
	Unknown	0	0	0	0	0
	Total	132	3	6	13	154

TABLE 2.1.2-10. Number of fish dealers who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons. (Continued).

County	CPS+SQUID<500	CPS=0 SQUID>=500	0<CPS<500 CPS+SQUID>=500	CPS>=500	Total
1997					
San Diego	15	0	0	0	15
Orange/LA	31	0	0	8	39
Vent/Sbarb	20	3	5	2	30
SanLuisObispo	4	0	0	0	4
Monterey/StaCruz	13	0	2	4	19
SanFran Bay Area	29	0	0	0	29
Northern California	9	0	0	0	9
Oregon	16	0	0	1	17
Washington	11	0	0	0	11
Unknown	0	0	0	0	0
Total	148	3	7	15	173

a/ Dealers include parent processing plants and associated buying stations.
Principal landing area is the area from which a dealer received the most landings.
Source: PacFIN summary data.

TABLE 2.1.2-11. Mean annual landings received by California CPS/squid processors[a/] and percentage of landings consisting of CPS and squid, by purchase category, 1986-1997.

	Category I CPS+Squid<500				Category II CPS=0, Squid>=500		
Year	mt	%CPS	%Squid	Year	mt	%CPS	%Squid
1986	329.0	4.0	6.2	1986	---	---	---
1987	237.4	5.0	4.9	1987	---	---	---
1988	313.2	3.9	5.0	1988	1,760.3	0.0	72.4
1989	270.1	2.8	4.0	1989	1,064.8	0.0	82.7
1990	235.1	5.6	1.7	1990	---	---	---
1991	191.1	10.9	1.8	1991	---	---	---
1992	195.6	4.2	3.4	1992	---	---	---
1993	191.8	5.0	2.5	1993	---	---	---
1994	291.9	4.0	3.2	1994	---	---	---
1995	198.4	4.6	3.6	1995	---	---	---
1996	250.5	4.1	1.5	1996	---	---	---
1997	202.9	3.8	1.5	1997	---	---	---
Avg.	242.2	4.8	3.3	Avg.	1,412.6	0.0	77.6

	Category III 0<CPS<500, CPS+Squid>=500				Weighted Average of II and III		
Year	mt	%CPS	%Squid	Year	mt	%CPS	%Squid
1986	1,570.5	7.8	64.3	1986	1,570.5	7.8	64.3
1987	---	---	---	1987	1,679.4	8.6	51.2
1988	---	---	---	1988	2,178.8	5.3	75.7
1989	1,545.5	2.9	79.8	1989	1,339.5	1.9	80.8
1990	2,367.2	8.3	52.4	1990	2,266.8	7.4	57.4
1991	2,462.5	5.9	76.5	1991	2,430.8	5.0	80.2
1992	2,022.7	1.0	71.4	1992	2,022.7	1.0	71.4
1993	4,843.1	2.5	77.1	1993	4,042.5	2.3	79.4
1994	4,920.3	1.6	75.0	1994	4,920.3	1.6	75.0
1995	5,061.0	3.3	73.8	1995	5,061.0	3.3	73.8
1996	4,831.7	2.5	92.0	1996	4,408.1	2.3	91.3
1997	3,010.0	3.9	96.2	1997	2,512.9	3.1	91.1
Avg.	3,263.4	4.0	75.8	Avg.	2,869.4	4.1	74.3

	Category IV CPS>=500		
Year	mt	%CPS	%Squid
1986	10,410.0	56.2	14.1
1987	7,962.8	53.0	14.9
1988	11,900.7	47.9	24.5
1989	9,964.6	50.8	27.0
1990	7,997.9	57.0	23.6
1991	8,587.3	55.3	32.9
1992	5,933.4	70.9	12.3
1993	6,975.1	42.3	42.4
1994	7,102.7	43.0	51.3
1995	11,859.5	43.0	46.1
1996	12,379.6	38.2	45.1
1997	10,294.0	54.0	46.1
Avg.	9,280.6	51.0	31.7

--- Fewer than three processors fell into category ii and iii in some years. In order to maintain confidentiality, statistics for categories ii and iii are not reported separately in this table for those three years but instead as weighted averages, with the weights being the respective number of processors in the two categories.
a/ Processors include parent companies only.
Source: PacFIN summary data.

TABLE 2.1.2-12. Percentage of total California CPS/squid processors[a/] and percentage of landings of CPS and squid accounted for by dealers in each of four purchase categories, 1986-1997.

	Category I CPS+Squid<500		
Year	%Dealers	%CPS	%Squid
1986	86.0	2.2	8.8
1987	85.1	2.0	5.6
1988	87.3	2.0	4.1
1989	84.2	1.3	2.7
1990	86.3	2.9	1.5
1991	85.3	4.0	0.8
1992	89.5	2.3	5.7
1993	87.0	2.9	1.0
1994	86.6	4.3	1.6
1995	86.4	1.6	0.9
1996	83.7	1.7	0.4
1997	83.6	1.0	0.4
Avg.	85.9	2.4	2.8

	Category II CPS=0, Squid>=500		
Year	%Dealers	%CPS	%Squid
1986	---	---	---
1987	---	---	---
1988	2.7	0.0	10.3
1989	2.5	0.0	6.5
1990	---	---	---
1991	---	---	---
1992	---	---	---
1993	---	---	---
1994	---	---	---
1995	---	---	---
1996	---	---	---
1997	---	---	---
Avg.	2.6	0.0	8.4

	Category III 0<CPS<500, CPS+Squid>=500		
Year	%Dealers	%CPS	%Squid
1986	5.6	1.3	28.6
1987	---	---	---
1988	---	---	---
1989	3.3	0.3	12.1
1990	4.8	2.4	26.1
1991	4.9	1.6	25.2
1992	3.2	0.2	44.0
1993	2.8	1.2	26.1
1994	6.3	2.2	46.2
1995	3.9	1.3	21.3
1996	5.1	1.3	27.7
1997	3.6	0.7	16.3
Avg.	4.4	1.2	27.4

	Weighted Average of Categories II & III		
Year	%Dealers	%CPS	%Squid
1986	5.6	1.3	28.6
1987	3.5	1.0	17.2
1988	3.6	0.8	17.7
1989	5.8	0.3	18.5
1990	5.6	2.4	32.0
1991	5.9	1.6	31.3
1992	3.2	0.2	44.0
1993	3.7	1.2	30.0
1994	6.3	2.2	46.2
1995	3.9	1.3	21.3
1996	6.1	1.3	30.1
1997	5.5	0.7	19.4
Avg.	4.9	1.2	28.0

	Category IV CPS>=500		
Year	%Dealers	%CPS	%Squid
1986	8.4	96.4	62.6
1987	11.4	97.0	77.1
1988	9.1	97.2	78.2
1989	10.0	98.5	78.8
1990	8.1	94.6	66.5
1991	8.8	94.4	67.9
1992	7.3	97.4	50.3
1993	9.3	95.9	69.0
1994	7.1	93.5	52.2
1995	9.7	97.2	77.8
1996	10.2	97.0	69.6
1997	10.9	98.3	80.2
Avg.	9.2	96.4	69.2

--- Fewer than three processors fell into category ii and iii in some years. In order to maintain confidentiality, statistics for categories ii and iii are not reported separately in this table for those three years but instead as weighted averages, with the weights being the respective number of processors in the two categories.
a/ Processors include parent companies only.
Source: PacFIN summary data.

TABLE 2.1.3-1. Estimated number of recreational fishing trips by various modes in California (thousands of trips), 1980-1997.

Year	Shore	CPFV[a/]	Private Boat	Total
1980	6,807	2,152	3,532	12,490
1981	3,745	1,422	2,765	7,933
1982	3,482	2,252	2,544	8,277
1983	3,613	1,629	2,893	8,135
1984	3,741	1,348	3,198	8,286
1985	3,434	1,377	2,989	7,800
1986	3,539	1,537	3,798	8,874
1987	2,836	1,073	3,692	7,601
1988	7,178	833	1,925	9,936
1989	3,220	1,350	2,481	7,051
1990		No survey		
1991		No survey		
1992		No survey		
1993	2,335	1,174	2,681	6,189
1994	2,575	1,201	2,939	6,714
1995	2,706	1,131	2,780	6,617
1996	2,361	1,080	1,935	5,375
1997[b/]	1,896	795	1,526	4,217

a/ Commercial passenger fishing vessels (CPFV's) transport passengers to and from the fishing grounds and provide bait, food, beverage service, gear rental and fish cleaning.

b/ Preliminary.

Source: RecFIN database.

TABLE 2.1.3-2. Proportion of recreational fishing trips in southern California for which anchovy is used as live or dead bait during 1989.

	Fishing Mode			
Bait Status	Beach	Pier	CPFV[a/]	Private Boat
Live	3%	12%	77%	44%
Dead	33%	60%	13%	34%
Live or Dead[b/]	35%	66%	84%	71%

a/ CPFV's transport passengers to and from the fishing grounds and provide bait, food and beverage service, gear rental and fish cleaning.

b/ "Live" + "Dead" do not necessarily sum to "Live or Dead" since some anglers use both live and dead bait on a single trip.

Source: Thomson and Crooke 1991.

TABLE 2.1.4-1. Mexican landings of sardine and Pacific (chub) mackerel (mt) in Ensenada, Baja California, 1961-1997, as available.

Year	Pacific Sardine	Pacific (chub) mackerel
1961	0	N/A
1962	4,580	N/A
1963	4,269	N/A
1964	4,907	N/A
1965	4,286	N/A
1966	2,575	N/A
1967	5,846	N/A
1968	5,135	N/A
1969	N/A	N/A
1970	N/A	N/A
1971	N/A	N/A
1972	N/A	N/A
1973	3,258	103
1974	6,284	82
	Data Not Available	
1978	0	0
1979	0	0
1980	0	0
1981	0	0
1982	0	0
1983	274	135
1984	0	128
1985	3,722	2,582
1986	243	4,883
1987	2,432	2,082
1988	2,035	4,884
1989	6,224	13,387
1990	11,375	35,767
1991	31,391	17,450
1992	34,568	24,345
1993	32,045	7,741
1994	20,877	13,319
1995	35,396	4,821
1996	39,064	5,603
1997	68,439	12,477

Sources: 1961-1974 data from Osuna, et al. 1976.
1978-1997 data from Garcia and Sanchez 1998.

3.0 SOCIOECONOMICS OF THE COASTAL PELAGIC FISHERY

The primary sources of socioeconomic information in this report are (1) the U.S. Bureau of the Census (1977, 1982, 1987-1990, 1997); (2) U.S. Bureau of Economic Analysis (1998); (3) the California Department of Finance (1998); and, (4) Kearney/Centaur (1987a 1987b). Socioeconomic information in this report is generally at the county level, but community-level information is included where available. Dollar amounts are adjusted for inflation using 1989 as the base year. Boats are assigned to a gear type or location by "plurality of landings." For example, a boat that used round haul gear to land 40% of its landings, gillnets to land 30%, and hook-and-line to land 30%, would be defined as a round haul boat.

In this report, demographic data are used to demonstrate changes in the racial and ethnic makeup of coastal counties. Racial groups discussed in this report are white, black, American Indian, Eskimo or Aleutian Islander, and Asian or Pacific Islander. Racial and ethnic groupings may overlap; a group of people with Hispanic ethnicity, for example, might have various racial backgrounds. Ethnic groups discussed in this report distinguish people with Hispanic ancestry from people without Hispanic ancestry.

3.1 Commercial Fleet

Northern anchovy, jack mackerel, Pacific sardine, Pacific (chub) mackerel, and squid are the coastal pelagic species (CPS) included in the CPS fishery management plan. Socioeconomic information is presented in this chapter for Los Angeles, Ventura, and Monterey counties, because they are the most important areas in the CPS fishery and likely to be affected by management of the CPS fishery. Most CPS landings (45% of 546,237 mt) during 1993 through 1997 occurred in Los Angeles and Orange counties where the largest number of CPS vessels and trips also occurred (Table 3.1-1). Ventura County was next with 38% of total CPS landings for the period, followed by Monterey County with 15%. Ventura County accounted for most of the CPS exvessel revenues from 1993 through 1997 (108.8 million in 1989 dollars), 54%, followed by Los Angeles County, 30%, and Monterey County, 14%. Other areas accounted for less than two percent of total landings and less than three percent of total revenues. Finfish comprised 70% of the Los Angeles County and Orange County landings for the period, while squid accounted for over 95% of the Ventura County landings for the period. Monterey had a better balance between finfish and squid landings for the period, 57% finfish, 43% squid (Table 3.1-1).

The most important counties along the West Coast in the context of CPS revenues and landings (Table 3.1-1) are Los Angeles/Orange (45% of CPS landings 1993 through 1997 and 30% of real revenues), Santa Barbara/Ventura (38% of landings and 53% or revenues), and Monterey (15% of landings and 14% of revenues). Socioeconomic information are presented in this chapter for Los Angeles and Monterey counties, because data were readily available.

Vessels using round haul gear (purse seines and lampara nets) are responsible for 99% of CPS total landings and revenues in any given year. The southern California round haul fleet, known locally as the "wetfish fleet", is the most important sector of the CPS fishery in terms of landings (Jacobson and Thomson 1992; Thomson et al. 1994). The wetfish fleet is based primarily in Los Angeles harbor, with small segments in the Monterey and Ventura areas. It harvests Pacific bonito, market squid, bluefin tuna, and other tunas, as well as CPS. During 1993, the fleet consisted of 37 active purse seiners (Thomson et al. 1994) averaging 20 meters in length (Thomson et al. 1991). Approximately one-third of the fleet were steel-hulled boats built during the last 20 years. The rest were wooden-hulled and built in the heyday of the Pacific sardine fleet from 1930 to 1949 (Murphy 1966).

3.2 Setnet Fleet

California setnet (gillnet and trammel net) fishers land small amounts of CPS, primarily for fresh fish markets. Setnet fishers expressed interest in converting to round haul gear and catching CPS after the California Marine Resources Protection Act displaced them from state waters.

Bramel and Kronman (1991) found it technically feasible to convert small gillnet vessels to run with lampara nets for catching CPS. The average fixed cost of conversion (including gear, vessel, and machinery modifications) was estimated to be $16,400 without sonar and $31,400 with sonar. By harvesting wetfish, a converted gillnet boat might earn gross weekly revenues of $1,500 to $2,000, if markets were available.

In 1980, between 100 and 120 Vietnamese fishers and boat owners used setnets to fish from about 40 converted pleasure boats of the 20-foot to 30-foot range in the Monterey Bay area (Orbach and Beckwith 1980). The active Vietnamese fleet, however, comprised 40 fishers to 60 fishers (in a single day as few as three to 15) who worked about 15 boats (in a single day as few as one). The Vietnamese fleet used setnets to target white croaker (kingfish) and halibut, but small amounts of CPS were also taken.

In 1984, 586 setnet fishers (95% of the total) held permits to operate from Pt. Sal to Pt. Reyes; 67% of these were traditional (nonVietnamese), and 33% were Vietnamese (Ueber 1988). The traditional fleet was estimated to include 266 fishers who independently operated 133 vessels, about half of which used setnets. The traditional setnet fleet fished predominantly for Pacific halibut, rockfish, white croaker, shark, lingcod, and sablefish.

3.3 Economic Impact of Commercial Fishery

Growth or decline in fishing affects production, trade, and employment throughout the California economy as fishers make purchases and as the fish are processed, distributed, and marketed. Revenues from these expenditures filter through local, state, and regional economies. Economic multipliers can be used to calculate change in income and employment resulting from a change in the level or the success of fishing (Radtke and Jensen 1987). Economic multipliers have been used to estimate indirect benefits of wetfish fishing (ICF et al. 1988), but the estimates are probably not reliable.

3.4 Sources of Income for California Commercial Fishers

Based on a survey of commercial fishers (ICF 1988), in 1984, 15% of California commercial fishers who operated trawl vessels and troll vessels earned all their income from fishing (ICF 1988). Another 66% earned more than half of their incomes from other occupations. Approximately one-third of trawlers and trollers held full-time shore-based jobs, and 30% held part-time shore-based jobs or pooled their incomes with working spouses who held shore-based jobs. Commerical fishers who were retired from other occupations represented about 20% of those sampled; 17% survived on investment incomes; and an unreported percentage were part-time or full-time students.

3.5 Recreational Fishery

Total participation in southern California sportfishing declined during 1980 to 1989 from 2,408,000 anglers to 1,390,000 anglers (Table 3.5-1). Coastal residents made up 70% to 80% of total anglers; out-of-state residents made up 18% to 25%; and noncoastal southern California residents made up only one to four percent.

3.5.1 Effort

Estimates of recreational fishing effort (number of trips) during 1980, 1985, and 1989 are provided in Table 3.5.1-1. Coastal residents made 89% to 90% of all trips in all years; out-of-state anglers made seven percent to nine percent of all trips; and noncoastal residents made one percent to two percent. In 1980 pier fishing was most popular; 33% of sportfishing was done from man-made structures (Table 3.5.1-1). In 1985, private and rental boat fishing dominated (37%), and in 1989 bank (shore) fishing dominated (40%), although the 1989 data are hard to interpret, because pier fishing may have been included in the figures for shore fishing. Thomson and Crooke (1991) reported that 40% of recreational fishing in 1989 was done from private and rental boats.

3.5.2 Expenditures

Table 3.5.2-1 lists 1989 recreational fishing expenditures by county of residence. The recreational fishery generated significant revenues through boat-related expenditures (moorage fees, insurance, etc.), expenditures on licenses and fishing gear, and trip-related expenditures. In 1989 $536 million was spent by local and visiting anglers in southern California, making recreational fishing an important contributor to local economies.

3.5.3 Demographics

Table 3.5.3-1 lists demographic characteristics for "key" anglers (the angler who made the most trips in a household) in southern California sportfishing households during 1989. The key anglers were predominantly nonHispanic white (85%) and male (91%) with median ages of 25 years to 45 years. Hispanics made up seven percent of total key anglers.

74% of anglers were employed for more than 35 hours per week; 11% were retired. A large proportion (41%) had some college education.

The highest percentage of recreational fishing households had annual incomes in the range of $30,000 to $40,000 (18%), with sizable fractions in the $40,000 to $50,000 range (15%), and the $20,000 to $30,000 range (13%).

3.5.4 Motivation to Fish

Sixty-two percent to 74% of anglers among all four modes (beach, pier, commercial party fishing vessel (CPFV), and private/rental boat) went fishing to relax and "get away from it all" (Table 3.5.4-1). Other motivations were "fishing as a means to do something with family or friends," "fishing to please someone else," "fishing to put food on the table," "the availability of bait," and "the availability of target species."

3.6 Resource Use Conflicts

In the early 1980s controversy arose about how to allocate northern anchovy between recreational and commercial fisheries (Huppert 1981; PMFC 1983). There was conflict over whether anchovy should be a commercial resource for reduction to fishmeal and oil or forage and bait for sportfish.

Hook-and-line fishers operating from Santa Barbara and Morro Bay have expressed concern about the effects of oil exploration in the Santa Barbara Channel. Sound waves from geophysical survey devices used in oil exploration may startle marine fish (Malme et al. 1986; Pearson et al. 1987), affecting search time and catch per unit of effort in adjacent fisheries and decreasing efficiency. Experiments revealed that rockfish catch was substantially reduced during periods of sound transmission such as that used during oil exploration (Kearney/Centaur 1987a, b).

Fishers and seismic boats in the Santa Barbara Channel now maintain sufficient distance to avoid conflict. A National Marine Fisheries Service (NMFS) source stated that seismic activity associated with oil exploration now has an insignificant effect on catch. But hook-and-line fishers from Santa Barbara and Morro Bay continue to encourage NMFS to study the effects of oil exploration.

3.7 Profile - Los Angeles County, California

Most CPS economic activity takes place in Los Angeles County (Table 3.1-1). Harvesting, processing, and support industries are located in San Pedro, Wilmington-Harbor City, and Long Beach.

3.7.1 Population and Housing

Between 1980 and 1990, the population of Los Angeles County increased from 7,477,000 to 8,897,000 (Table 3.7.1-1), from 1,800 persons per square mile to 2,200 persons per square mile. The number of housing units grew at about half the rate of population growth.

3.7.2 Demographics

Between 1980 and 1990 the number of whites in Los Angeles County declined from 68.7% to 56.8% of the total population, and blacks from 12.6% to 11.2%. People of Hispanic ethnic origin increased from 27.6% of the population to 37.8%. The numbers of Asians or Pacific Islanders grew at an average rate of 13.3% annually, from 5.5% in 1980 to 10.8% in 1990 (Table 3.7.1-1).

In 1980, 27.2% of the population was younger than 18 years; 62.9% was between 18 years and 64 years; and 9.9% was older than 64 years. In 1990, the age structure remained virtually the same. The median age was 29.8 years in 1980 and 30.7 years in 1990 (Table 3.7.1-1).

3.7.3 General Economy

The number of employees in Los Angeles County was 3,185,000 in 1980, 3,701,000 in 1991 and 4,053,000 in 1996, about 50% of the population in each year. Unemployment was 6.6% in 1980, 5.8% in 1990 and 8.2% in 1996. Income per employee (in 1989 dollars) was $25,000 in 1991 and rose 12% to $28,383 in 1995. The 1996 per capita income (in 1989 dollars) was $20,413, 15th out of 58 counties in the state, and was 98% of the state average, $20,759.

Payrolls in the county grew for most major industrial sectors from 1980 through 1991. Total payroll grew at an average annual rate of 2.3%, from $73 billion to $92 billion. Agriculture, forestry, and fishing ranked third among major industries with four percent average annual payroll growth; but agriculture, forestry, and fishing contributed a very small portion (0.3%) to total 1991 payrolls. The total county payroll (in 1989 dollars) was $87.1 billion in 1993, increasing to $87.6 billion in 1995. Los Angeles' agriculture, forestry, and fishing sector had a $254.8 million payroll in 1993, 0.3% of the county's total payroll. In 1995, the County's agriculture, forestry, and fishing sector payroll was $242.9 million, a 4.6% decrease from 1993, and was slightly less than 0.3% of the county's total payroll in 1995.

The number of persons employed in Los Angeles County grew 1.3% annually, from 1980 to 1991. Agriculture, forestry, and fishing grew second fastest (3.1% annually), from 10,622 employees in 1980 to 16,059 (0.3% of total employees) in 1991. Employment in agriculture, forestry, and fishing was 16,066, 1.3% of overall employment in 1993, and 15,278 in 1995, 0.4% of total employment.

3.7.4 Earnings

Average 1991 earnings (payroll in 1989 dollars divided by number of employees) were relatively low at $17,000 in the agriculture, forestry, and fishing sector. Average earnings for employees in agriculture, forestry, and fishing were $16,000 per employee in 1993, a 5.9% decrease from 1991, and further decreased 6.3% to $15,000 in 1995.

3.8 Community Profile - San Pedro, California

San Pedro is the single most important port for CPS in Los Angeles County and along the West Coast. It is located in southwest Los Angeles on the southeastern slope of the Palos Verdes Peninsula. San Pedro was incorporated as an independent city in 1909, but annexed in 1988 by the City of Los Angeles. The community's roots developed over a century of participation in fishing and related industries and are described in the San Pedro Community Plan (Environmental Perspectives 1989). The community is small, with a hometown feeling, enhanced by the fact that many residents are employed locally.

The Fisherman's Fiesta has been the most visible community activity associated with fishing. Since its beginning in 1945, the fiesta has celebrated fisher's role in the historical development of the San Pedro area. In October 1991 the fiesta was sponsored by 20 local organizations and drew thousands of people to Fishermen's Wharf to enjoy ethnic foods and entertainment. Sponsors included the Italian American Club, the Apostolic Church of San Pedro and Harbor City, and the Los Angeles Police Department Explorers. The fiesta acknowledges the importance of religious ceremony to fishing with the blessing of the fleet.

3.8.1 Population and Housing

Population in the San Pedro area grew from 62,336 in 1980 to 69,526 in 1990, and density increased from 9.6 persons per acre in 1980 to 11.4 in 1989. Total housing units in San Pedro increased from 25,053 in 1980 to 27,904 in 1990.

3.8.2 Demographics

San Pedro's population is mostly white and nonHispanic (59.7% of the total population in 1980 and 55.0% in 1990) although the proportion of nonwhites (mainly Hispanics) has increased in recent years. Hispanics made up 30.8% of the population in 1980 and 34% in 1990; blacks made up 4.4% of the population in 1980 and five percent in 1990.

3.8.3 Income, Employment, and Poverty

San Pedro's mean household income during 1980 was $29,829. Income earned from wages and salaries averaged $22,362; self-employed income averaged $1,884; income from interest and dividends averaged $1,945; social security, $1,544; and public assistance, $472.

The civilian labor force in 1980 consisted of 27,303 people (43.8% of the total population). Of the total jobs, 35.5% were manufacturing or service, 18.8% clerical, 10.9% professional, 9.6% sales, 9.1% management and administrative, 6.4% labor, 2.3% technical, and 7.3% other.

In 1980, 8,500 people, or 13.6% of the total population in San Pedro, were below the poverty line. Most of the impoverished people were younger than 55.

3.8.4 History

The San Pedro wetfish industry began in the early 1890s with the *F/V Alpha*, a 22-ton sloop-rigged vessel skippered by Captain Young (Scofield 1951). Captain Young supplied sardines and mackerel to the area's first cannery, the California Fish Company, later renamed the Southern California Fish Company. The *F/V Alpha* operated with a seven-man crew, making the first recorded California seine gear harvests in 1894. In addition to CPS, the *F/V Alpha* landed yellowtail, barracuda, and white sea bass, and generally supplied them to canneries rather than fresh fish markets.

The wetfish seine fleet grew as San Pedro shipbuilders added three new vessels from 1895 to 1914. The fleet remained small for nearly 20 years, until success at harvesting bluefin tuna led to a dramatic expansion of the fleet to 125 purse seine vessels by 1920. Some of the additional boats were built locally; others moved into the area from the northeast Pacific. By 1922 the operating fleet dwindled to 65, as many boats returned to the northeast Pacific or remained in port, because of the poor post-World War I economy and reduced prices.

Southern California canneries grew at a rate parallel to that of the fishing fleet. The processing sector expanded first in San Pedro, after early experimentation with fish canning. Albacore tuna was first canned in 1911, and 16 tuna canneries had been established from San Pedro to San Diego by 1916. The capacity of the processing plants grew in response to the success of canned tuna, which also led to the processing of large amounts of mackerel and sardines.

The wetfish industry suffered from the sharp decline in sardine abundance from the mid 1940s through the 1960s. This was compounded in the 1970s by rising operating costs (primarily fuel) and static fish prices. Perrin and Noetzel (1970) found expansion or construction of new wetfish seiners economically infeasible, even with construction subsidies, because of catch rates and fish prices.

During the 1980s, the commercial fishing industry in Los Angeles continued to decline, directly affecting the local economies of San Pedro and Wilmington. One reason cited for the decline was price-cutting competition from foreign fisheries, which allegedly operated with lower labor costs and government subsidies. State and local taxes and high insurance costs were blamed as additional burdens on the struggling industry. By 1986, only one fish packing plant remained of the 14 that constituted the industry in 1960. The business community, dependent on San Pedro's revenue base, was severely affected by job losses in the local fishery and related industries. The Terminal Island Star-Kist facility closure in October 1984 reportedly caused the loss of 1,200 jobs (California Legislature Senate Committee on Governmental Organization 1986). Two additional major canneries closed in the early 1990s.

3.8.5 Residential Distribution of Crew Members

Zip codes on file with the American Federation of Labor - Congress of Industrial Organizations (AFL-CIO) office in San Pedro are probably representative of crew residence, although some fishers may keep post office boxes near their work. According to Ms. Terry Hoinsky, Fisherman's Union representative, in 1991 the AFL-CIO represented 184 crewmen, or about 30% of the crew members who worked on vessels out of San Pedro.

Crew members resided primarily (89.0%) in the San Pedro area. Some (5.4%) lived in the surrounding communities of Wilmington, Lomita, Palos Verdes Peninsula, and South Gate; others (3.2%) commuted from Carson, Van Nuys, and Torrance.

3.8.6 Crew Demography

Ethnicity and demographic data are available for commercial fishers employed on six vessels that operated in the wetfish fishery during 1977, 1980, 1985, and 1990 (Table 3.8.6-1). These vessels employed between 98 crewman and 70 crewmen annually for the years specified. It was not possible to determine the ages for six crew members, but ethnicity data were available for all.

Italian crew members were the dominant ethnic group throughout the entire period and ranged from 54% to 63% of the total (Table 3.8.6-1). Yugoslavians ranged from 14% to 34% of the total crew and were the second most numerous group until 1990 when they were displaced by Hispanics. All six boats were owned by Italians, who may have employed Italian crew members, because of cultural and familial ties.

The crew became younger over the first period, averaging 47 years in 1977 and 40 years in 1980 (Table 3.8.6-1). Average age increased during the remaining periods (45 years in 1985 and 49 years in 1990). Hispanic crew over the entire period were comparatively younger (30 years to 42 years) than crew members from other ethnic groups, except for a single 27-year-old Portuguese in 1990. Ages for Italian crew ranged from 40 years to 51 years and were equal to or greater than the median in all years.

Jacobson and Thomson (1992) indicate that changes in the ethnicity of crew members are due to different "opportunity costs" among traditional Italian and Yugoslavian crew members and more recent participants who were mostly Hispanic. Declining economic opportunities in the fishery may have contributed to the overall decline in crew members.

3.9 Profile - Ventura County, California

Ventura represented the most important region in terms of revenues and the second most important region in terms of landings by the CPS fishery for the 1993 through 1997 period, because of squid. Port Hueneme is the center of CPS fishing activity in Ventura County.

3.9.1 Population and Housing

Total population in Ventura County was 529,174 in 1980 and grew on average by 2.6% annually to 669,016 in 1990. The estimated population in 1997 was 725,968, an 8.5% increase since 1990. Population density also increased by 2.6% annually, from 286 persons per square mile in 1980 to 362 in 1990 and to 393 in 1997. Between 1980 and 1990, available housing units grew at 2.5% average annually, from 183,384 to 228,478.

3.9.2 Demographics

From 1980 to 1990, the white population of Ventura County grew at an average annual rate of 1.4%. Hispanics increased at an average annual rate of 5.4%, from 21.6% of the population in 1980 to 26.6% in 1990. Although the number of Asians and Pacific Islanders increased at an average annual rate of 10.9%, they still represented only small segments of the population: 3.0% in 1980 and 4.9% in 1990. Even though the black population grew at 1.9% annual rate, their proportion of the total population remained virtually unchanged from 2.1% in 1980 to 2.2% in 1990. American Indians, Eskimos, and Aleutian Islanders constituted 0.7% of the total population (3,805) in 1980 and 0.5% (3,440) in 1990, a decline of 1.0% average annually.

In 1980, 31.2% (166,095) of Ventura County's population was younger than 18; 61.2% was between the ages of 18 and 65; and 7.6% was older than 65. By 1990 the population had aged slightly: 27.6% was less than 18; 64% was between the ages of 18 and 65; and, 8.7% was greater than 65. The median age in the county was 27.8 in 1980 and 30.5 in 1990.

3.9.3 General Economy

The civilian labor force in Ventura County was 249,037 persons in 1980, 353,613 in 1990, and 381,800 in 1996. The unemployment rate dropped from 9.1% in 1980 to 8.8% in 1990 and to 7.1% in 1996. Per capita income (in 1989 dollars) was $13,276 in 1979, $17,861 in 1989, and $20,647 in 1995. The 1996 per capita income increased to $21,144, 13th out of 58 counties in California, and was 102% of the state average, $20,759.

The total county payroll (in 1989 dollars) was $3.7 billion in 1993, increasing to $4.3 billion in 1995. Ventura's agriculture, forestry, and fishing sector had a $47.6 million payroll in 1993, 1.3% of the county's total payroll. In 1995, Ventura's agriculture, forestry, and fishing sector payroll was $45.3 million, a 4.8% decrease from 1993, and was 1.1% of the county's total payroll.

The total number of employees in Ventura's agriculture, forestry, and fishing sector grew from 15,922 in 1980 to 17,892 in 1990, an average of 1.2% annually. The overall civilian labor force increased 41.9% between 1980 and 1990, a 4.2% annual average. Employment in the agriculture, forestry, and fishing sector was 6.4% of overall employment in 1980, 5.1% in 1990, 5.6% in 1993 and 4.9% in 1995.

3.9.4 Earnings

Ventura County earnings (in 1989 dollars) averaged $21,176 per worker in 1993 and increased slightly to $21,517 in 1995. Among major industrial sectors, agriculture, forestry, and fishing paid $13,760 per employee in 1993 and increased 2.7% to $14,129 per employee in 1995.

3.10 Profile - Monterey County, California

Monterey represents the third most important region in terms of landings and revenues by the CPS fishery.

3.10.1 Population and Housing

Total population in Monterey County was 290,444 in 1980 and grew on average by 2.2% annually to 355,660 in 1990 (Table 3.9.1-1). Population density also increased by 2.2% annually, from 88 persons per square mile in 1980 to 107 in 1990. Available housing units grew at 1.7% average annually, from 103,557 in 1980 to 121,224 in 1990. The estimated population in 1997 was 361,907, up 1.8% from 1990, with a density of 109 persons per square mile.

3.10.2 Demographics

From 1980 to 1990, the white population of Monterey County grew at an average annual rate of 1.3% (Table 3.9.1-1). This rate was less than the county average. Hispanics increased at an average annual rate of 5.9%, from 25.9% of the population in 1980 to 33.6% in 1990. Although the number of Asians and Pacific Islanders increased at an average annual rate of 3.9%, they still represented only small segments of the population, 6.9% in 1980 and 7.8% in 1990. Although the black population grew at 1.9% average annually, their proportion of the total population declined from 6.6% in 1980 to 6.4% in 1990. American Indians, Eskimos, and Aleutian Islanders constituted 1.2% of the total population (3,550) in 1980 and 0.8% (3,017) in 1990, a decline of 1.5% average annually.

In 1980, 28.3% (82,295) of Monterey County's population was younger than 18; 62.4% was between the ages of 18 and 64; and 9.2% were older than 64 (Table 3.9.1-1). By 1990, there had been no significant change. The median age in the county was 27.8 in 1980 and 29.6 in 1990.

3.10.3 General Economy

The civilian labor force in Monterey County was 64,801 persons in 1980, 85,875 in 1991, and increased 108.8% to 179,300 in 1996. The unemployment rate dropped from 9.1% in 1980 to 8.8% in 1990, and rose to 11.0% in 1996. Income per capita (in 1989 dollars) was $19,000 in 1991 and 20,500 in 1996, a 7.9% increase.

The total county payroll (in 1989 dollars) was $1.6 billion in 1988 (Table 3.10.3-1). Among Monterey's major industrial sectors, agriculture, forestry, and fishing was second in payroll growth (6.1% average annually), rising from $24 million in 1980 to $41 million in 1991. Although this sector's growth was strong, it contributed only a small percentage (2.5% in 1991) to the total payroll. The Monterey county payroll was $1.7 billion in 1993, increasing to $1.9 billion in 1995. Monterey County's agriculture, forestry, and fishing sector had a $38.6 million payroll in 1993, 2.3% of the county's total payroll. In 1995, the County's agriculture, forestry, and fishing sector payroll was $89.7 million, a 132.4% increase from 1993, and represented 4.7% of the county's total payroll in 1995.

The total number of employees in Monterey County grew 2.2% average annually, from 65,000 to 86,000. Agriculture, forestry, and fishing grew at 3.3% average annually, the fourth fastest rate. Agriculture, forestry, and fishing maintained 2.2% of the total employees in 1991. Employment in agriculture, forestry, and fishing was 1,787, 2.0% of overall employment in 1993, and increased to 3,315, 3.5% of total employment in 1995.

3.10.4 Earnings

Monterey County earnings (payroll in 1989 dollars divided by number of employees) in 1988 averaged $19,000. Among major industrial sectors, agriculture, forestry, and fishing paid sixth highest, $21,000 per employee. Average earnings for employees in the agriculture, forestry, and fishing sector were $22,000 in 1993 up 4.8% from 1988, and rose another 22.7% to $27,000 in 1995.

3.10.5 History

The history of the sardine fishery in the Monterey area is described by Reinstedt (1978).

3.10.6 Residential Distribution of Crew Members

The residential distribution of 128 crew members in the AFL-CIO Fisherman's Union who lived in Monterey County is described in Table 3.9.8-1: 79.7% (102) lived in the Monterey city area, and 11.7% in the Seaside area. Some came from Pacific Grove, Marina, King City, and Carmel.

TABLE 3.1-1. Total commercial landings and revenues (1997 dollars) for species in the PacFIN "WETF" (wetfish) complex (includes Pacific [chub] mackerel, jack mackerel, market squid, northern anchovy, Pacific bonito, Pacific sardine, and unspecified mackerel) by county in Washington, Oregon, and California during 1993 through 1997. Counties are listed from south to north.

County	Landings (mt)	% Total Landings	Revenues ($1997)	% Total Revenues
San Diego	522	0%	$285,184	0%
Los Angeles/Orange	246,204	0%	41,268,508	0%
Santa Barbara/Ventura	209,401	38%	$73,148,255	53%
San Luis Obisbo	3,804	1%	$1,625,244	1%
Monterey	80,999	15%	$18,669,794	14%
Santa Cruz	424	0%	$134,053	0%
San Mateo	4,789	1%	$1,521,630	1%
San Francisco	638	0%	$233,455	0%
Alameda	0	0%	$97	0%
Sonoma/Marin	10	0%	4,606	0%
Mendocino	1	0%	$1,448	0%
Humboldt	117	0%	$30,084	0%
Del Norte	10	0%	$4,395	0%
Other or Unknown California	40	0%	$17,706	0%
Curry	0	0%	$4	0%
Coos	19	0%	$2,959	0%
Douglas	1	0%	$214	0%
Lincoln	2,554	0%	$28,650	0%
Tillamook	0	0%	$5	0%
Clatsop	1,080	0%	$17,533	0%
Pacific	257	0%	$108,056	0%
Grays Harbor	395	0%	$189,595	0%
Snohomish	0	0%	$2	0%
Jefferson	0	0%	$4	0%
Whatcom	4	0%	$562	0%
Clallam	0	0%	$8	0%
Skagit	28	0%	$16,526	0%
Total	551,297	100%	$137,308,578	100%

TABLE 3.5-1. Estimated number of marine recreational fishers (thousands) in southern California.[a/]

Residence of Participant	1980 Number	1980 Percent	1985 Number	1985 Percent	1989 Number	1989 Percent
Coastal[b/]	1,710	71.00	994	71.60	1,119	80.50
Noncoastal	91	3.80	50	3.60	20	1.40
Out of state	607	25.20	344	24.80	250	18.10
Total	2,408	100.00	1,388	100.00	1,390	100.00

a/ Los Angeles, Orange, San Diego, San Luis Obispo, Santa Barbara, and Ventura counties.
b/ Within 25 miles of the coast.

Sources: Department of Commerce, NOAA, NMFS, Marine Recreational Fishing Statistical Survey (MRFSS). Report Numbers 8321 and 8328 and 1989 tables (Washington, D.C.: 1984, 1986, and 1989).

TABLE 3.5.1-1. Estimated number of marine recreational fishing trips (thousands) in southern California[a/] during 1980, 1985, and 1989 by mode and residence.

Mode	Coastal[b/]	Percent	Noncoastal	Percent	Out-of-state	Percent	Total	Percent
				1980				
Pier[c/]	2,700	30.2	59	0.7	203	2.3	2,962	33.1
Bank[d/]	1,540	17.2	45	0.5	160	1.8	1,745	19.5
CPFV[e/]	1,392	15.6	33	0.4	274	3.1	1,699	19.0
Private[f/]	2,371	26.5	53	0.6	116	1.3	2,540	28.4
Total	8,003	89.5	190	2.2	753	8.5	8,946	100.0
				1985				
Pier	1,284	24.3	27	0.5	104	2.0	1,415	26.8
Bank	654	12.4	21	0.4	68	1.3	743	14.1
CPFV	947	17.9	19	0.4	186	3.5	1,152	21.8
Private	1,826	34.6	43	0.8	98	1.9	1,967	37.3
Total	4,711	89.2	110	2.1	456	8.7	5,277	100.0
				1989				
Pier								
Bank	1,744	37.5	19	0.4	89	1.9	1,852	39.9
CPFV	937	20.2	16	0.3	180	3.9	1,133	24.4
Private	1,590	34.2	20	0.4	50	1.1	1,660	35.7
Total	4,271	91.9	55	1.2	319	6.9	4,645	100.0

a/ Los Angeles, Orange, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.
b/ Within 25 miles of the coast.
c/ Structures such as piers, docks, jetties, breakwaters, breachways, bridges, and causeways.
d/ Beaches and banks.
e/ Party and charter boats.
f/ Private and rental boats.

Sources: Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, MRFSS, Report Numbers 8321, 8328, (Washington, D.C.: 1984 and 1986) and 1989 data tables.

TABLE 3.5.2-1. Total annual expenditures for saltwater fishing ($1,000s), by expenditure category and county of residence during 1989.

			Trip-Related Expenditures					
County of Residence	Licenses and Gear	Boat-Related Expenditures	Beach	Pier	CPFV	Private Boat	Total	Grand Total
Los Angeles	35,765.60	27,106.10	3,275.20	10,240.00	80,960.10	40,709.00	135,184.40	198,056.10
Orange	14,914.90	39,551.80	1,888.70	2,576.60	31,296.00	27,963.00	63,724.30	118,191.00
Riverside	2,660.50	2,203.10	281.40	1,309.20	8,526.80	4,752.70	14,870.10	19,733.70
San Bernardino	3,077.60	4,010.90	46.60	1,915.60	6,016.30	5,191.60	13,170.00	20,258.50
San Diego	13,101.20	19,490.70	4,614.80	3,801.20	15,959.00	19,095.20	43,470.30	76,062.20
San Luis Obispo	1,156.90	1,037.40	492.40	462.1	2,454.30	1,953.10	5,361.90	7,556.20
Santa Barbara	1,719.10	2,473.40	1,256.60	894.6	1,210.90	3,893.00	7,255.10	11,447.60
Ventura	3,018.50	5,544.70	908.60	1,340.30	6,817.00	5,267.40	14,333.30	22,896.50
Noncoastal	12,678.30	18,967.10	3,532.30	5,163.30	14,752.30	6,965.50	30,413.40	62,058.80
Total	88,092.70	120,385.20	16,296.60	27,703.00	167,992.70	115,790.60	327,782.80	536,260.60

Source: Thomson and Crooke 1991.

TABLE 3.5.3-1. Demographics of southern California anglers by county of residence during 1989.

	LA (%)	Orange (%)	River (%)	San Bern (%)	San D (%)	San L Ob (%)	San B (%)	Vent (%)	Other (%)	Average (%)
Age										
1-12	0.6	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.1
13-16	0.2	2.0	2.3	1.0	1.0	2.8	2.0	1.8	2.4	1.8
17-24	10.4	9.0	9.7	8.2	14.9	8.8	11.4	7.7	12.9	10.3
25-34	31.8	31.3	27.3	28.2	30.8	28.9	22.9	28.1	18.8	27.6
35-44	23.7	26.4	36.4	32.8	22.9	24.5	33.8	26.7	21.2	27.6
45-54	16.8	15.9	13.6	15.9	14.9	14.9	13.4	19.5	25.9	16.8
55-64	9.2	10.4	5.7	8.7	9.0	8.4	7.0	10.0	10.6	8.8
>64	5.0	5.1	5.1	6.5	11.6	9.0	6.3	6.3	8.2	7.0
Male	91.3	92.1	90.4	90.8	88.6	88.4	92.1	92.3	90.6	90.7
Ethnicity										
Asian/Pac	5.1	3.9	2.2	2.0	5.4	1.6	3.9	3.1	0.0	3.0
Black	6.3	0.0	1.7	3.5	1.5	0.4	1.0	1.3	1.2	1.9
Hispanic	10.8	7.8	4.5	7.5	3.5	6.5	8.8	7.6	5.9	7.0
Non-Hispanic (White)	77.3	86.3	88.2	82.4	86.1	89.5	83.9	85.7	89.4	85.4
Other	0.6	2.0	3.4	4.5	3.5	2.0	2.4	2.2	3.5	2.7
Employment Status										
<35 h/wk	75.1	77.8	79.1	73.5	74.4	66.5	68.0	75.0	76.7	74.0
>35 h/wk	4.5	4.3	4.0	7.5	6.4	7.5	4.9	4.5	1.2	5.0
Retired	10.2	6.3	7.9	9.0	9.9	15.0	12.1	11.6	15.1	10.8
Student	5.6	4.3	3.4	3.5	3.9	6.3	8.7	1.8	3.5	4.6
Homemaker	1.1	2.4	1.7	0.5	1.5	1.2	1.0	0.4	2.3	1.3
Unemployed	0.0	0.0	1.1	2.0	1.0	0.8	2.4	1.8	0.0	1.0
Other	3.4	4.8	2.8	4.0	3.0	2.8	2.9	4.9	1.2	3.3
Education										
Less than 8th grade	1.7	0.5	1.7	1.5	0.0	0.8	0.5	0.0	0.0	0.7
8th grade graduate	2.8	0.5	0.0	0.0	1.0	0.4	0.5	1.3	2.3	1.0
Some high school	5.1	4.3	9.0	4.5	3.4	6.7	6.3	3.1	7.0	5.5
High school graduate	17.0	11.1	5.7	5.6	10.8	13.8	16.5	12.1	17.4	14.4
Some trade school	7.4	3.4	2.8	4.5	3.9	1.6	4.9	4.9	8.1	4.6
Trade/technical school graduate	5.7	4.8	4.5	9.0	5.9	7.5	6.8	7.2	4.7	6.2
Some college	34.1	40.6	3.8	2.7	44.8	41.7	37.9	43.0	38.4	40.8
BA	15.3	15.9	1.2	0.1	18.2	14.6	15.5	14.8	11.6	14.1
Postgraduate	10.8	18.8	1.2	2.1	11.8	13.0	11.2	13.5	10.5	12.5
Annual Household Income										
<10k	2.5	1.0	2.9	2.7	3.2	5.8	7.3	1.4	2.3	3.3
10-20k	11.9	4.1	5.8	9.6	9.5	14.5	9.3	2.4	12.3	8.8
20-30k	13.1	9.8	13.5	11.8	15.8	17.4	14.5	11.4	13.6	13.4
30-40k	13.1	17.4	12.9	16.6	16.8	22.0	18.7	18.6	24.7	17.9
40-50k	15.6	14.9	21.1	17.1	13.7	15.8	11.4	17.1	12.3	15.4
50-60k	2.5	9.8	12.3	14.4	10.5	10.0	13.5	13.3	11.1	11.9
60-70k	7.5	13.9	9.4	8.0	10.5	4.1	8.3	10.0	7.4	8.8
70-80k	4.4	6.7	9.9	7.5	7.9	2.9	6.7	6.7	8.6	6.8
80-90k	5.0	6.7	3.5	3.7	2.6	2.9	2.6	6.7	3.7	4.2
90-100k	2.5	2.1	2.3	2.1	1.6	0.4	1.6	2.9	0.0	1.7
100-110k	3.1	2.6	2.3	2.7	2.1	0.4	1.6	3.3	1.2	2.1
110-120k	1.3	2.6	1.2	1.6	0.5	1.2	0.5	1.4	0.0	1.1
120-130k	1.9	3.1	0.0	0.0	3.2	0.0	1.0	1.0	1.2	1.3
130-140k	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.1
>140k	5.0	5.2	2.9	2.1	2.1	2.5	3.1	3.3	1.2	3.0
Sample	160	194	171	187	190	241	193	210	81	181
Total						100.00				

Source: Thomson and Crooke 1991.

TABLE 3.5.4-1. Motivation for fishing for southern California anglers in 1989, by mode, on a scale of one (not at all important) to seven (very important).

Scale	Food	Challenge	Fish	Bait	Relax	Social	Pleasure
				Beach			
1	51.70	2.00	34.50	60.60	0.70	5.50	81.40
2	8.30	0.70	8.30	9.90	1.30	4.10	4.80
3	13.80	2.70	9.00	7.00	2.00	2.10	2.80
4	13.80	12.20	17.20	8.50	1.30	10.30	5.50
5	6.20	8.20	9.00	4.90	6.00	11.00	1.40
6	1.40	17.70	11.70	2.10	14.80	13.10	0.70
7	4.80	56.50	10.30	7.00	73.80	53.80	3.40
				Pier			
1	70.30	4.20	51.90	64.30	0.90	3.80	67.50
2	9.00	0.00	9.00	8.90	0.90	1.90	6.70
3	7.10	3.30	9.40	8.00	2.30	1.90	3.80
4	7.10	14.00	11.80	7.00	7.00	7.50	4.80
5	0.90	19.20	8.00	3.30	10.30	9.90	4.30
6	1.40	14.50	2.80	2.80	16.80	19.20	2.90
7	4.20	44.90	7.10	5.60	61.70	55.90	10.00
				CPFV			
1	49.80	2.00	24.90	47.50	2.10	2.10	73.50
2	14.80	1.70	7.10	13.70	1.10	0.90	7.00
3	11.80	2.50	9.20	9.90	2.10	3.40	4.10
4	12.10	10.70	14.90	9.70	6.50	10.10	5.10
5	4.70	16.10	13.70	6.00	10.90	14.10	2.80
6	2.70	13.50	9.80	3.60	15.10	22.10	3.20
7	4.10	53.60	20.40	9.60	62.20	47.20	4.50
				Private Boat			
1	49.00	3.10	25.20	52.00	1.10	1.40	73.30
2	11.10	0.50	5.60	8.50	0.70	1.10	6.50
3	12.30	3.60	10.40	8.70	2.00	2.90	5.20
4	14.60	9.00	15.70	13.30	6.40	7.70	6.70
5	7.70	17.00	13.90	6.00	9.60	13.20	2.70
6	1.80	15.40	7.40	2.80	14.30	17.60	3.10
7	3.50	51.30	21.80	8.70	66.00	56.10	2.50

Food=Fishing gives me the opportunity to put food on the table.
Challenge=I enjoy the challenge of catching fish.
Fish=A species that I particularly like to fish for was available at this time.
Bait=A bait that I like to fish with was available at this time.
Relax=Fishing gives me the opportunity to relax and "get away from it all."
Social=Fishing gives me the opportunity to do something with family and/or friends.
Please=I went fishing to please someone else.
Source: Thomson and Crooke, 1991.

TABLE 3.8.6-1. Ethnicity, median birth year, median age during fishing year, and number of crew members on six wetfish boats based in San Pedro during four years.[a/]

Fishing Year		Ethnicity						
		Unknown/Other	Hispanic	Italian	Asian	Port.	Yugo.	All
1977	Birth Year	1951	1945	1930	NA	1920	1927	1930
	Age	26	32	47	57	50	47	47
	Number	5	6	53	1	0	33	98
	Proportion (%)	5	6	54	1	0	34	100
1980	Birth Year	1959	1950	1940	NA	1931	1922	1940
	Age	21	30	40	49	58	40	40
	Number	3	4	49	2	0	22	80
	Proportion (%)	4	5	61	3	0	28	100
1985	Birth Year	1960	1952	1939	NA	1931	1935	1940
	Age	25	33	46	54	50	45	45
	Number	6	6	44	4	0	10	70
	Proportion (%)	9	9	63	6	0	14	100
1990	Birth Year	1955	1948	1939	1943	1963	1938	1941
	Age	35	42	51	47	27	52	49
	Number	3	15	46	2	1	7	74
	Proportion (%)	4	20	62	3	1	9	100

a/ In 1985, for example, there were six Hispanic crew members whose median birth year was 1952 and median age was 33 years. Data are for boats affiliated with the Fishermen's Cooperative Association in San Pedro, California, from 1977 to 1990 that had crew members belonging to the Fisherman and Allied Workers Union in San Pedro. Data were obtained from personnel records. Ethnicity of each crew member was determined by surname and checked by someone familiar with the fishery and the crew members. Birth dates were not available for six crew members (<2 of the total sample), who are not included in the table.

Source: Jacobson and Thomson (1992).

TABLE 3.9.8-1. Residence of fishers belonging to AFL-CIO Fisherman's Union, the San Pedro area, Los Angeles County, California.

County/Number	Percentage	Zip Code	Area
Los Angeles County			
136	74	97031	Terminal Island Fort MacArthur
14	8	90011	Washington Station, Los Angeles
12	7	90732	Fidelity Federal Bldg. 29000 Western Ave.
4	2	90745	Carson
3	2	90744	Wilmington
3	2	90717	Lomita
2	1	90733	San Pedro
2	1	90274	Palos Verdes Peninsula
2	1	90280	South Gate
1	<1	91401	Van Nuys
1	<1	90501	Torrance
1	<1	90007	Adams Blvd., Los Angeles
1	<1	90810	Cabrillo, Long Beach
1	<1	95456	Northern Cal
1	<1	Unknown	Unknown
184	100		Total Los Angeles County
San Diego County			
4	100	92139	San Diego
Monterey County			
102	80	93940	Monterey
15	12	93955	Seaside
5	4	93950	Pacific Grove
4	3	93933	Marina
1	<1	93930	King City
1	<1	93923	Carmel
128	100		Total Monterey County

ADDITIONAL REFERENCES

1. California Department of Finance. 1998. California county profiles. Sacramento, California.

2. U.S. Bureau of the Census. 1997. Statistical abstract of the United States: county business patterns, 1993 and 1995, California. U.S. Department of Commerce. Washington D.C.

3. U.S. Bureau of Economic Analysis. 1998. Regional accounts data: statistics for California; "BEARFACTS". U.S. Department of Commerce. Washington, D.C.

APPENDIX B
OPTIONS AND ANALYSES FOR THE COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

Page

1.0 OPTIONS AND ANALYSES FOR THE COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

This appendix (Appendix B) explains the options and analysis for the fishery management plan (FMP) for coastal pelagic species (CPS). CPS include Pacific sardine, northern anchovy, Pacific (chub) mackerel, jack mackerel, and market squid. Stocks and fisheries are described in detail in Appendix A. Costs involved in this FMP are estimated in Appendix C. Essential fish habitat is described in Appendix D. References are included in Appendix E. The Council's final recommendations on options constitute the main plan amendment document.

1.1 Introduction

CPS are found in the exclusive economic zones (EEZ) of Mexico, the U.S., and Canada as well as further offshore in international waters. They are taken in U.S. waters in a multispecies fishery (along with bonito, tunas, and other species) that operates mainly off southern California but occasionally as far north as Washington State. Components of the CPS fishery in U.S. waters currently or potentially include U.S. commercial fisheries (that produce fish for human food, pet food, fish meal, fish food, live bait, dead bait, and other uses), foreign catcher and processor vessels, foreign vessels engaged in joint ventures, party, and charter boats that carry anglers, and other anglers who target CPS or use them as bait.

CPS are taken directly and incidentally in fisheries that use many types of gear. Purse seines and other roundhaul nets are the primary gear used to harvest CPS; but midwater trawls, pelagic trawls, longlines, gill nets, dip nets, trammel nets, trolls, pots, hook and line, and jigs are also used.

Sardine and Pacific (chub) mackerel are currently managed by the California Department of Fish and Game (CDFG) under state laws with substantial scientific support from the National Marine Fisheries Service (NMFS). There are currently few regulations pertaining to CPS harvest in Oregon and Washington, other than provisions for experimental fisheries. The Pacific Fishery Management Council (Council) manages northern anchovy under the northern anchovy FMP and jack mackerel (as bycatch north of 39° N latitude) under the Pacific coast groundfish FMP. The CPS FMP will remove management of jack mackerel from the groundfish plan. In addition, existing state regulations are consistent with the FMP.

Northern anchovy, market squid, and sardine are forage for at least two bird species (brown pelican and least tern) and four marine mammals (fin whale, humpback whale, sei whale, and Guadalupe fur seals) classified as endangered under the Endangered Species Act (ESA); one marine mammal species (Northern or Steller's sea lion) classified as threatened under the ESA; and one marine mammal species (northern fur seal) classified as depleted under the Marine Mammal Protection Act. In addition, anchovy, sardine, and squid are forage for all depleted, threatened, and endangered salmon stocks along the coast.

CPS finfish are taken in both state and federal waters. CDFG staff estimate that roughly 95% of anchovy were taken in federal waters during the historical reduction fishery (state regulations did not allow reduction fishing near shore). The same sources estimate that 30% of Pacific (chub) mackerel, 50% of jack mackerel, and 50% of Pacific sardine are taken in federal waters. A larger fraction of sardine landings were taken in federal waters during the historical fishery when biomass was high.

Landings, exvessel prices, and revenues for northern anchovy, sardine, mackerel, and market squid landed in California during 1997 are given in Table 1.0-1. Together, these species account for most of the landings in the CPS fishery. Landings of anchovy are stable at low levels and used primarily for live and dead bait in the valuable recreational fishery. Landings of mackerels have been low in recent years due to poor availability. Landings of sardine have increased in recent years with increased biomass and higher quotas. In 1997, sardine supported the second largest (by volume, not value) fishery in California. Squid landings increased recently to record high levels due to increased availability and prices but decreased dramatically during the El Niño of 1997 to 1998. In 1997, squid supported the largest and most valuable fishery in California. There are roughly 20 processing plants in California that handle about 95% of total CPS finfish and squid landings and roughly half handle at least 500 mt per year.

The CPS fishery as a whole is the largest in California. In 1997, CPS finfish contributed 32% and CPS finfish plus squid contributed 68% of total commercial landings in California (Table 1.0-2). Market squid, sardine and chub mackerel were the top three species in terms of total landings.

1.2 Need for Fishery Management Plan Management

1.2.1 Incidental Catch Considerations

Consolidation of responsibilities for CPS under a single FMP would make management of directed fisheries and incidental catch more efficient and effective. Incidental catch is common in the CPS fishery but may be difficult to coordinate under current management. For example, if the current downward trend in anchovy abundance were to continue and the stock became overfished, it would be difficult for federal authorities to manage anchovy catch in the directed sardine fishery which is managed by California.

1.2.2 International and Interstate Cooperation

Management of all CPS under a single FMP would facilitate cooperative international and interstate management and scientific work. CPS are transboundary resources shared by the U.S., Mexico, and Canada. Harvest levels in Mexico have increased to the point where combined U.S. and Mexican harvests threaten the long term productivity of all CPS stocks except jack mackerel and anchovy. Modest, but increasing, catches of CPS are occurring off Oregon and Washington. Sardine, anchovy, and Pacific (chub) mackerel are all taken in Canadian waters. No cooperative arrangement for management of CPS in U.S., Mexican, and Canadian waters exists. Experience with the anchovy fishery indicates that management agreements and programs for collaborative scientific work with Mexico are difficult to obtain, even for FMP managed species. In the absence of an FMP and direct federal involvement, however, the likelihood of cooperative management and scientific work is further reduced.

The U.S., Mexico, and ten other nations recently signed the "Declaration of Panama" which commits the signatories to measures that ensure the long-term sustainability of living marine resources in the eastern Pacific Ocean. In addition, the United Nations conference on straddling stocks and highly migratory species is expected to result in a treaty that the U.S. and Mexico will both sign. The new agreements and climate of cooperation between the U.S. and Mexico provide a unique opportunity for cooperative work and management of CPS, particularly Pacific sardine, that support fisheries in both countries. A decision to implement an FMP for CPS will demonstrate U.S. support for these international agreements and help capitalize on the currently favorable international climate for management of stocks shared by the U.S. and Mexico.

1.2.3 Continued NMFS Participation in CPS Management

In the absence of an FMP for CPS, it is likely that scientific expertise and capability in NMFS will deteriorate in the short term to the point where collection of data, monitoring, stock assessment, and field studies are not possible for CPS. NMFS is downsizing and reductions in staff and support can be expected in areas where federal responsibilities are not clearly defined. Although NMFS has informally agreed to continue assisting California with management of CPS in the absence of an FMP, details have not been spelled out and NMFS assistance may not be possible beyond the short term without an FMP. In the absence of an FMP, the CPS fishery may lose scientific and management support of NMFS, reducing benefits to the ecosystem and taxpayers.

Continued federal involvement in the fishery would facilitate exchange of information necessary for management of CPS in U.S. waters. Landings, age composition, and other data from Mexico, Oregon, Washington, and Canada are required for biomass assessments used to manage CPS fisheries in U.S. waters. Federal and Council involvement lends weight and urgency to international requests for data from federal agencies in Mexico and Canada.

Continued federal involvement in the fishery is also essential for data collection. Stock assessment models used by state and federal biologists to determine the status of CPS stocks and set quotas are all based on California Cooperative Oceanic Fishery Investigation (CalCOFI) and fish spotter data which are collected by NMFS. In the absence of an FMP, it is likely that CalCOFI and fish spotter information would disappear or degrade, because neither state nor Mexican scientists have the resources or expertise to carry out the necessary data collection and analysis. The size of the CalCOFI survey area has been reduced over the last two decades to the minimum size useful for fishery management. Further reductions would render CalCOFI data useless.

Continued federal involvement in the fishery is essential for effective scientific cooperation. Field surveys for direct estimation of CPS biomass need to be conducted along the entire coast in Mexican as well as U.S. waters. These surveys are too large and complicated in scope to be managed by California, Oregon, Washington, Canada, and Mexico scientists without assistance from NMFS.

1.2.4 Control of Future Fishery Expansion

There is a high probability for further rapid development of CPS, particularly sardine and market squid, fisheries that could not be managed effectively without an FMP. Pacific sardine biomass has increased by about 35% per year since 1983 and is currently around 600,000 mt. As sardine biomass increased, fishing opportunities in northern areas increased and sardine began to occur off Oregon, Washington, British Columbia, and international waters more than 200 miles offshore of southern California. Sardine were taken in large commercial quantities as far north as British Columbia during the historical fishery when sardine biomass was around one million mt. Catches off Oregon, Washington, and outside state waters (50% of Pacific sardine are taken in federal waters) could not be managed effectively under existing California regulations.

An FMP for CPS facilitates limited entry management in the CPS finfish (anchovy, sardine, and mackerels) fishery. California could develop a limited entry plan for finfish unilaterally, but has no economists and few staff to carry out supporting analyses and develop options.

An important advantage in implementing an FMP with limited entry at this time is that future increases in capacity of the CPS fishery could be managed before problems arise. The collapse of the historical sardine fishery in the 1950s was due to overcapitalization and resulting overfishing at the same time as unfavorable environmental conditions. It is likely that the CPS fishery will become overcapitalized faster than management authorities can react if sardine, or other CPS, increase in abundance or markets develop. Experience with the CPS and other fisheries indicates that the process of developing fishery management programs at the state or federal level is slower than the rate at which a fishery can become overcapitalized. There is substantial excess capacity in the groundfish, herring and salmon fisheries (including the factory trawler fleet), for example, that could enter the CPS fishery in a matter of months if markets develop. Boats from overcapitalized herring fisheries off Oregon, Washington, and Alaska, for example, recently entered the California squid fishery in response to increased availability and prices. The total number of boats harvesting squid in the California squid fishery approximately doubled during 1994 to 1997.

NMFS could manage CPS under emergency authority if a crisis were to develop. However, recent experience in Alaska with management of the scallops suggests that this approach is unsatisfactory, because NMFS cannot use emergency authority to address allocation problems, which are usually paramount. At most, NMFS can open or close a fishery to all vessels when operating under emergency authority. An FMP provides a more comprehensive and effective approach that can handle all contingencies.

Trawl fleets (joint venture and factory trawlers) expressed interest in developing an offshore fishery for underutilized jack mackerel in the early 1990s. There would be substantial incidental catch of other CPS if an offshore fishery for jack mackerel developed (SWFSC 1991). To date, exploratory fishing and marketing efforts for jack mackerel have failed and no offshore fishery has developed, but the possibility of an offshore fishery remains, particularly for sardine. An offshore fishery and associated incidental catch could not be managed under current state regulations.

1.2.5 State and Federal Scientific and Monitoring Resources

At the present time, neither NMFS nor CDFG have enough scientific or monitoring resources to manage CPS on their own, but their combined resources may be sufficient. Stock assessment and management resources in state and federal agencies for stock assessment and management have declined over the last decade.

CDFG resources are currently insufficient to collect fishery data and conduct stock assessments for Pacific (chub) mackerel and sardine, which are the mainstay of the CPS finfish fishery. Federal resources available for management of northern anchovy are eroding slowly, but at a rate that may increase in the absence of an FMP for CPS. State and federal authorities are currently able to meet their responsibilities for management of CPS because of informal cooperation and collaboration. An FMP for CPS would make maximum use of scarce resources available at the state and federal levels to manage one of the largest fisheries on the West Coast.

1.2.6 Industry Support

Industry strongly supports an FMP in the CPS fishery. Strong industry support is unusual and an important advantage in implementing an FMP with limited entry at this time. As conditions in the fishery improve, excess capacity increases, and more stakeholders become involved, it is likely that industry support will become less unanimous and effective management will become more difficult.

1.2.7 Opportunity for Risk Averse Management

An FMP for CPS would conform to the NMFS stated policy of risk averse management which is described in National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and ensure that one of the largest fisheries in the Nation continues to be managed according to risk averse principals. Risk averse management is particularly important for CPS which are highly variable, often at low abundance levels, but potentially very productive, and ecologically important as forage for predators that include sportfish and endangered species.

1.2.8 Overfished Status of Pacific Sardine and Pacific (Chub) Mackerel

NMFS has identified both Pacific sardine and Pacific (chub) mackerel as being overfished in a recent report. This FMP amendment clearly responds to concerns about the status of these stocks relative to their long-term potential yield. Under overfishing definitions in this plan, neither Pacific sardine nor Pacific (chub) mackerel are overfished (See sections 4.1 and 4.2 of this appendix).

1.2.9 Council Involvement in California Fisheries

Benefits to the nation would likely be enhanced if the CPS FMP is adopted, because it provides an opportunity for federal authorities to better serve constituents in southern and central California (where a large fraction of the West Coast population resides) at relatively low, near status quo costs.

1.3 History of the Fishery Management Plan

Council initiated the development of the FMP for northern anchovy in January of 1977. A final draft of the Plan was approved and submitted to the U.S. Secretary of Commerce (Secretary) in June of 1978. Regulations implementing the FMP for northern anchovy were published in the *Federal Register* on September 13, 1978. Subsequently, the Council has considered seven amendments.

The first amendment changed the method of specifying the domestic annual harvest for northern anchovy and added a requirement for an estimate of domestic processing capacity and expected annual level of domestic processing. Approval for this amendment was published in the *Federal Register* on July 18, 1979.

The second amendment, which became effective on February 5, 1982, was published in the *Federal Register* on January 6, 1982. The purpose of this amendment was to increase the domestic fishing fleet's opportunity to harvest the entire optimum yield (OY) of northern anchovy from the U.S. EEZ. This was to be accomplished by reallocating all or part of the northern area reduction quota reserve if the northern fishery had not harvested or demonstrated an intent to harvest the full reserve by the end of the fishing season.

During the spring of 1982, the Council considered a third amendment that divided the quota for northern anchovy into two halves and made release of the second half conditional on the results of a mid-season review of the status of the stock. The methods proposed for the mid-season assessment were considered too complex to implement, and the amendment was not approved.

The fourth amendment, which had two parts, was published in the *Federal Register* on August 2, 1983 and became effective on August 13, 1983. The first part abolished the five-inch size limit in the commercial fishery and established a minimum mesh size of 5/8 inch for northern anchovy. The mesh size requirement did not become effective until April 1986 in order to give the fleet additional time to comply without undue economic hardship. The second part established a mid-season quota evaluation that was simpler in design than the method proposed in Amendment 3. The annual quota was split in half. The first half was allocated at the beginning of the season. The second half was allocated unless available evidence indicated that its harvest would reduce the following year's spawning biomass below the level of one million short tons.

The fifth amendment in 1983 incorporated advances in scientific information concerning the size and potential yield of the central subpopulation of northern anchovy. When the original FMP was developed, scientists had estimated that the subpopulation ranged up to about 3.6 million mt (four million short tons) and could support an average annual catch of about 454,000 mt (500,000 short tons). These estimates were based on the larva census method of stock assessment. New estimates, based upon an egg production method of assessment, were developed and showed that the population had a maximum size of only about 2.5 million mt and a maximum average yield of about 340,000 mt per year. Since annual fishery catch quotas are based upon measurements of population size, the FMP had to be revised to incorporate OY formulas consistent with the new scientific assessments.

In addition, the fifth amendment included changes to a variety of other management measures. Two or more alternative actions were considered in each of seven general categories (1) OY and harvest quotas; (2) season closures; (3) area closures; (4) quota allocation between areas; (5) the reduction quota reserve; (6) minimum fish size or mesh size; and (7) foreign fishing and joint venture regulations. The alternatives for the fifth amendment were reviewed by the Council during 1983. The final rule, on the fifth amendment measures adopted, was published in the *Federal Register* on March 14, 1984.

The sixth amendment in 1990 implemented a definition of overfishing for northern anchovy consistent with National Standard 7 of the Magnuson-Stevens Act. The amendment defined overfishing as any harvest of northern anchovy when the estimated spawning biomass during the current and proceeding seasons was less than 50,000 mt.

Council began developing the seventh amendment as a new FMP for CPS on a motion from NMFS and California in 1990. A complete draft was available in November of 1993. Council suspended further work because NMFS withdrew support due to budget constraints. In July of 1994, the Council decided, on a motion by California, to proceed with the plan through the public comment period. NMFS agreed with the decision on the condition that the Council also consider the options of dropping or amending the anchovy FMP. Thus, four principal options were considered for managing CPS (1) drop the anchovy FMP (no federal or Council involvement in CPS); (2) continue with the existing FMP for anchovy (status quo); (3) amend the FMP for northern anchovy; and (4) implement an FMP for the entire CPS fishery. In March of 1995, after considering all four principal options, the Council decided to proceed with the FMP for CPS. Final action was postponed until June 1995, so that NMFS and the Council's Scientific and Statistical Committee (SSC) could review the draft plan in detail and provide comments to the Coastal Pelagic Species Plan Development Team (CPSPDT). At the June meeting in 1995, the Council adopted a draft plan that had been revised to address comments provided by NMFS and the SSC and the plan was submitted to the Secretary. Amendment 7 was rejected by NMFS, Southwest Region, because of cost considerations. NMFS announced its intention to drop the FMP for northern anchovy (in addition to FMPs for other species) in the *Federal Register* on March 26, 1996, but the action was never completed.

1.3.1 History of Amendment 8

At a meeting during June 23-25, 1997, the Council directed the CPSPDT to amend the FMP for northern anchovy to conform to the recently revised Magnuson-Stevens Act and to expand the scope of the FMP to include the entire CPS fishery. The Council's decision was based on a motion by the CDFG and supported by NMFS. Supporting documentation was provided by the CDFG in the form of an "issue paper" that described increases in the abundance, distribution, and catch of sardine and market squid and insufficient resources available at the state level for management. The CPSPDT was directed to base its work on Amendment 7 (which was rejected by NMFS as described above), to consider market squid for inclusion in the plan, and to analyze options for limited entry in the CPS fishery south of 39° N latitude.

TABLE 1.0-1. Landings, prices, revenues and percent of total revenues for the principal species in the CPS fishery (including live bait) during 1997.

	Landings (round wt, mt)	Revenue ($1,000)	Average Price ($/lb)	Percent Total Revenue
Anchovy[a/]	7,416	1,979	0.12	six percent
Mackerel[b/]	17,061	2,711	0.07	nine percent
Sardine[c/]	40,419	5,127	0.06	16%
Squid	70,683	21,941	0.14	69%

a/ Includes 2,000 mt (approx) of live bait at $681/mt and 1,757 mt landed at $281/mt.
b/ Pacific (chub) mackerel plus jack mackerel plus unspecified mackerel.
c/ Includes 2,000 mt (approx) mt of live bait at $681/mt and 11,933 mt landed at $148/mt.

TABLE 1.0-2. Commercial landings and revenues for the most important species landed in California during 1997. Landings, revenues and prices from fish tickets and do not include figures for live bait.

Species	Landings (mt)	Revenues ($1000)	Price ($/lb)	Landings Rank	Revenue Rank
Market Squid	70,683	21,941	0.14	1	1
Pacific Sardine	38,419	3,765	0.04	2	13
Pacific Chub Mackerel	16,015	2,478	0.07	3	19
Pacific Herring	7,300	12,173	0.76	4	3
Red Sea Urchin	7,010	12,518	0.81	5	2
Pink Shrimp	6,378	5,381	0.38	6	8
Pacific Whiting	6,336	583	0.04	7	33
Northern Anchovy	5,416	617	0.05	8	32
Skipjack Tuna	5,060	4,395	0.39	9	11
Dover Sole	5,008	3,152	0.29	10	16
Yellowfin Tuna	4,364	4,638	0.48	11	10
Albacore	3,277	5,631	0.78	12	7
Sablefish	2,747	8,346	1.38	13	5
Chinook Salmon	2,732	7,256	1.21	14	6
Bluefin Tuna	2,228	2,727	0.56	15	17
Dungeness Crab	1,926	8,374	1.97	16	4
Nominal Longspine Thornyhead	1,920	3,168	0.75	17	15
Unspecified Rockfish	1,608	1,513	0.43	18	20
Unspecified Skate	1,316	556	0.19	19	37
Nominal Widow Rockfish	1,292	954	0.34	20	27
Nominal Chilipepper	1,103	1,070	0.44	21	24
Jack Mackerel	1,046	233	0.10	22	49
Total (all species)	193,184	111,469			

2.0 GOALS, OBJECTIVES, AND A FRAMEWORK MANAGEMENT PROCESS FOR THE COASTAL PELAGIC SPECIES FISHERY

Amendment 8 replaces the fishery management plan (FMP) for northern anchovy to establish procedures for management of coastal pelagic species (CPS) along the West Coast of the United States. It also changes the name from the existing "Northern Anchovy Fishery Management Plan" to "Fishery Management Plan for Coastal Pelagic Species".

The CPS fishery targets Pacific sardine, Pacific (chub) mackerel, northern anchovy, jack mackerel, and market squid. Of these, Pacific sardine and Pacific (chub) mackerel are "Actively managed" while the others are "Monitored" (Table 1.0-1). Management decisions and procedures are based on a framework process described below. Degree/intensity of monitoring, assessment, and management will vary by fish species depending on stock and fishery status as recommended by the Coastal Pelagic Species Management Team (CPSMT), Coastal Pelagic Species Advisory Subpanel (CPSAS), or the Pacific Fishery Management Council (Council).

2.1 Goals and Objectives

Goals and objectives for the CPS FMP (not listed in order of priority):

1. Promote efficiency and profitability in the fishery, including stability of catch.
2. Achieve optimum yield (OY).
3. Encourage cooperative international and interstate management of CPS.
4. Accommodate existing fishery segments.
5. Avoid discard.
6. Provide adequate forage for dependent species.
7. Prevent overfishing.
8. Acquire biological information and develop long term research program.
9. Foster effective monitoring and enforcement.
10. Use resources spent on management of CPS efficiently.
11. Minimize gear conflicts.

2.1.1 "Active" Management versus "Monitored" Management

The CPS FMP includes two management categories for CPS fish stocks: "Active" management and "Monitored" management. "Active" is for stocks and fisheries with biologically significant levels of catch, or biological or socioeconomic considerations requiring relatively intense harvest management procedures. This category is particularly important for stocks that are or may be overfished. The second category, "Monitored," is for stocks and fisheries not requiring intensive harvest management and where monitoring of catches and available abundance indices are considered sufficient to manage the stock.

The purpose of Active and Monitored management is to use available agency resources in the most efficient and effective manner while satisfying goals and objectives of the FMP. The distinction enables managers and scientists to concentrate efforts on stocks and segments of the CPS fisheries that need greatest attention or where the most significant benefits might be expected.

Active management may be characterized by periodic stock assessments, and/or periodic adjustments of target harvest levels based on maximum sustainable yield (MSY) control rules. Monitored management, in contrast, involves tracking trends in catches and qualitative comparison to available abundance data but without periodic stock assessments or periodic adjustments to target harvest levels. Species in both categories may be subject to management measures such as catch allocation, gear regulations, closed areas, closed seasons, or other forms of Active management.

Explicit MSY control rules, definitions of overfishing and overfished stocks must be developed for all Actively managed species. Monitored management, in contrast, may use "generic" or general definitions of overfishing and overfished stocks that do not have specific fishing mortality or biomass cutoffs. Essential fish habitat (EFH) must be described for all stocks in the management unit, including Actively managed and Monitored species.

The CPSMT will annually review all CPS stocks and make recommendations to the Council and agencies regarding appropriate management categories for each stock ("Active" or "Monitored"). Changes to the appropriate management category for each species can be made annually by the Council based on all available data, including acceptable biological catch (ABC) levels and MSY control rules, and the goals and objectives of this FMP. Changes in a management category may be accomplished according to any of the four procedures for establishing and adjusting management measures described below in section 2.2.1. In addition, CPS in the Monitored management category can be reassigned to Active management on short notice under the point-of-concern framework.

TABLE 2.1.2. Species included in the CPS FMP (other species can be added as appropriate).

Common Name	Scientific Name
ACTIVE MANAGEMENT:	
Pacific sardine	*Sardinops sagax*
Pacific (chub) mackerel	*Scomber japonicus*
MONITORED MANAGEMENT:	
Northern anchovy	*Engraulis mordax*
Central and northern subpopulations	
Market squid	*Loligo opalescens*
Jack mackerel	*Trachurus symmetricus*

2.2 Framework Management

The framework approach to management of CPS allows changes and modifications to be made in a timely and efficient manner without need to amend the FMP. The FMP establishes two framework procedures through which the Council is able to recommend establishment and adjustment of management measures. The "point-of-concern" framework allows the Council to develop management measures in response to resource conservation and ecological issues. The "socioeconomic" framework allows the Council to develop management measures in response to social and economic issues.

Management measures are normally imposed, adjusted, or removed at the beginning of the fishing year but may, if the Council determines it necessary, be imposed, adjusted, or removed at any time during the year. Management measures may be imposed for resource conservation ecological, social, or economic reasons consistent with FMP procedures, goals, and objectives.

Because potential actions taken may cover a wide range, analyses of biological, ecological, social, and economic impacts will be considered when a particular change is proposed. As a result, time required to take action will vary depending on nature of the action, its impacts on the fishing industry, resource, and environment, as well as review of these impacts by interested parties. Satisfaction of legal requirements for other applicable laws (e.g., the Administrative Procedure Act, Regulatory Flexibility Act, Executive Order 12866, etc.) for actions taken under this framework requires analysis and public comment before measures may be implemented by the U.S. Secretary of Commerce (Secretary).

Management measures addressing a resource conservation or ecological issue must be based on the point-of-concern framework consistent with procedures and criteria listed in Section 2.2.1.2.

Management measures addressing social or economic issues must be based on the socioeconomic framework consistent with procedures and criteria described in Section 2.2.1.3.

2.2.1 Procedures for Establishing and Adjusting Management Measures

Under the point-of-concern or the socioeconomic frameworks, there are four different categories of management actions, requiring slightly different processes. Management measures may be established, adjusted, or removed using any of four actions:

1. **Automatic Actions** may be initiated by the National Marine Fisheries Service (NMFS) Regional Administrator without prior public notice, opportunity to comment, or a Council meeting. These actions are nondiscretionary and the impacts must previously have been taken into account. Examples include fishery closure when a harvest guideline is attained and an inseason release of geographic allocations. The Secretary will publish a single notice in the *Federal Register* making the action effective.

2. **"Notice" Actions** require at least one Council meeting and one *Federal Register* notice. These include all management actions other than automatic actions that are either nondiscretionary or have probable impacts that have been previously analyzed.

   Notice actions are intended to have temporary effect and the expectation is that they may need frequent adjustment. They may be recommended at a single Council meeting, although the Council will provide as much advance information to the public as possible concerning the issues it will be considering. The primary examples are management actions defined as routine in Section 2.2.1.1. These include release of surplus incidental catch harvest guidelines to the directed fishery, and inseason changes to incidental catch allowances. Previous analysis must have been specific as to species and gear type before a management measure can be defined as routine and acted upon at a single Council meeting. If recommendations are approved, the Secretary may waive, for good cause, the requirement for prior notice and comment in the *Federal Register* and will publish a single notice in the *Federal Register* making the action effective. This category of actions presumes the Secretary will find that the extensive notice and opportunity for comment along with other information provided by the Council will serve as good cause to waive the need for additional prior notice and comment in the *Federal Register*.

3. **Abbreviated Rulemaking Actions** normally require at least two Council meetings and one *Federal Register* rule. These include all management actions intended to have permanent effect and be discretionary in nature with impacts that have not been previously analyzed. Examples include specification of harvest guidelines and quotas, including incidental catch portions and any amount allocated to joint venture processing (JVP), total allowable level of foreign fishing (TALFF), etc. The Council will develop and analyze the proposed management actions over the span of at least two Council meetings and provide public advance notice and opportunity to comment on proposals and analysis prior to and at the second Council meeting. If the NMFS Regional Administrator approves the Council's recommendation, the Secretary may waive, for good cause, the requirement for prior notice and comment in the *Federal Register* and publish a final rule in the *Federal Register* which will remain in effect until amended. If a management measure is designated as routine by final rule under this procedure, specific adjustments of that measure can subsequently be announced in the *Federal Register* by notice as described in this FMP. The Secretary may waive the opportunity for prior notice and comment in the *Federal Register*.

   The primary purposes of the previous two categories of abbreviated notice and rulemaking procedures are (1) to accommodate the Council's meeting schedule for developing annual management recommendations; (2) to satisfy the Secretary's responsibilities under the Administrative Procedures Act; and (3) to address the need to implement management measures by a specified date each fishing year.

   The two-Council meeting process refers to two decision meetings. The first meeting to develop proposed management measures and their alternatives, and the second meeting to make a final recommendation to the Secretary. Identification of issues and the development of proposals normally will begin at a Council meeting prior to the first decision meeting.

4. **Full Rulemaking Actions** normally require at least two Council meetings and two *Federal Register* rules (Regulatory Amendment). These include any proposed highly controversial management measure or

any measure which directly allocates resources. The Council will follow the two meeting procedures described for the abbreviated rulemaking category. The Secretary will publish a proposed rule in the *Federal Register* with an appropriate period for public comment followed by publication of a final rule in the *Federal Register*.

2.2.1.1 Routine Management Measures

Routine management measures are those the Council determines likely to be adjusted annually or more frequently. Measures are classified as routine by the Council through either full or abbreviated rulemaking process. In order for a measure to be classified as routine, the Council will determine that the measure addresses an issue at hand and may, in the near future, require further adjustment to achieve its purpose.

Once a management measure has been classified as routine through the abbreviated or full rulemaking procedures, it may be modified thereafter through the single meeting notice procedure if (1) modification is proposed for the same purpose as the original measure; and (2) impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as routine. Analysis need not be repeated when the measure is subsequently modified if the Council determines impacts do not differ substantially from original analysis. The Council may remove a routine classification.

Any measure designated as routine for one specific species, species group, or gear type may not be treated as routine for a different species, species group, or gear type without first having been classified as routine through the rulemaking process.

To facilitate this process, the Council will appoint a CPSMT in consultation with the CPSAS, state and federal resource agencies, Council staff, and interested persons. The CPSMT will annually review all CPS stocks and make recommendations to the Council and agencies regarding assessment or management needs, and appropriate management categories ("Active" or "Monitored"). The Council will consider need for changing management category based on all available data or acceptable biological catch (ABC) levels and MSY control rules specified in Section 4.4 (Monitored stocks) as it meets the goals and objectives of this FMP.

The following measures are classified as routine measures at the outset of this FMP:

1. Reallocation of surplus incidental catch harvest guideline to the directed fishery (all species and fishery segments).
2. Inseason changes in the incidental catch allowance.

2.2.1.2 Resource Conservation Issues and Point-of-Concern Framework

The point-of-concern process is the Council's second major tool (along with setting harvest guidelines and harvest quotas) for exercising resource stewardship responsibilities. The process is intended to foster continuous and vigilant review of Pacific Coast CPS stocks and fisheries. The process is also to prevent overfishing or any other resource damages. CPSMT will monitor the fishery throughout the year, and account for any new information on status of each species or species group to determine whether a resource conservation issue exists. Point-of-concern criteria are intended to assist the Council in determining when a focused review on a particular species is warranted and may require implementation of specific management measures. This framework provides the Council authority to act based solely on a point-of-concern. Thus, the Council may act quickly and directly to address resource conservation issues. In conducting this review, CPSMT will utilize the most current catch, effort, abundance and other relevant data from the fishery.

In the course of the continuing review, a "point-of-concern" occurs when one or more of the following is found or expected:

1. Catch is projected to exceed the current harvest guidelines or the harvest quota.
2. Any adverse or significant change in the biological characteristics of a species (age composition, size composition, age at maturity, or recruitment) is discovered.
3. An overfishing condition appears to be imminent or likely within two years.
4. Any adverse or significant change in the availability of CPS forage for dependent species or in the status of a dependent species is discovered.
5. Developments in a foreign fishery occur that affect the likelihood of overfishing of CPS.
6. An error in data or a stock assessment is detected that significantly changes estimates of impacts due to current management.
7. MSY control rule (harvest policy) parameters or approach require modification.
8. Projected catches for a Monitored species are expected to exceed the ABC using either a species-specific control rule or the default control rule. This could require moving a Monitored species to the Actively managed classification.

Once a point-of-concern is identified, the CPSMT will evaluate current data to determine if a resource conservation issue exists and will provide its findings in writing at the next scheduled Council meeting. If the CPSMT determines a resource conservation issue exists, it will provide its recommendation, rationale, and analysis for appropriate management measures that will address the issue.

In developing its recommendation for management action, CPSMT will recommend options from one or more of the following categories which include types of management measures most commonly used to address resource conservation issues.

MANAGEMENT MEASURES

- MSY, OY, a harvest guideline, or harvest quota.
- Cessation of directed fishing (foreign, domestic or both) with appropriate allowances for incidental harvest of that species or species group.
- Landing limits.
- Trip frequency limits.
- Area or subarea closures.
- Time closures.
- Seasons.
- Size limits.
- Gear limitations, which include but are not limited to definitions of legal gear, mesh size specifications, cod end specifications, marking requirements, and other gear specifications as necessary.
- Observer coverage.
- Reporting requirements.
- Other appropriate measures.

Direct allocation of a resource between different segments of a fishery is, in most cases, not the preferred response to a resource conservation issue. The Council recommendations to directly allocate the resource will be developed according to criteria and processes in the socioeconomic framework described in Section 2.2.1.3.

After receiving the CPSMT report, the Council will take public testimony and, if appropriate, recommend management measures to the NMFS Regional Administrator accompanied by supporting rationale and analysis of impacts. The Council analysis will include a description of (1) resource conservation issues consistent with FMP objectives; (2) likely impacts on other management measures and other fisheries; and (3) socioeconomic impacts, particularly cost and benefit to commercial and recreational segments of the fishing industry.

The NMFS Regional Administrator will review the Council's recommendation and supporting information and will follow appropriate implementation processes described in Section 2.2.1, following public notice and comment. If the Council contemplates frequent adjustments to the recommended measures, it may classify them as "routine" through the appropriate process described in Section 2.2.1.1.

If the NMFS Regional Administrator does not concur with the Council's recommendation, he/she will notify the Council in writing of the reasons for rejection. Nothing prevents the Secretary from exercising authority to take emergency action under Section 305 © and d) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). Nothing precludes or limits Council access to the point-of-concern framework.

2.2.1.3 Nonbiological Issues and the Socioeconomic Framework

From time to time, nonbiological issues may arise which require the Council to recommend management actions to address certain social or economic conditions in the fishery. Resource allocation, fishing seasons, or landing limits based on market quality and timing, safety measures, and prevention of gear conflicts are examples of possible management issues with a social or economic basis. In general, there may be situations where the Council determines that management measures are necessary to achieve social or economic FMP objectives.

Either on its own initiative or by request, the Council may evaluate current information and issues to determine if social or economic factors warrant imposition of management measures to achieve the Council's established management objectives. Actions that are permitted under this framework include all categories of actions authorized under the point-of-concern framework with the addition of direct resource allocation and access-limitation measures.

If the Council concludes that management action is necessary to address a social or economic issue, the Council or the CPSMT will prepare a report containing rationale supporting its conclusion. The report will include proposed management measures, a description of viable alternatives, and analyses addressing (1) achievement of FMP goals and objectives; (2) likely impacts on other fisheries and other management measures; (3) sociobiological impacts; and (4) economic impacts, particularly costs and benefits to the fishing industry.

The Council, following review of the report, supporting data, public comment and other relevant information, may recommend management measures to the NMFS Regional Administrator accompanied by relevant background data, information, and public comment. The recommendation will explain the urgency in implementation of the measure(s), if any.

The NMFS Regional Administrator will review the Council's recommendation, supporting rationale, public comments and other relevant information and, if it is approved, will undertake the appropriate method of implementation. Rejection of the recommendation will be explained in writing.

Procedures specified in this FMP do not affect authority of the Secretary to take emergency regulatory action under Section 305(e) of the Magnuson-Stevens Act; nor do they affect the Secretary's ability to take action under Section 305(g) of the Magnuson-Stevens Act.

If conditions warrant, the Council may designate a management measure developed and recommended to address social and economic issues as a routine management measure provided that the criteria and procedures in Section 2.2.1.1 are followed.

2.2.1.3.1 Allocation

In addition to other requirements in this FMP, the Council will consider the following factors when considering direct allocation of the resource:

1. Present participation in and dependence on the fishery, including alternative fisheries.
2. Historical fishing practices in, and historical dependence on, the fishery.
3. Economics of the fishery.

4. Agreements or negotiated settlements between the affected participants in the fishery.
5. Potential biological impacts on any species affected by the allocation.
6. Consistency with the Magnuson-Stevens Act national standards.
7. Consistency with the goals and objectives of this FMP.

Modification of a direct allocation cannot be designated as "routine" unless the specific criteria for the modification have been established in the regulations.

2.2.1.4 Procedures for specifying Maximum Sustainable Yield and Optimum Yield

As data become available, improve, or are updated, MSY control rules and OY specifications or procedures for setting MSY control rules or OY specifications may need to be modified. Changes and additions to these formulas are authorized by the FMP and may be accomplished through the point-of-concern mechanism or the socioeconomic mechanism.

2.2.1.5 Management Agreements with Other Nations

In the event that a management agreement between the U.S. and a foreign nation concerning CPS occurs, the FMP authorizes changes or modifications to any management measure through Council processes described herein.

2.2.1.6 Management Measures to Protect Non-Coastal Pelagic Species

CPS fishing activities may directly impact certain non-CPS species. This FMP authorizes implementation of measures to control CPS fishing to support conservation objectives identified under overfishing definitions adopted by the Council, the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), or other applicable law, while minimizing disruption of the CPS fishery. Any of these measures described in this FMP may be employed to control fishing impacts on non-CPS species. However, allocation may not be the primary intention of any such regulation.

The process for implementing and adjusting such measures may be initiated at any time. In addition, some measures may be designated as routine (see Section 2.2.1.1), which will allow adjustment at a single meeting based on relevant information available at the time if (1) modification is proposed for the same purpose as the original measure, and (2) impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as routine.

Generally, the Council will initiate the process of establishing or adjusting management measures when a resource problem with a non-CPS is identified, and it has been determined that CPS fishing regulations will reduce the total impact on that species or stock. It is anticipated this will generally occur when a state or federal resource management agency (such as the U.S. Department of the Interior, NMFS, or a state fishery agency) presents the Council with information substantiating its concern for a particular species. The Council will review the information and refer it to the Scientific and Statistical Committee, CPSMT or other appropriate technical advisory group for evaluation. If the Council determines that management measures may be necessary to address requirements of the ESA, MMPA, international agreements, or other relevant federal law or policy, it may implement appropriate management measures in accordance with the procedures identified in Section 2.2.1. The intention of the measures may be to share conservation burdens while minimizing disruption of the CPS fishery, but under no circumstances may the intention be simply to provide more fish to a different user group or to achieve other allocation objectives.

2.2.2 Other Management Measures

2.2.2.1 Generic

These management measures apply to all vessels participating in the CPS fishery.

2.2.2.1.1 Observers

All fishing vessels operating in this management unit, including catcher/processors, at-sea processors, and vessels that harvest in Washington, Oregon, or California and land catch in another area, may be required to accommodate NMFS certified observers on board to collect scientific data. An observer program will be considered only for circumstances where other data collection methods are deemed insufficient for management of the fishery. Implementation of any observer program will be in accordance with appropriate procedures outlined under this framework.

As determined by the NMFS Regional Administrator, there may be a need for observers on at-sea processing vessels to collect data normally collected at shore-based processing plants. Processing vessels must accommodate on board observers and may be required to provide the NMFS certified observers prior to issuance of any required federal permits. Observers are required on foreign vessels operating in U.S. waters.

2.2.2.1.2 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (revised in Public Law 104-267, The Sustainable Fisheries Act [SFA]) requires Councils to include descriptions of EFH in all federal FMPs. In addition, the Magnuson-Stevens Act requires federal agencies to consult with NMFS on activities that may adversely affect EFH. Appendix D of this FMP includes a description of EFH for the five CPS included in this plan (Northern anchovy, Pacific [chub] mackerel, Jack mackerel, market squid, and Pacific sardine), fishing effects on EFH, non-fishing effects on EFH, and options to avoid or minimize adverse effects on EFH or promote conservation and enhancement of EFH.

2.2.2.1.2.1 Magnuson-Stevens Act Directives Relating to EFH

Magnuson-Stevens Act directives and NMFS guidance on implementation are addressed in greater detail in Appendix D. The Magnuson-Stevens Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." To clarify this definition, the following interpretations are made: "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers the full life cycle of a species. The definition of EFH may include habitat for an individual species or an assemblage of species, whichever is appropriate to the FMP.

The Magnuson-Stevens Act requires councils to describe in FMPs any fishing activities that may adversely affect EFH. The Magnuson-Stevens Act also requires FMPs to include management measures that minimize adverse effects on EFH from fishing, to the extent practicable.

In addition, the EFH regulations require identification of nonfishing adverse impacts on EFH. The Magnuson-Stevens Act specifies that councils may comment on and make recommendations to the Secretary and any federal or state agency concerning any activity authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken, by any state or federal agency that, in the view of the Council, may affect the habitat, including EFH, of a fishery resource under its authority. If the Secretary receives information that an activity of a state or federal agency would adversely affect EFH, the Secretary shall recommend to such agency measures that can be taken by such agency to conserve such habitat. Nonfishing impacts on EFH and corresponding potential conservation measures are included in Appendix D.

2.2.2.1.2.2 Definition of Essential Fish Habitat for CPS

The CPS fishery includes four finfish (Pacific sardine, Pacific [chub] mackerel, northern anchovy, and jack mackerel) and the invertebrate, market squid. CPS finfish are pelagic (in the water column near the surface and not associated with substrate) because they generally occur above the thermocline in the upper mixed layer.

Options

Option 1: No Definition of EFH

This option is not acceptable under the Magnuson-Stevens Act

Option 2: Define CPS EFH as follows:

For the purposes of EFH, the four CPS finfish are treated as a complex because of similarities in their life histories and similarities in their habitat requirements. Market squid are also treated in this same complex because they are similarly fished above spawning aggregations.

This definition of EFH for CPS finfish is based on a thermal range bordered by the geographic area where CPS occur at any life stage, where CPS have occurred historically during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by CPS. The identification of EFH for CPS accommodates the fact that the geographic range of CPS varies widely over time in response to the temperature of the upper mixed layer of the ocean.

The east-west geographic boundary of EFH for CPS is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the exclusive economic zone (EEZ) and above the thermocline where sea surface temperatures range between 10º C - 26º C. The southern boundary is the United States-Mexico maritime boundary. The northern boundary is more dynamic, and is defined as the position of the 10º C isotherm, which varies seasonally and annually. Appendix D provides a more detailed description of this variability.

Option 3: Define CPS EFH to include the entire EEZ

At high abundance levels, It is possible that CPS range throughout the entire EEZ. However, CPS finfish are generally not found at temperatures colder than 10° C or warmer than 26° C and preferred temperatures and minimum spawning temperatures are generally above 13°C. Defining CPS EFH as the entire EEZ is not a preferred option because it would include a broader area than the waters necessary for spawning, breeding, feeding, or growth to maturity.

The Council chose Option 2.

2.2.2.1.2.3 Management Measures To Minimize Adverse Impacts on EFH from Fishing

The Council may use any of the following management measures to minimize adverse effects on EFH from fishing, if there is evidence that a fishing activity is having an identifiable adverse effect on EFH. Currently, there is not evidence that a fishing activity is having an identifiable adverse effect on CPS EFH. Such management measures shall be implemented under the Point of Concern Framework as described in Section 2.2.1.2.

- Fishing Gear Restrictions
- Time/Area Closures
- Harvest Limits, or other applicable measures

In determining whether it is practicable to minimize an adverse effect from fishing, the Council should consider whether, and to what extent, the fishing activity is adversely impacting EFH, including the fishery; the nature and extent of the adverse effect on EFH; and whether management measures are practicable, taking into consideration the long and short term costs and benefits to the fishery and EFH, along with other appropriate factors, consistent with National Standard 7 (conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication).

2.2.2.1.3 Vessel Safety Considerations

The Council will consider and may provide, after consultation with the U.S. Coast Guard and persons utilizing the fishery, temporary adjustments for access to the fishery by vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safety of the vessels.

2.2.2.1.4 Limited Entry

This FMP authorizes changes and modifications to any effort limitation programs established herein and development of additional effort limitation programs. Changes may include, but are not limited to, requirements for obtaining, maintaining, and renewing permits in any effort limitation system.

2.2.2.2 Domestic Commercial

All measures, unless otherwise specified, apply to all domestic vessels regardless of whether catch is landed and processed on shore or processed at sea.

2.2.2.2.1 Permits

Federal permits may be required for individuals or vessels that harvest CPS, and for individuals or facilities (including vessels) that process CPS or purchase live CPS. In determining whether to require a harvesting or processing permit, and in establishing the terms and conditions for issuing a permit, the Council may consider any relevant factors including whether a permit:

1. Will enhance the collection of biological, economic, or social data.
2. Will provide better enforcement of laws and regulations, including those designed to ensure conservation and management and those designed to protect consumer health and safety.
3. Will help achieve the goals and objectives of the FMP.
4. Will help prevent or reduce overcapacity in the fishery.
5. May be transferred, and under what conditions.

Separate permits or endorsements may be required for harvesting and processing, or for vessels or facilities based on size, type of fishing gear used, species harvested or processed, or such other factors that may be appropriate. The permits and endorsements are also subject to sanctions, including revocation, as provided by section 308 of the Magnuson-Stevens Act.

In establishing a permit requirement, the Council will follow the rulemaking procedures in Section 2.2.1.

2.2.2.2.1.1 Permit Revocation and Reinstatement

This FMP allows National Oceanic and Atmospheric Administration (NOAA), under procedures of 15 CFR Part 904, to revoke or suspend any permit issued under authority of the CPS FMP.

2.2.2.2.2 Catch Restrictions

This FMP authorizes the commercial and recreational harvest of CPS and provides for limiting the harvest of CPS managed under this plan. Catch restrictions may be modified under the framework provisions.

2.2.2.2.2.1 Prohibited Species

This FMP does not authorize the taking, retaining, or possessing of any species by CPS gears, if such taking or possessing is prohibited by other state or federal regulations. Current federal regulations prohibit retention of Pacific halibut and salmonids caught with trawl gear. State regulations prohibit the landing of crab incidentally caught in trawl gear off Washington and Oregon. However, trawl fishers may land Dungeness crab in the State of California in compliance with the state landing law. All groundfish species are prohibited unless caught with legal groundfish gear or according to specifications in the Groundfish FMP. Retention of Pacific halibut by any net gear is prohibited. Salmonids are prohibited species for longline and pot gear and purse seines. Sturgeon are prohibited species for purse seine, lampara, or drag seine gear in certain areas off Washington. Halibut may be retained and landed by troll and longline gear only during times and under conditions set by International Pacific Halibut Commission and other federal regulations. Salmon taken by troll gear may be retained and landed only as specified in troll salmon regulations. Steelhead, striped bass, yellowtail, barracuda, or white seabass are prohibited species for roundhaul gear in California.

Species identified as prohibited must be returned to the sea as soon as practical with a minimum of injury after allowing for sampling by an observer, if any. Exceptions may be made for recovery of tagged fish.

This FMP authorizes the designation of other prohibited species in the future, or the removal of a species from this classification, consistent with other applicable law for that species.

2.2.2.2.3 Gear Restrictions

This FMP authorizes the use of net gear, hook-and-line, pots (traps), longlines, and any other types of gear as legal gear for the commercial harvest of CPS, unless such gear is specifically prohibited by state law. A complete listing of current state regulations in Washington, Oregon, and California is in Section 2.2.5.2.

Various state restrictions on gear, season, and area exist in Washington, Oregon, and California. Logbooks are required by states in some instances. Washington requires an experimental permit to take certain CPS in ocean waters with purse seine, and use of seines and dip bag nets in certain bays to take anchovy and sardine is permitted, but with specific gear, area, and time restrictions. Oregon permits the use of seines only in specific estuaries, and the use of set and drift gill nets is restricted and requires an experimental permit in specific areas. Other gear (trawl, pots, traps, longlines) are subject to gear restrictions. Gear, season, and areas are restricted for anchovy in some areas off California.

Implementation and modification of specific management measures regarding gear, such as definitions of legal gear, mesh size restrictions, gear marking, or other gear restrictions are authorized by this FMP. Gear restrictions may be established, modified, or removed under the point-of-concern or socioeconomic frameworks. Any changes in gear regulations should be scheduled so as to minimize costs to the fishing industry, insofar as this is consistent with achieving the goals of the change.

2.2.2.2.4 Option for Closed Fishing Areas

The northern anchovy fishery management plan closes certain areas to commercial round-haul fishing or fishing for reduction processing (See Figure 2.2.2.2.4-1). Those areas were originally closed by the State of California to avoid commercial fishing conflicts with sport fisheries and reduce potential impacts on sport fish and salmon. This FMP authorizes the issuance of exempted fishing permits (See 2.2.2.8 Exempted Fishing) for fishing in closed areas consistent with the goals and objectives.

Options considered are (1) retain all closed areas to reduction or round-haul fishing for anchovy, (2) retain all closed areas to all CPS fishing, (3) have no closed areas, or (4) consider each closed area separately for inclusion in the FMP.

The Council chose Option 1.

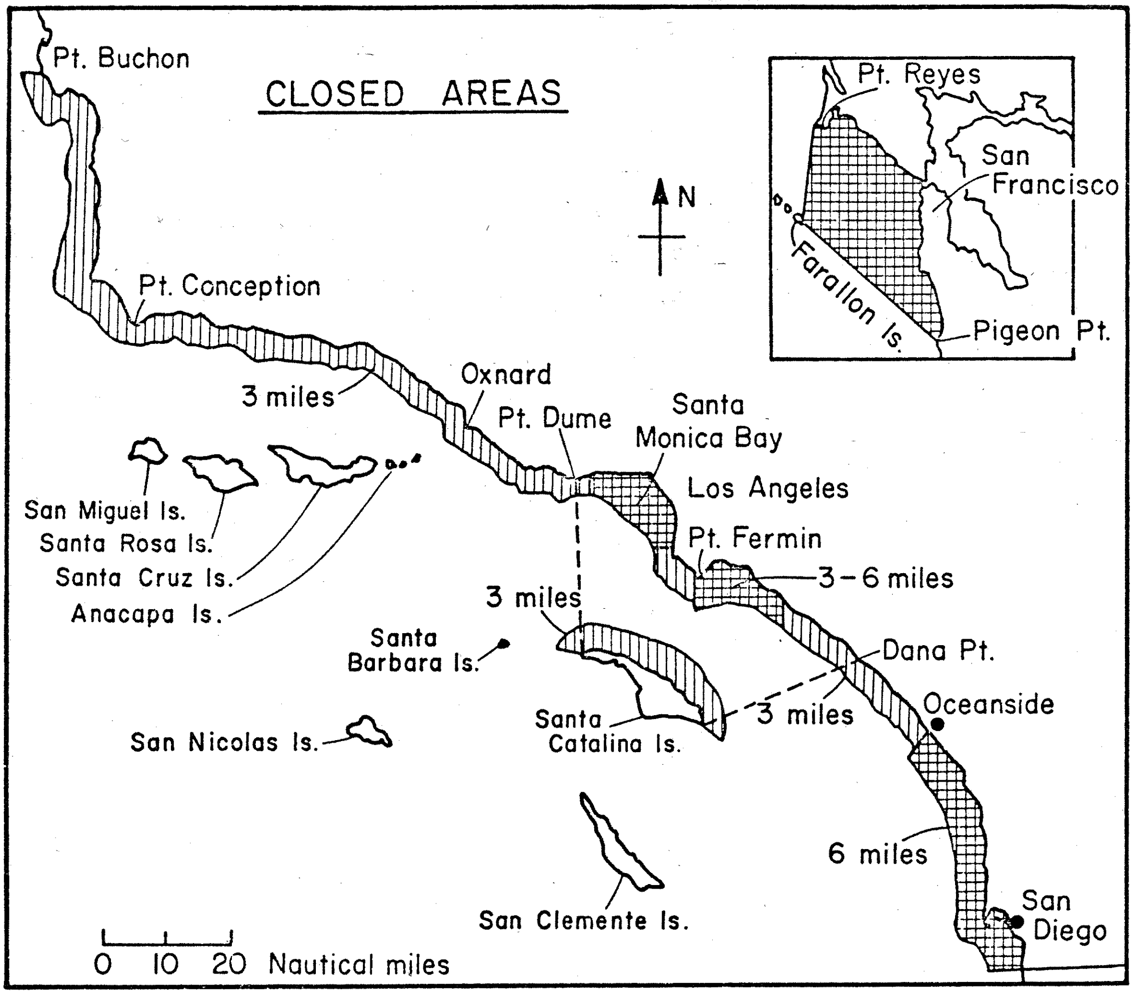

FIGURE 2.2.2.2-4. Existing California area closures, and optional Catalina Channel closure (outlined by dashed lines).

2.2.2.2.5 Reporting Requirements

This FMP authorizes domestic annual harvest (DAH) survey, exempted fishing permit (EFP) application, and foreign vessel reporting and records keeping requirements. This FMP authorizes other domestic vessel permit applications and reporting requirements in the future.

2.2.2.2.5.1 Surveys to Determine Domestic Annual Harvest

Surveys of the domestic industry will be conducted by NMFS at the appropriate time to determine amounts of fish not needed by the domestic processing industry, which then may be made available to joint venture or foreign fishing.

2.2.2.2.5.2 Other Reporting and Record Keeping Requirements

This FMP authorizes DAH survey, EFP application, and foreign vessel reporting and records keeping requirements. This FMP authorizes other domestic vessel permit applications and reporting requirements in the future.

Surveys to Determine Domestic Annual Harvest

Surveys of the domestic industry will be conducted by NMFS at the appropriate time to determine amounts of fish not needed by the domestic processing industry, which then may be made available to joint venture or foreign fishing.

Other Reporting and Record Keeping Requirements

Catch, effort, biological, and other data necessary for implementation of this FMP will continue to be collected by the states of Washington, Oregon, and California under existing state data collection provisions. Federal reporting requirements, such as logbooks, will be implemented only when data collection and reporting systems operated by state agencies fail to provide the Secretary with statistical information for adequate management. Any special reporting requirement should be imposed only if it is expected to enhance NMFS' ability to monitor the catch accurately.

Conditions may develop in the CPS fishery that make current state reporting requirements insufficient. For example, a large capacity vessel such as a factory trawler might operate within state waters but outside the area of limited entry trip limit restrictions (i.e., north of 39° N latitude), harvest substantial amounts of CPS, and either unload catch after a period of delay or outside the management area. It is possible that delays in obtaining catch data or missing catch data could affect stock assessments or other management efforts. To address these potential future problems, the FMP authorizes implementation of federal reporting requirements in addition to those of the various states. The purpose of these measures would be to enhance Council's ability to manage CPS stocks effectively. Additional reporting requirements would be developed under framework management procedures and announced in the *Federal Register*.

The Council intends that any special reporting requirement be imposed only if it is expected to enhance NMFS' ability to monitor the catch accurately.

2.2.2.2.6 Vessel Identification

The FMP authorizes vessel identification requirements which may be modified as necessary to facilitate enforcement and vessel recognition.

2.2.2.3 Domestic Recreational

Measures described in this section apply to domestic recreational fisheries only, although most measures could be used to manage foreign recreational fisheries as well.

2.2.2.3.1 Permits

Washington, Oregon, and California have state laws concerning recreational licenses and permits. In the event that a federal licenses or permits become necessary, they may be required under this FMP.

2.2.2.3.2 Catch Restrictions

This FMP authorizes establishment of catch restrictions on the recreational fishery consistent with goals and FMP objectives and national standards established by Magnuson-Stevens Act.

2.2.2.3.3 Gear Restrictions

There are no federal restrictions on legal recreational gear for CPS. Existing state regulations apply in Washington, Oregon, and California. The FMP authorizes federal recreational regulations for CPS.

2.2.2.4 Domestic Vessels in a Joint Venture

U.S. vessels operating in joint ventures on the West Coast are domestic vessels and traditionally have been treated the same as U.S. vessels delivering to shore facilities. However, conditions in the fishery could warrant separate treatment in the future. Although all U.S. vessels have been subject to the same regulations, joint venture catcher operations may be affected indirectly by restrictions (such as closed areas) placed on the foreign processing vessels that receive U.S. catch at sea.

2.2.2.5 Foreign Vessels in a Joint Venture or Foreign Fishery

These measures apply to foreign vessels that process fish taken by U.S. catcher-boats under joint venture processing or to foreign vessels that operate in a fishery directed at a species for which there is a TALFF. The CPS FMP provides authority to establish, modify or remove future regulations including; but not limited to, harvest guidelines, harvest quotas, seasons, area closures, incidental harvest restrictions, trip and landing limits, and gear restrictions.

2.2.2.5.1 Permits

All foreign vessels operating in this management area shall have on board a permit issued by the Secretary pursuant to the Magnuson-Stevens Act.

2.2.2.5.2 Target Species

A foreign nation may conduct joint venture operations only for species for which there is a JVP and only using boats with appropriate permits. Directed fishing is allowed only for species for which the foreign nation has received an allocation of TALFF.

2.2.2.5.3 Incidental Catch

Incidental catch refers to CPS which are unavoidably caught while fishing for another species. It is recognized that incidental harvest of domestically fully utilized CPS is unavoidable in joint venture and foreign fisheries. Minimal incidental allowances consistent with the status of the stocks and the efficiency of the joint venture or foreign fisheries will usually be allowed. These incidental allowances are not to be considered as surpluses to domestic processing needs and are allowed only to provide for full utilization of the species targeted in the joint venture or foreign fishery.

Allowances for incidental harvest in joint ventures or foreign fisheries may be percentages or some other quantity at the Council's discretion. Incidental allowances may be established or changed at any time during the year, but are published at least annually, concurrent with the annual specifications of JVP.

The NMFS Regional Administrator may establish or modify incidental species allowances to reflect changes in the condition of the resource and performance of the U.S. industry. The Council will consider public testimony, and consider the following factors before establishing or changing incidental allowances, (1) observed catch rates in any previous joint venture or foreign fishery; (2) current estimates of relative abundance and availability of species caught incidentally; (3) ability of the foreign vessels to take the JVP or TALFF; (4) past and projected foreign and U.S. fishing effort; (5) status of stocks; (6) impacts on the domestic industry; and (7) other relevant information. Inseason changes will be made as a routine management measure.

2.2.2.5.4 Prohibited Species

Prohibited species means salmonids or any species of fish that a joint venture or foreign vessel is not authorized to retain. Prohibited includes fish received in excess of any authorization, landing limit, or harvest guideline. These species must be immediately returned to the sea with a minimum of injury after allowing for sampling by an observer, if any. This FMP authorizes the designation of other prohibited species in the future, or the removal of a species from this classification if consistent with the applicable law for that species.

2.2.2.5.5 Season and Area Restrictions

There is no season restriction unless otherwise specified according to this FMP. There is no area restriction, unless otherwise specified according to this FMP. Joint venture and foreign fisheries for CPS may not be conducted within the license limitation area if one is adopted.

Season and area restrictions for foreign vessels operating in a joint venture or foreign fishery may be established, modified, or removed at any time during the year in accordance with the procedures in sections 2.2.1.2 and 2.2.1.3 or by foreign vessel permit conditions.

2.2.2.5.6 Reporting and Record Keeping Requirements

Foreign nations receiving U.S. harvested fish in a joint venture or participating in a foreign fishery are required to submit detailed reports of fishing effort, location, amount, and disposition by species or species group, and transfer of fish or fish products, as needed for monitoring and management of the fishery. Reports may be required at specified time intervals. The NMFS Regional Administrator may require daily reports when a specified fraction of JVP, TALFF, or incidental allowance is reached. In addition, each country may be required to report arrival, departure, and positions of each of its vessels, as specified under the regulations and permit conditions, as needed for monitoring fleet deployment. Logbooks may be required to fulfill fishery conservation, management, and enforcement purposes of Magnuson-Stevens Act. These logs may include; but are not be limited to, communications logs, transfer logs, or daily joint venture logs with haul by haul and daily receipt data, effort, and production information.

2.2.2.5.7 Dumping

Foreign and other vessels are prohibited from dumping pollutants and fishing gear which would degrade the environment or interfere with domestic fishing operations.

2.2.2.5.8 Fishery Closure

A joint venture or directed foreign fishery shall cease each year when, (1) the JVP or TALFF is reached; (2) the maximum incidental catch allowance for that nation of any species or species group is reached; (3) the overall harvest guideline or harvest quota for the allocated species is reached; (4) the applicable open season is ended; or (5) as necessary for resource conservation reasons under the point-of-concern mechanism.

2.2.2.5.9 Observers

Observers shall be placed on each foreign vessel while it is operating in a foreign or joint venture fishery, as provided by Title II of the Magnuson-Stevens Act. The law provides for the following exceptions to this requirement:

1. If observers are aboard motherships of a mothership/catcher vessel fleet.
2. If the vessel is in the EEZ for such a short time that at observer would be impractical.
3. If facilities for quartering an observer are inadequate or unsafe.
4. For reasons beyond the control of the Secretary an observer is not available.

2.2.2.5.10 Other Restrictions

The Secretary may impose additional requirements for the conservation and management of fishery resources covered by the vessel permit or for national defense or security reasons. These restrictions include, but are not limited to, season, area, and reporting requirements.

The highest priority of this FMP is to provide for conservation of the resource. Any restriction on the joint venture fishery may be modified under the point-of-concern mechanism for resource conservation reasons.

2.2.2.6 Foreign Recreational

Foreign recreational fishing refers to any fishing from a foreign vessel not operated for profit or scientific research, and not involved the sale, barter, or trade of any part of the catch. This FMP authorizes establishment of catch restrictions on the foreign recreational fishery which are consistent with the goals and objectives of the FMP and the national standards established by the Magnuson-Stevens Act.

2.2.2.7 Limited Entry

Research and monitoring programs may need to be developed and implemented for the CPS fishery so that information required in a limited entry program is available. Such data should indicate the character and level of participation in the fishery, including but not limited to, (1) investment in vessel and gear; (2) the number and type of units of gear; (3) the distribution of catch; (4) the value of catch; (5) the economic returns to the participants; (6) mobility between fisheries; (7) purchase or sale prices of limited entry permits; various social and community considerations.

2.2.2.8 Exempted Fishing

"Exempted fishing" is defined to be fishing practices that are new to the fishery or not allowed under the FMP. Under this FMP, the NMFS Regional Administrator may authorize the targeted or incidental harvest of CPS for experimental or exploratory fishing that would otherwise be prohibited including closed areas. The NMFS Regional Administrator may restrict the number of experimental permits by total catch, time, or area. The NMFS Regional Administrator may also require any level of industry-funded observer coverage for these experimental permits.

Exempted fisheries are expected to be of limited size and duration and will require EFPs issued under Section 303(b)(1) of the Magnuson-Stevens Act. The duration of EFPs will ordinarily be one year. Permits will not be renewed automatically. An application must be submitted to the NMFS Regional Administrator for each year. A fee sufficient to cover administrative expenses may be charged for EFPs. An applicant for an EFP need not be the owner or operator of the vessel(s) for which the EFP is requested as long as the proposed activity is compatible with limited entry and other management measures in the FMP.

The FMP authorizes mandatory data reporting and mandatory on-board observers with exempted fishing permits. Installation of vessel monitoring units aboard vessels with exempted fishing permits may be required.

Criteria and procedures for the issuance of EFPs are as follows:

1. Applicants must submit a completed application in writing to the NMFS Regional Administrator at least 60 days prior to the proposed effective date of the permit. The application must include, but is not limited to, the following information:

   A. Date of the application.

   B. Applicant's name, mailing address, and telephone number.

C. Statement of the purposes and goals of the experiment for which an EFP is needed, including, as appropriate:

   1. Identification the problem or potential opportunity addressed .
   2. A description of area to be fished.
   3. A description of unauthorized gear or fishing practices which are proposed under the EFP.
   4. A description of all relevant aspects of the experimental fishing arrangements.
   5. A general description of arrangements for disposition of all fish harvested under the EFP.
   6. Valid justification explaining why issuance of the EFP is warranted.

D. Statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals.

E. For each vessel to be covered by the EFP:

   1. Vessel name.
   2. Name, address, and telephone number of owner and master.
   3. U.S. Coast Guard documentation, state license, or registration number.
   4. Home port.
   5. Length of vessel.
   6. Net tonnage.
   7. Gross tonnage.

F. Description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment.

G. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size and amount of gear to be used.

H. Signature of the applicant.

The NMFS Regional Administrator may request additional information necessary to make required determinations.

2. The NMFS Regional Administrator will review each application and make a preliminary determination whether or not the application contains all required information and constitutes a valid experimental program that is appropriate for further consideration. If the NMFS Regional Administrator finds any application does not warrant further consideration, he/she shall notify both the applicant and the Council in writing of the reasons for his/her decision. If the NMFS Regional Administrator determines any application warrants further consideration, he/she will publish a notice of receipt of the application in the *Federal Register* with a brief description of the proposal, and will give interested persons an opportunity to comment. The notice may establish a cutoff date for receipt of additional applications to participate in the same or a similar experiment, or may limit the total number of applications that will be accepted.

   The NMFS Regional Administrator also will forward copies of the application to the Council, U.S. Coast Guard, and fishery management agencies of Oregon, Washington, California, and Idaho, accompanied by the following information:

   A. Current utilization of DAH and processing capacity (including existing experimental harvesting, if any) of the target and incidental species.

   B. Statement of why the target species is considered underutilized or why the issue and opportunity are important (if applicable).

C. Citation of the regulation or regulations which, absent the EFP, would prohibit the proposed activity.

D. Biological information relevant to the proposal.

3. At a Council meeting following receipt of a complete application, the NMFS Regional Administrator may choose to consult with the Council and the directors of the state fishery management agencies concerning the permit application. The Council shall notify the applicant in advance of the meeting, if any, at which the application will be considered and invite the applicant to appear in support of the application if the applicant desires.

4. As soon as practicable after receiving responses from the agencies identified above, and after any consultation, the NMFS Regional Administrator shall notify the applicant in writing of his/her decision to grant or deny the EFP, and, if denied, the reasons for the denial. Grounds to deny issuance of an EFP include, but are not limited to, the following:

   A. The applicant has failed to disclose relevant information, or has made false statements in the application.

   B. According to the best scientific information available, the harvest to be conducted under the permit would detrimentally affect any species of fish in a significant way.

   C. Issuance of the EFP would inequitably allocate fishing privileges among domestic fishermen or would have economic allocation as its sole purpose.

   D. Activities to be conducted under the EFP would be inconsistent with the goals and objectives of the FMP.

   E. The applicant has failed to demonstrate a valid justification for the permit.

   F. The activity proposed under the EFP could create a significant enforcement or safety problem.

5. If the permit is granted, the NMFS Regional Administrator will publish a notice in the *Federal Register* describing the experimental fishing to be conducted under the EFP. The NMFS Regional Administrator may attach terms and conditions to the EFP consistent with the purpose of the experiment, including, but not limited to:

   A. The maximum amount of each species which can be harvested and landed during the term of the EFP, including trip limitations and incidental harvest restrictions (trip allowance and/or total incidental reserve, harvest guideline, or harvest quota) for incidental species, where appropriate.

   B. The number, size, names, and identification numbers of the vessel authorized to conduct fishing activities under the EFP.

   C. The time(s) and place(s) where experimental fishing may be conducted.

   D. The type, size, and amount of gear which may be used by each vessel operated under the EFP.

   E. The condition that observers be allowed aboard vessels operated under an EFP.

   F. Reasonable data reporting requirements.

   G. Such other conditions as may be necessary to assure compliance with the purposes of the EFP consistent with the objectives of this FMP.

   H. Provisions for public release of data obtained under the EFP.

6. Failure of a permittee to comply with the terms and conditions of an EFP shall be grounds for revocation, suspension, or modification of the EFP with respect to all vessels conducting activities under that EFP. Any action taken to revoke, suspend, or modify an EFP shall be governed by 15 CFR §904, Subpart D.

   Nothing in this FMP is intended to exclude or to limit use of CPS, markets, or processing methods as long as the process in question is compatible with measures and intentions of this FMP.

2.2.2.8.1 Policies for Issuing Exempted Fishing Permits

Priorities for issuing EFPs are as follows:

1. Domestic boats delivering to domestic processors and domestic factory trawlers (with equal priority).
2. Domestic catcher-boats delivering to a foreign offshore processor.

Boats already involved in developing a fishery for an underutilized species (i.e., boats with a catch history or previous EFP) should receive highest priority in applying and renewing permits.

2.2.2.9 Other Fees and Permits

Nothing in this FMP is intended to exclude use of additional fees or permits in the future as long as the fee or permit is consistent with applicable law, management measures, and intent of this FMP. It may, for example, become desirable to issue permits for processing CPS in onshore plants or processing vessels offshore. It may be desirable to charge fees sufficient to cover administrative costs of issuing additional types
of permits. Changes in requirements for obtaining, maintaining, and renewing permits are authorized.

2.2.3 Scientific Research

Nothing in this FMP is intended to inhibit or prevent any scientific research involving CPS which is acknowledged by the Secretary through procedures set out in 50 CFR §600.745.

Proposed activity is not scientific research unless it is submitted in writing to the Secretary in the form of a research proposal which addresses all of the factors below. An activity may be acknowledged as scientific research if its primary objective, purpose, or product is the acquisition of data, information, or knowledge as determined by consideration of all of the following factors:

1. The proposed program will result in information useful for scientific or management purposes.
2. The application of existing knowledge alone is insufficient to solve the scientific or management subject or problem presented by the scientific research proposal.
3. Facts/data/samples will be collected or observed and analyzed in a scientifically acceptable manner and the results will be formally prepared and available to the public.
4. Recognized scientific experts, organizations, or institutions with expertise in the field or subject matter area are conducting, sponsoring or are otherwise affiliated with the activity.

2.2.3.1 Secretarial Acknowledgment of Scientific Research

If the Secretary agrees that an activity constitutes scientific research involving CPS, a letter of acknowledgment should be issued to the applicant and operator or master of the vessel conducting the scientific research. The letter will include information on the purpose, scope, location, and schedule of the acknowledged activities. Any activities not in accordance with the letter of acknowledgment should be subject to all provisions of the Magnuson-Stevens Act and its implementing regulations. The Secretary should transmit copies of letters of acknowledgment to the Council, state or federal administrative and enforcement agencies to ensure they are aware of the research activities.

CPS taken under the scientific research exclusion may be sold to offset all or part of the cost of carrying out the research plan including costs associated with operating the research vessel.

2.2.4 Restrictions on Other Fisheries

For each non-CPS fishery, a reasonable limit on the incidental CPS catch may be established that is based on the best available information. The objectives of restrictions on other fisheries under this framework are to:

1. Minimize discards in the non-CPS fishery by allowing retention and sale, thereby increasing fishing income.
2. Discourage targeting on CPS by the non-CPS fleet.

Incidental limits may be imposed or adjusted in accordance with appropriate procedures described in this FMP. The Secretary may accept or reject but not substantially modify the Council's recommendations.

2.2.5 Procedures for Reviewing State Regulations

This FMP acknowledges that state regulations are a fundamental part of CPS management. All existing state regulations at the time of implementation of this plan are consistent with this FMP. Those regulations are listed in section 2.2.5.2.

This FMP establishes a framework review process by which any state may obtain a determination that its regulations are consistent with the FMP and the national standards. As necessary, the Council may also recommend to the NMFS that duplicate or different federal regulations be implemented in the EEZ. While the Council retains the authority to recommend federal regulations be implemented in the EEZ, the preference is to continue to rely on state regulations in that area as long as they are consistent with the FMP.

While states are not required to submit regulations which they wish to apply in the EEZ to the Council for a consistency determination, regulations which have not received a consistency determination run the risk of being declared inconsistent and invalid if challenged in state law enforcement proceeding. The Council invites submission of all present and future state fishery regulations relating to the harvest of species managed under this FMP which are applicable in the EEZ.

2.2.5.1 Review Procedure

Any state may propose that the Council review a particular state regulation for the purpose of determining its consistency with the FMP and the need for complementary federal regulations. Although this procedure is directed at the review of new regulations, existing regulations affecting the harvest of CPS managed by the FMP may also be reviewed under this process. The state making the proposal will include a summary of the regulation in question and concise arguments in support of consistency.

Upon receipt of a state's proposal, the Council may make an initial determination whether or not to proceed with the review. If the Council determines that the proposal has insufficient merit or little likelihood of being found consistent, it may terminate the process immediately and inform the petitioning state in writing of the reasons for its rejection.

If the Council determines sufficient merit exists to proceed with a determination, it will review the state's documentation or prepare an analysis considering, if relevant, the following factors:

1. How the proposal furthers or is not otherwise consistent with the objectives of the FMP, the Magnuson-Stevens Act, and other applicable law.
2. Likely effect on or interaction with any other regulations in force for the fisheries in the area concerned.
3. Expected impacts on the species or species group taken in the fishery sector being affected by the regulation.
4. Economic impacts of the regulation, including changes in catch, effort, revenue, fishing costs, participation, and income to different sectors being regulated as well as to sectors which might be indirectly affected.

5. Any impacts in terms of achievement of harvest guidelines or harvest quotas, maintaining year-round fisheries, maintaining stability in fisheries, prices to consumers, improved product quality, discards, joint venture operations, gear conflicts, enforcement, data collection, or other factors.

The Council will inform the public of the proposal and supporting analysis and invite public comments before and at the next scheduled Council meeting. At its next scheduled meeting, the Council will consider public testimony, public comment, advisory reports, and any further state comments or reports, and determine whether or not the proposal is consistent with the FMP and whether or not to recommend implementation of complementary federal regulations or to endorse state regulations as consistent with the FMP without additional federal regulations.

If the Council recommends the implementation of complementary federal regulations, it will forward its recommendation to the NMFS Regional Administrator for review and approval. The NMFS Regional Administrator will publish the proposed regulation in the *Federal Register* for public comment, after which, if approved, he/she will publish final regulations as soon as practicable. If the NFMS Regional Administrator disapproves the proposed regulations, he/she will inform the Council in writing of the reasons for disapproval.

2.2.5.2 Current State Regulations

Each of the West Coast states has regulations managing pelagic fisheries. They are presented in summary form and are available in full text from each state.

2.2.5.2.1 Washington Coastal Pelagic Species Regulations - Summary

SARDINE

No fishing except by special permit in the ocean. No sardine fishing in Puget Sound.

ANCHOVY

Puget Sound - seine, dip net, and lampara only. Puget Sound open except specific areas and times are closed to prevent bycatch of herring. Detailed list of closed times/areas available. Maximum seine net length is 600 feet.

Ocean - seine, lampara, and dip net only. Open all year. Maximum seine or lampara length is 1,400 feet with 0.5 inch mesh.

Columbia River - purse seine and lampara. Open all year.

Gray's Harbor and Willapa Bay - dip net. Open all year. Purse seine and lampara open June 1 to October 31.

SQUID

Ocean and Puget Sound - beach seine gears, dip net, brail, and jig gear only. No fishing within .25 mile of any incorporated city or town. No more than ten kilowatts of lighting may be used. Director may issue special permits. NOTE: Treaty Indian fishing not under these limits.

MACKEREL

Incidental catch only.

EMERGING COMMERCIAL FISHERY PERMITS

The Director has the authority to issue experimental fishery permits to a new or emerging commercial fishery. The number of participants may be limited.

2.2.5.2.2 Oregon Coastal Pelagic Species Regulation Summary

Anchovy, sardine, and squid are listed as Category A species under Oregon's Developmental Fisheries Program. Pacific (chub) mackerel and jack mackerel are Category C species because the vast majority of the catch of these two species is incidental to the Pacific whiting fishery.

Oregon Administrative Rules Chapter 635

Sec 635-006-0820

Each January the Commission adopts a list of food fish species to be managed under the Develpmental Fisheries Program. Any person may request that species be added or removed from the list by October 31 of the preceding year.

Sec 635-006-0830 Listing as a developmental species.

Species must be underutilized to be included on a developmental list, there are three categories:

A. Not under any other state or federal FMP and shall have permit and gear limitations established annually by the commission.
B. Not under any other state or federal FMP and not shown to have any potential to be a viable fishery.
C. Currently under another state or federal FMP already establishing permit and/or gear limitations .

Sec 635-006-0840 Removing a species from developmental list.

1. *Fishery becomes developed.*
2. *Declared threatened or endangered.*
3. *Harvest is in excess of optimum yield.*
4. *User conflicts.*
5. *Gear conflicts, habitat damage, incidental catch, etc.*

Sec 635-006-0850 The list.

Partial list of category A species.
Anchovy and Herring
Sardine and Saury
Market Squid and Other Squid

Partial list of category C species.
Pacific (Chub) Mackerel
Jack Mackerel

Number of Permits

Anchovy and Herring --15
Sardine and Saury------15
Market squid--------------30 trawl and 30 other gear permits split geographically at Heceta Head.
Mackerel-------------------Managed under FMP, no permit required.

Requirements

Renewal requirements for all these Developmental Fishery Permits are the same:
Five annual landings totaling at least 500 pounds.
One landing of at least 5,000 pounds.

Gear

Specially adapted small mesh gill nets may be used for anchovy and sardine. Experimental gear permits may be required.

Sec.635-006-0870 Methods of Obtaining Information.

For all category A species.
Department shall collect fishery and biological information with the goal of a long term management plan.

Sec.635-006-0880 Establish Commercial Harvest Program and Limited Entry System.

Establishes authority and applies to species in category A.

Sec.635-006-0890 Log Books.

Log books are required for developmental fisheries.

Sec.635-006-0900 Requirements for Developmental Species Permit.

Effective January 1, 1995.
Unlawful to take a species in developmental list without a permit.
Unlawful to buy a listed species from a person without a permit.
Permit is in addition to commercial fish licenses and boat registrations.
Permit is not required if species is allowed to be taken incidentally under a federal FMP.

Sec. 635-006-0910 Procedures for Issuing Permits, Transfer and Renewal.

Cost $75.
One permit per person per species.
Nontransferable.

2.2.5.2.3 California Pelagic Fish Regulations - Summary

2.2.5.2.3.1 California Code of Regulations Title 14 - Anchovy

Sec. 147 Anchovy Reduction.

Areas

Northern Permit Area August 1 to June 30.
Southern Permit Area September 15 to June 30.

Permits

Issued to owner or operator of vessel.
Permittee must be aboard vessel.

Condition of Permits

48-hour notice to permittee of any season closure.
Valid until revoked or terminated.

1. *Gear Specifications.*

   Roundhaul net wet-stretched mesh not less than 10/16 of an inch.
   Except bag of net maybe not less than 8/16 of an inch wet-stretched mesh.
   Bag may not be more than 12.5% of total area of net.
   No other fishing gear may be possessed aboard when fishing for reduction purposes.

2. *Gear Inspections.*

   Gear may be inspected by department at anytime.

3. *Vessel I.D.*

Each vessel must display in 14-inch numerals (black on white background) its Fish and Game number on the sides and top of superstructure amidships.

4. *File letter of declaration to take anchovies for reduction.*

   In southern permit area, a vessel must file letter of intent to take, carry,or deliver anchovies for reduction.

Exception must be filed to take anchovies for any other purpose when declaration is in force.

5. *Permit Areas and Quotas.*

   (a) *Northern permit area - Waters of Pacific Ocean north of a line due west for Pt. Buchon. Closed areas are Districts 2, 8, 9, 11, 12, 13, 15, Tomales and Bodega Bays, District 10 from Pigeon Pt. to the U.S. Navigational Light at SE Farallon Island and a line to Point Reyes Navigational Light, District 16 lying southerly of Monterey breakwater magnetic east to Shoreline, District 18 within three miles of shore between a line drawn magnetic west Pt Estero and Point Buchon, and District 18 within three miles of shore between a line drawn magnetic west from Point San Luis and Arroyo Grande Creek.*

   (b) *Southern Permit Area - Waters of Pacific Ocean south of a line due west from Pt. Buchon. Closed areas - within three miles of shore south of Pt. Buchon, all areas where roundhaul nets are prohibited; within four miles of shore between a line 235 magnetic from steam plant stack at Mandalay Beach and 205 magnetic from steam plant stack at Ormond Beach; within the area encompassed by a line extending six miles 165 magnetic from Point Fermin, thence to a point located three miles offshore on a line drawn 210 magnetic from Huntington Beach Pier; within six miles of the mainland shore south of a line running 210 magnetic from the tip of the outer breakwater at Oceanside Harbor.*

   (c) *Quotas*

   5,000 tons if no biomass estimate.

   (d) *Adjustments to Quota*

   Commission may increase quota in northern or southern area.
   After May 15, any remaining northern quota will be available to southern area.

(6) *Permits to Reduce Anchovies*

- (a) *Qualifications*
  Must have license in 8042a (no section).
- (b) *Applications*
  Must be received by Commission by July 15.
- (c) *Limitation of permit*
  One per plant.
  Nontransferable.
- (d) *Duration of permit*
  Specified on permit.
- (e) *Records*
  Must submit daily landing records to department.
- (f) *Plant Delivery*
  No plant may take delivery of anchovies from a vessel unless the vessel has filed a letter of intent to take anchovies for reduction.
- (g) *Weighing of Fish Landed*
  Anchovies taken for reduction must be unloaded at a weighing device approved by the Bureau of Weights and Measures, and operated by a state licensed weighmaster, and a receipt must be issued to the fisherman immediately after unloading.
- (h) *Fish from South of the International Border*
  If landed in California they will apply to the southern quota.

(7) *Applicant Must Sign That He Understands and Agrees to Be Bound by the Terms of Permit*

(8) *Revocation of Permit*
Commission may revoke permit.

2.2.5.2.3.2 California Department of Fish And Game Code (CDFG)- Anchovy

CDFG Code 8180. Take for human consumption; South of Pt. Mugu.

South of a line drawn east and west through Pt. Mugu anchovies may be taken in any quantity for bait or human consumption in a fresh state, or, by contract with the department for hatchery food not to exceed 500 tons per year.

CDFG Code 8181. Anchovies taken south of line.

Anchovies taken south of that line in waters not less than three nautical miles form the nearest point of land on the mainland shore, and anchovies taken north of that line in any waters, may be possessed, transported, sold, or otherwise dealt within any district or part of a district south of that line.

CDFG Code 8182. Registration number to be displayed at all times on boats south of line duplicates Title 14.

CDFG Code 8183. Humboldt Bay taking.

- (a) *Live bait may be taken May 1 to Dec 1 and dead bait May 1 to August 31. Operator of a vessel must use anchovies in his or her own fishing operation, **except anchovies may be sold to local sport fishermen as bait.***
- (b) *Observers may inspect and halt operation if game species are affected.*
- (c) *Anchovies may be taken only north of a line between channel marker 8 and 9 in District 8 an 9 in Humboldt Bay.*
- (d) *No more than 15 tons of anchovies may be taken between May 1 and August 31 and not more than 15 tons between Sept 1 and Dec 1 of each year.*

(e) Use only bait nets.
(f) Release game fish immediately by hand scoop or by lowering cork line. Accurate records must be kept and must be available for inspection by department.

CDFG Code 8190. State policy regarding anchovy resource; larvae surveys; effective dates.

This section is operative only with federal funding.

Round Haul Area Closures

CDFG Code 8751. District 1, 2, and 3.

These are inland districts that include parts of bays or harbors.

CDFG Code 8752. In Districts 6, 7, 8, 9, 10, and 11 roundhaul nets may be used.

CDFG Code 8754. Districts 16, 17, 18,and 19.

Purse seines and ring nets may not be used in that portion of District 19 lying within three miles offshore from the line of the highwater mark along the coast of Orange County from sunrise Saturday to sunset Sunday from May 1 to September 10, inclusive.

CDFG Code 8755. District 20A and 21 (Should be 20 not 21).

(1) Catalina Island week end closure within three nautical miles.
(2) Catalina Island closure June 1 to September 10.

CDFG Code 8757. Use of roundhaul nets for live bait.

Allows the use of roundhaul nets for the take of live bait in areas otherwise closed in District 16, 17, 18, 19, 20, 20A, and 21.

(a) Round haul nets may not be use within 750 feet of Seal Beach Pier or Belmont Pier.
(b) It is unlawful to possess, sell, or process dead fish taken under this section.

CDFG Code 8780. Definitions.

(a) Bait net means a lampara net made of Number 9 cotton twine or equivalent. The net shall not have rings or any method of pursing the net.
(b) Bait nets may be used to take fish for bait in Districts 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 19A, 19B, 20A, 21, 118 and 118.5.
(c) In District 19A bait nets may be use to take only anchovies, queenfish, white croakers, mackerel, sardines, squid, and smelt for bait only.
(d) In district 19A no other species of fish may be taken by a boat carrying a bait net, except that a load may contain up to 18% by weight of fish other than baitfish which are taken incidentally to fishing operations.

CDFG Code 8870. Restrictions.

Dip nets may by used with following restrictions:

(a) In Districts 1, 1.5, 2, 3, and 4, dip nets may not be baited and may not measure more than six feet in greatest breadth.
(b) In District 19, hand held dip nets 30 feet or less in greatest breadth may be used. They may not be use within 750 feet of any pier, wharf, jetty, or breakwater, except to take anchovies, squid, and sardine for bait, and to take smelt.

2.2.5.2.3.3. California Code of Regulations Title 14 - Sardines

Section 157. Importation of Sardines for Bait.

Persons importing sardines for bait must send bill of lading to CDFG with country of origin. Must advise CDFG where sardines are stored and they must be packaged showing bait only and country of origin, etc.

Section 158. Sardines.

Establishes a sardine live bait permit and requires permittee to keep an accurate record of their activities in a live bait log provided by the department.

2.2.5.2.3.4 California Fish And Game Code - Sardines

CDFG Code 8150.5. Taking sardines; Restrictions, etc.

- *(a) Loads of fish may contain 15% or less by weight of sardines which are taken incidentally to fishing operations.*
- *(b) Allows importation, see Title 14, Section 157.*
- *(c) Allows imported sardines for dead bait, see Title 14, Section 157.*
- *(d) A is operative only when 8151 is inoperative.*

CDFG Code 8150.7. Intent of Legislature to Rehabilitate Sardine Resource.

Requires CDFG to estimate sardine biomass during first two months of the year. If biomass is over 20,000 tons, a 1,000 ton fishery will be allowed. May raise quota if warranted.

CDFG Code 8150.8. Quota Allocation of Sardines.

One-third, two-thirds allocation between northern and southern California. San Simeon is the division between north and south.

CDFG Code 8150.9. Untaken Sardines-Reassignment of Quotas.

Any remaining quota on September 30 will be reallocated and divided evenly between north and Game Code *south areas.*

CDFG Code 8151. Incidentally Taken Sardine Tolerances.

Established tolerance of 25% to 45% by weight when mixed with other species and an elaborate scheme to adjust tolerance on a monthly basis.

CDFG Code 8152. Sardine as Live Bait.

Allows the take of sardines for bait at any time.

CDFG Code 8154. Receive, Possess, or Sell Sardines; Exceptions.

No person shall receive, possess, or sell sardines for any purpose except for that purpose specified on the landing receipt completed at the time of landing.

Round Haul Area Closures

All code sections listed under anchovy also apply to sardines.

2.2.5.2.3.5. California Code of Regulations Title 14 - Pacific (chub) mackerel (Chub Mackerel)

Section 148. Permits to Commercially take Pacific (Chub) Mackerel.

(a) Permits are valid April 1 to March 31 of each year.

(1) Revocable nontransferable permits are issued to the owner or operator of a currently registered California commercial fishing vessel. Permittee must be aboard and any permittee who has had his permit revoked may not assist in taking Pacific (chub) mackerel for the remainder of the season. Permits are required to take or possess more than three tons or to use round haul nets for Pacific (chub) mackerel.

(2) Only issued in Long Beach.

(b) Condition of Permits.

(1) Monitoring of Resource.
CDFG shall sample landings and determine tonnages of Pacific (chub) mackerel landed. Director may revoke permits when allowable catch has been taken. If the resource can withstand additional harvest, the Director my activate the permits again. Notice of changes in allowable catch or permit status shall be by certified mail and shall be effective 48 hrs after CDFG posts such notice.

(2) Permit areas.
(A) Northern Permit Area.
Waters of Pacific Ocean between a line due west of Pt. Buchon and the Oregon Border.
(B) Southern Permit Area.
Waters of the Pacific Ocean between a line due west of Pt. Buchon and the US-Mexican border.

(3) Load composition.
Does not apply to northern area.
(A) Department may sample loads of Pacific (chub) mackerel to determine compliance with load composition requirements. Permittee may not obstruct or delay department personnel in performing their duties.
(B) Permittee shall not possess loads of fish containing Pacific (chub) mackerel except as follows:
(1) In effect only during season until quota is taken. All Pacific (chub) mackerel landings including those landed mixed with other species will be counted toward the allowable catch quota. The department shall announce via VHF/channel 16 when the quota has been reached. This shall be considered official notice.
(2) When the quota has been taken, Pacific (chub) mackerel may only be taken subject to Code Sections 8415 and ***8416.***
a. Loads of fish three tons or less may contain any percentage of Pacific (chub) mackerel.
b. Loads of fish greater than three tons may only contain 50% by weight of Pacific (chub) mackerel.
c. For the purpose of this section only jack mackerel shall be considered when determining percentage species composition.

(4) *Landing requirements.*
   (A) *All Pacific (chub) mackerel must be landed and weight at an approved weigh station.*
   (B) *Such fish shall be weighed by a license weighmaster and immediately recorded on a fish and game receipt.*
   (C) *Copies of receipts shall be handled in accordance with CDFG Code Sections 8011and 8015. Weights record shall be used to calculate species composition.*

(5) *Director may revoke permits for violations.*

2.2.5.2.3.6 California Fish And Game Code - Pacific Mackerel (Chub Mackerel)

CDFG Code 8410. Establishes season July 1 to June 30.

CDFG Code 8411. Population Studies.

CDFG will maintain population above 20,000 tons.

Total population is defined as all Pacific (chub) mackerel over age one on July 1 of each year.

Prepare status report on or before February 1 of each year. Report shall include population size for current season and an estimate of population size at the beginning of the next season.

CDFG Code 8412. Moratoriums and Quotas.

(a) *When population is below 20,000 tons a moratorium will be in effect, except that mixed loads containing no more than 18% by weight of Pacific (chub) mackerel taken incidental to other fishing operations will be permitted.*
(b) *If population is over 20,000 tons but less than 150,000 tons the director may establish a quota based on 30% of the amount over 20,000 tons.*
(c) *If the population is over 150,000 tons there will be no limit on the take of Pacific (chub) mackerel.*
(d) *Quotas may be taken with a permit issues by the department. Part of the quota may be allocated for landing from waters of the Pacific Ocean north of Pt. Sal.*

CDFG Code 8413. Department Shall Make Public Notice 48 Hours Prior to the Closing of the Season.

CDFG Code 8414. During Any Portion of the Season the Director May Decrease or Increase the Quota Established under Section 8412.

CDFG Code 8415. Mixed Species Tolerance Level.

After the quota is taken, the director may establish a tolerance level of 50% by number in landings greater than six tons and up to 100% in landings six tons or less.

Round Haul Area Closures

Area closure listed under Anchovy also apply to Pacific (chub) mackerel.

Jack Mackerel

The take of jack mackerel is unrestricted in California, except that net restrictions listed for anchovy also apply to jack mackerel.

2.2.5.2.3.7 California Code of Regulations Title 14 - Market Squid

Section 149. Taking of Squid North of Point Conception (Will be amended to conform with CDFG Code.)

(a) In District 16 and 17 squid shall not be taken by a vessel using or possessing a roundhaul net between 1200 hours (noon) Friday and 2400 hours (midnight) Sunday.
(b) In District 16 and 17 south of a line running 252 magnetic from Moss Landing Harbor Entrance, squid may not be taken by a vessel using or possessing a roundhaul net, between 200 hours (noon) and 2400 hours (midnight) on any calender day Monday through Thursday.

2.2.5.2.3.8 California Fish And Game Code -Summary Squid

CDFG Code 8399. Superceded by Article 9.7 (Sher Bill).

CDFG Code 8399.1 Take Restrictions on Squid in District 10.

(a) Following activities are unlawful:
  (1) Attract squid by displaying lights except from a vessel deploying nets for the take of squid or from the seine skiff of the same vessel.
  (2) Attract squid by displaying lights from a vessel whose primary purpose is not deploying nets for the take of squid.
  (3) To encircle any vessel, other than by the seine skiff of a vessel deploying nets for the take of squid, while that vessel is engaged in the taking of squid.

(d) Defines seine skiff-unlicenced vessel that assist larger licensed vessel.

Article 9.7

CDFG Code 8420. Legislative Funding and Declaration.

Establishes the importance of squid as a commercial species and for forage. Declares that overfishing is possible because of lack of data and recommends that a plan for sustainable harvest be developed possibly including a limit on the number of days per week that squid may be taken.

CDFG Code 8420.5.

North of a line due west from point conception squid may be taken for commercial purposes only between noon on Sunday and noon on Friday of each week.

CDFG Code 8421. Permit.

(a) Establishes a squid permit.
(b) Squid vessel permit will be issued only to vessel deploying purse seine, lampara, or dip nets. No other nets may be used to take squid. Permit not required if landings are less than two tons per day. It is also unlawful to possess more than two tons taken incidentally per trip.
(c) Permit is issued to person who is owner of a commercial fishing vessel.
(d) Owner includes a person who has a lease purchase agreement for the vessel.
(e) Permit may not be sold, trade, or transferred to another person.
(f) Permit will be issued annually beginning with the 1998 through 1999 permit year.
(g) Commission may revoke permit.
(h) Squid landed in excess of limit in CDFG Code 8421b shall be forfeited to the CDFG.

CDFG Code 8421.5.

If permit is issued to a corporation or partnership, the individual who operates the vessel shall be identified at the time the permit is issued. Following any change in agreement the CDFG will reissue the permit to the new operator.

CDFG Code 8422.

(a) Established squid vessel permit and fee of $2,500.
(b) Purchase by April 30, 1998, renewable annually only if you had a permit the preceding year.
(c) $250 late fee if purchased by May 31, 1998.
(d) All applications received after May 31 will be denied.

CDFG Code 8423 .

Establishes light boat permit and fee of $2,500.

CDFG Code 8423.5.

(a) Deadline for applying for light boat permit is April 30, 1998. Renewable only if you had a permit the preceding year.
(b) $250 late fee after April 30.
(c) Permits denied if application received after May 31 of each year.

CDFG Code 8424. Landing Requirements.

(a) No person shall purchase squid from a vessel unless that person is a licensed fish buyer, employs a certified weighmaster, and the facility is located at permanent fixed location.
(b) This section does not apply to the transfer at sea of squid for live bait in an amount of less than 200 pounds per day.

CDFG Code 8425.

Commission will hold annual public hearings at which squid regulations are adopted.

CDFG Code 8426.

(a, b) Director shall establish squid research scientific committee and a fishery advisory committee and hold public hearings.
(c) Report to the legislature due April 1, 2001.

CDFG Code 8427. Transfer of Permits.

(a) May be transferred to another vessel owned by the permit holder only if the original vessel was lost, stolen, or inoperable.
(b) Claim rejected if fraudulent.
(c) Proof of loss is required.
(d) Establishes a $250 transfer fee.

CDFG Code 8428.

Funds collected from permit fees must be used for squid research.

CDFG Code 8429.

Permit may be revoked under penalty of perjury if false statements made on application.

CDFG Code 8429.5. Authority of Director.

CDFG 8429.7.

Article 9.7 (squid) will become inoperative on April 1, 2001 and repealed as of January 1, 2002 unless extended.

Roundhaul Area Closure

See anchovy section which also applies to squid.

2.2.6 Annual Assessment and Management Cycles

This FMP specifies that annual schedules for Actively managed CPS must be developed based on the Council's workload and meeting schedule, opportunity for industry and technical review of biomass estimates and harvest guidelines or quotas, seasonal patterns in the fishery, collection and processing of California Cooperative Fisheries Investigations (CalCOFI) data during the peak spawning season, collection of other data, time required for notification of fishers, and workload of the Coastal Pelagic Species Plan Development Team and CPSAS. The FMP does not specify what those schedules will be, since they will be implemented through regulations.

The Council's decisions about harvest levels will be made as "notice" actions requiring one *Federal Register* notice and one Council meeting under the CPS framework process.

2.2.6.1 Pacific (Chub) Mackerel

At the outset of this FMP, Pacific (chub) mackerel will be managed using a July-June annual cycle already used by the State of California (Table 2.2.6.1-1). Under this schedule, Pacific (chub) mackerel is assessed during late March-early May and reviewed during late May. Harvest guidelines will be set by the Council at the annual meeting held in June. NMFS will make all necessary *Federal Register* announcements prior to the season opening on July 1.

TABLE 2.2.6.1-1. Assessment schedule for Pacific (chub) mackerel.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1. Spawning season	Aug								Apr	----	----	----	Aug						
2. Recruitment				Nov	----	----	Feb									Nov	----	----	Feb
3. Fishery data						Jan												Jan	
4. CalCOFI survey	Aug							Mar	----	May	Jun	----	Aug						
5. CalCOFI data avail.			Oct												Oct				
6. Aerial spotter index				Nov				Mar								Nov			
8. Stock assessment									Apr										
9. Preliminary review										May									
10. Council Meetings	Aug	Sep		Nov				Mar	Apr		Jun			Sep		Nov			
11. Fishing season starts												Jul							

2.2.6.2 Pacific Sardine

At the outset of this FMP, Pacific sardine will be managed using the January to December annual cycle already used by the State of California (Table 2.2.6.1-1.). Pacific sardine will be assessed during late August-early October and reviewed during late October. Harvest guidelines will be set by the Council at the annual meeting held in November. NMFS will make all necessary *Federal Register* announcements prior to the season opening on January 1.

TABLE 2.2.6.1-2. Assessment schedule for Pacific sardine.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1. Spawning season						Jan	----	----	Apr										
2. Recruitment	----	----	----	----	----	Jan						Jul	----	----	----	----	----	Jan	
3. Fishery data	Aug												Aug						
4. CalCOFI survey						Jan	----	----	Apr									Jan	----
5. CalCOFI data										May									
6. Aerial spotter index										May									
7. DEPM							Feb-Mar												
8. DEPM results avail.											Jun								
9. Biomass estimation		Sep												Sep					
10. Preliminary review			Oct												Oct				
11. Council Meetings		Sep		Nov				Mar	Apr		Jun			Sep		Nov			
12. Season starts						Jan												Jan	

2.2.6.3 Monitored Species

The CPSMT will prepare an annual Stock Assessment and Fishery Evaluation (SAFE) report describing the status of the CPS fishery as a whole including landings, prices, revenues, and economic, biological or environmental conditions not covered elsewhere in assessments for Actively managed species. The report will include all available information that may be used to determine if a stock should be promoted to the Actively managed category because a point of concern exists (e.g., overfishing is expected to occur within two years based on a default or species-specific MSY control rule) or for some other reason. At a minimum, the report should contain landings data for Monitored stocks and any available information about trends in abundance.

3.0 LIMITED ENTRY IN THE COASTAL PELAGIC SPECIES FINFISH FISHERY

The Pacific Fishery Management Council (Council) is considering limited entry for coastal pelagic species (CPS) finfish including northern anchovy, Pacific (chub) mackerel, jack mackerel, and Pacific sardine landed south of 39° N latitude as part of Amendment 8 to the fishery management plan (FMP) for northern anchovy. As described below, the Council considered extending limited entry to market squid, another key species in the CPS fishery, but decided to limit options to CPS finfish only. Limited entry was a preferred option in Amendment 7, which was adopted by the Council but rejected by the U.S. Secretary of Commerce (Secretary).

The Council currently has responsibility for management of the central subpopulation of northern anchovy (central Baja California and central California) and jack mackerel north of 39° N latitude. California currently has sole responsibility for management of the California fisheries for Pacific sardine and Pacific (chub) mackerel. Oregon and Washington have responsibility for fishing on CPS stocks (i.e., northern subpopulation of anchovy) and portions of stocks (e.g., sardine) found in state waters. Options being developed for Amendment 8 would bring all CPS finfish into the Council process under a single FMP.

3.1 Background

Northern anchovy biomass has increased recently from a low to a moderate level, more than 390,000 mt in 1997. Pacific (chub) mackerel has declined over the last decade and biomass is currently at a moderate level, about 100,000 mt during 1997. Pacific sardine biomass increased dramatically over the last decade and was about 500,000 mt in 1997. Sardine availability seems to be increasing all along the coast from Baja California to British Columbia, Canada. Biomass and harvests are expected to increase in the near term. Jack mackerel abundance and trends are unknown.

The 1997 to 1998 El Niño had significant effects on availability, distribution and (probably) abundance of CPS finfish. Stocks were shifted to northern areas and CPS finfish fishing opportunities increased, at least temporarily, in Oregon, Washington, and British Columbia. Abundance estimates and management advice for 1997 and 1998 were particularly uncertain, because El Niño conditions will likely be short lived.

Limited entry is complicated for CPS stocks, because of natural variability in stock size (e.g., sardine biomass has ranged from almost zero to 3.5 million mt) and stock distribution (sardine and Pacific [chub] mackerel range from Baja California to British Columbia when abundant but are confined to the Southern California Bight or Mexico when abundance is low). Abundance of CPS stocks and available harvest for the coastal pelagic fishery as a whole (see landings data below) may be less variable, but natural variability in stock size undermines the concept of an "optimum" fleet size. However, the current CPS fleet is able to adapt to changes in available harvest and abundance by targeting alternate CPS and non-CPS species, because operating costs are low. The same degree of flexibility could be expected if limited entry is adopted.

Fisheries that currently harvest CPS finfish include (1) the directed net gear (roundhaul, gillnet and trammel net) fisheries for CPS finfish; (2) the live bait fishery for CPS finfish; (3) the dead bait fishery for CPS finfish; (4) fisheries for non-CPS finfish species that take incidental quantities of CPS finfish; (5) the small boat fishery for CPS finfish; and, (6) recreational fisheries. Additionally, at-sea harvester-processors and the offshore trawl fleet could potentially harvest significant quantities of CPS finfish. There is a great deal of overlap among CPS finfish fisheries (e.g., among the gill and trammel net, small boat, and incidental segments), as well as the directed roundhaul fisheries for CPS finfish and squid.

3.1.1 Historical Participants

Approximately 200 vessels participated in the sardine fishery during its heyday in the 1940s and 1950s. Some present day roundhaulers are remnants of the sardine fleet. Other remnants of the fleet can be found among roundhaulers that target squid but land very small amounts of CPS finfish (primarily near Ventura and Monterey, California). Although such vessels may not have fished CPS finfish during the Council's window period, many of them use the same type of gear used in the directed CPS finfish fishery, and would likely be interested in fishing for mackerel and sardine in northern areas such as Monterey if markets and resource availability are sufficient.

3.1.2 Present Participants

Over the last five years California roundhaulers have accounted for 99% of Pacific Coast CPS finfish landings. The roundhaul fleet's CPS finfish landings are sold as relatively high volume/low value products (e.g., mackerel canned for animal and human consumption, and anchovy reduced to meal and oil). In addition to fishing for CPS finfish, many of these vessels also target market squid, Pacific bonito, bluefin tuna, and Pacific herring.

There are other vessels that target CPS finfish in small quantities and usually sell their landings to specialty markets for relatively high prices. These include:

a. Approximately 18 live bait vessels in southern California and two vessels in Oregon and Washington that take about 5,000 mt per year of CPS finfish (mostly anchovy) for sale to recreational anglers (live bait harvest of anchovy off southern California is unrestricted except at very low levels of spawning biomass).

b. Roundhaul vessels that take a maximum of 1,000 mt to 3,000 mt of anchovy per year that are sold as dead bait to recreational anglers.

c. Roundhaul and other mostly small vessels that target CPS finfish (particularly mackerel and sardine) for sale in local fresh fish markets or canneries.

Many other vessels routinely harvest CPS finfish incidentally while targeting other species.

3.1.3 Potential Participants

There is a general level of excess harvest capacity (maximum potential harvest exceeds the available or target harvest) in most West Coast and North Pacific fishing fleets (e.g., groundfish, shrimp, crab, halibut, salmon, etc). As these other fisheries become increasingly overcrowded, it becomes likely that capacity will be redirected to the West Coast CPS finfish fishery when downturns occur elsewhere. This occurred in the CPS fishery for market squid. When export markets for squid developed, landings and number of vessels increased by 66% and 56% respectively during 1993 to 1997. In addition, the largely unexploited population of jack mackerel has attracted the attention of factory trawlers and offshore trawl vessels. Harvesting and marketing experiments have been unsuccessful to date, but a new fishery may develop in the future. CPS may become available in northern areas when abundance is high (e.g., sardine) or water is warm (e.g., Pacific [chub] mackerel during El Niño) so that fisheries may develop, at least temporarily, in northern areas.

3.2 Landings, Revenues, and Trips

Between 50,000 mt to 100,000 mt of CPS per year were landed coast wide during 1981 to 1997 (Figure 3.2-1). Landings of finfish declined recently while squid landings increased (data for 1997 are incomplete). El Niño conditions virtually eliminated the squid fishery in 1998, and its future is uncertain. About 99% of the total CPS harvest during each year is landed in central and southern California. Small quantities are landed in Oregon and Washington although interest in northern fisheries for sardine and Pacific (chub) mackerel seems to be increasing.

Squid have been the economic mainstay of the CPS fishery in recent years (see below). In 1996, market squid supported the largest (80,000 mt) and most valuable ($33 million exvessel) fishery in California. Sardine, mackerel and anchovy landings in California during 1996 were about 44,000 mt with exvessel revenues about $6 million. Exvessel prices for CPS finfish are relatively low (often less than $100 per mt) while prices for market squid are much higher (often around $400 per mt). Although squid has been the mainstay in recent years, finfish (including tunas and non-CPS species) have been the dominant species historically.

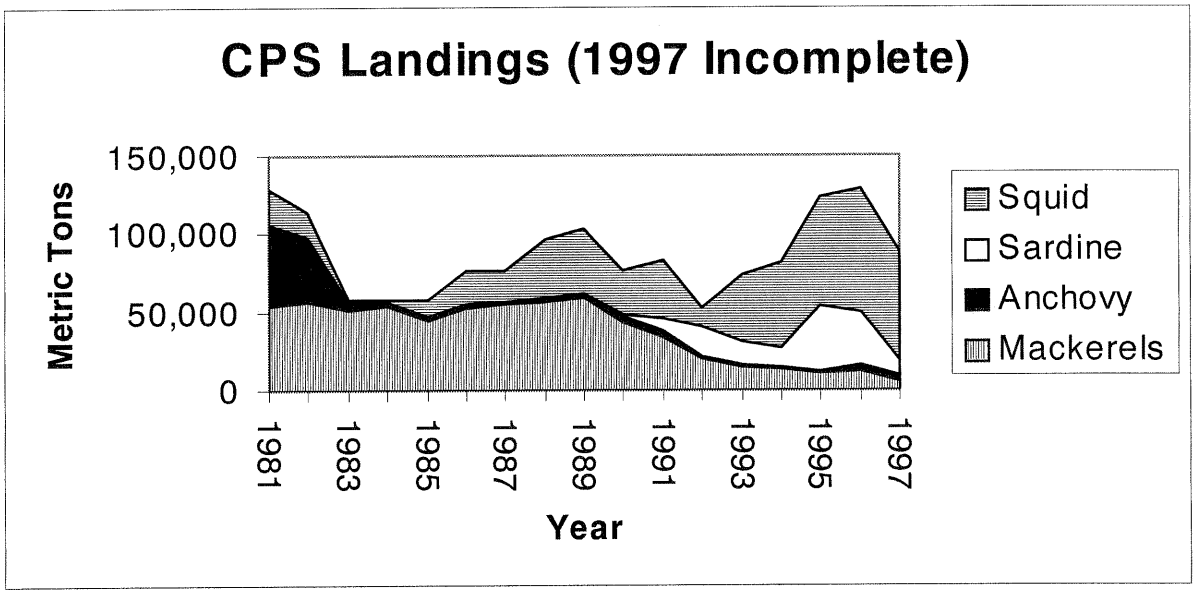

Figure 3.2-1

The number of squid trips (trips with any squid) has increased while the number of finfish trips (trips with any anchovy, sardine or mackerel) has remained static (Figure 3.2-2). Activity in the fishery, measured as total number of trips, was relatively high during 1996 (the last year with complete data). Preliminary data indicate that the number of squid trips plummeted during 1997 to 1998 due to El Niño conditions.

Over the last decade, the number of vessels along the coast harvesting at least five mt of CPS finfish per year has increased slightly (Figure 3.2-3). The number of vessels catching at least five mt of squid or at least five mt of squid plus finfish has increased more rapidly.

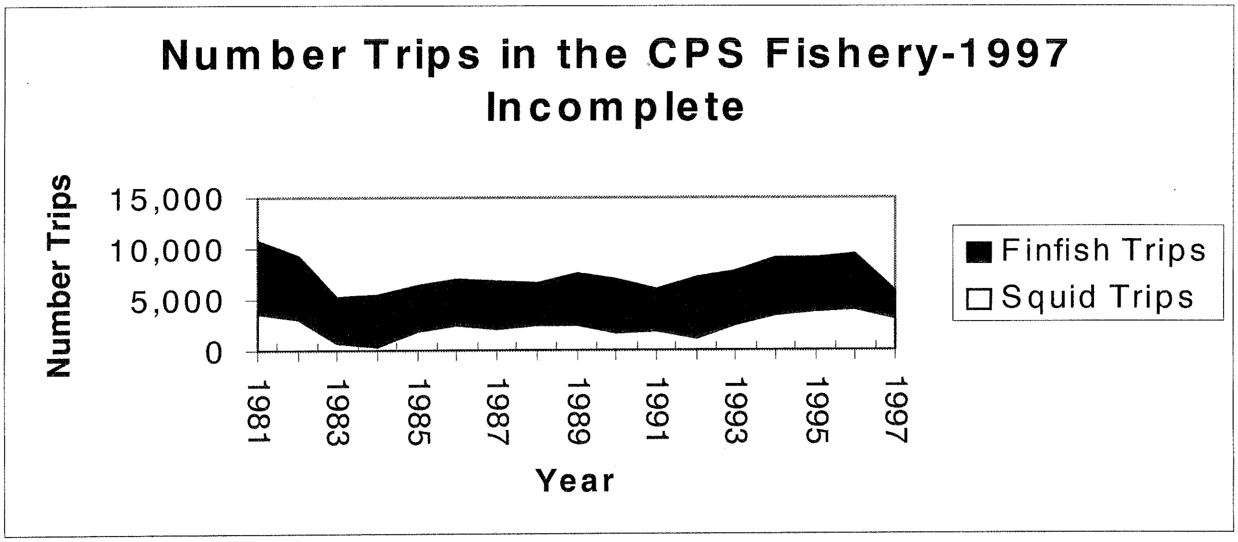

Figure 3.2-2

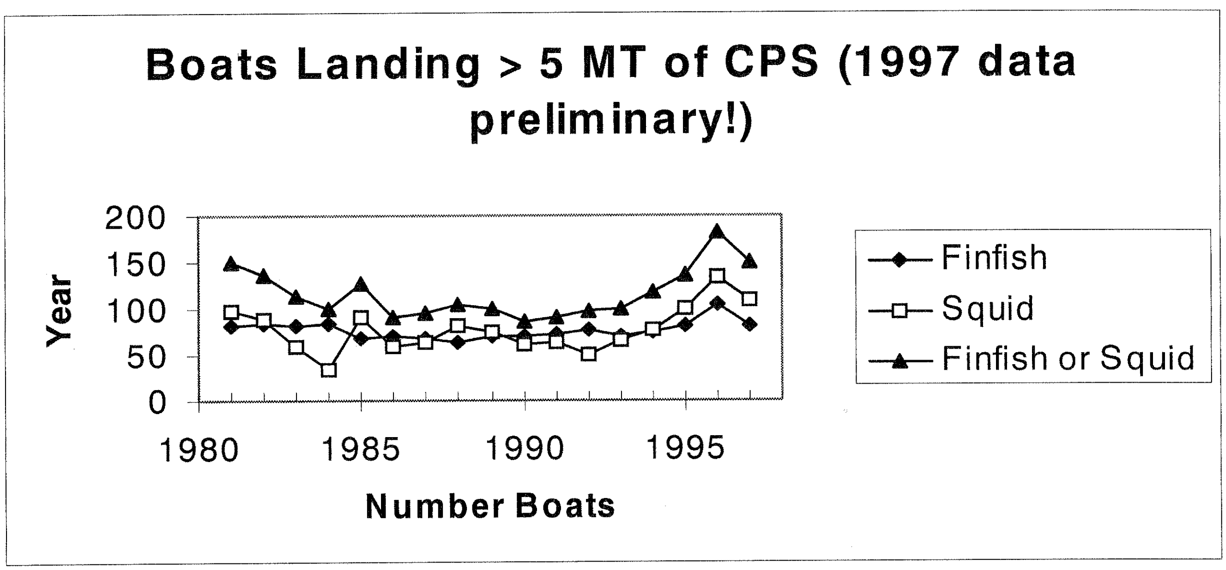

Figure 3.2-3

The largest vessels in the CPS fishery have hold capacities of more than 20 mt but the median size of trips is about 20 mt, probably due to landings limits imposed by processors (Figure 3.2-4). For the figure below, total landings of CPS finfish plus squid were calculated for each boat that landed any squid or CPS finfish during 1993 to 1997. Totals for each boat (one record for each boat) were then sorted into 100 mt landings categories (e.g., "50" means 1-99.9 mt) and merged with fish ticket (single trip data) so that distributions of landings per trip could be plotted against landings category using "box-whisker" plots. In the plots, the central '◆' is at the median trip size (50% of trips smaller and 50% larger). The box starts on the left at the first quartile (25% of trips are smaller than the first quartile) and extends to the third quartile (25% of trips are larger than the third quartile). Thus, the box covers the central 50% of the data and the right hand side of the box has a value that is larger than 75% of the trips. Trips that lie outside the median ± `.5 inter-quartile range are shown individually.

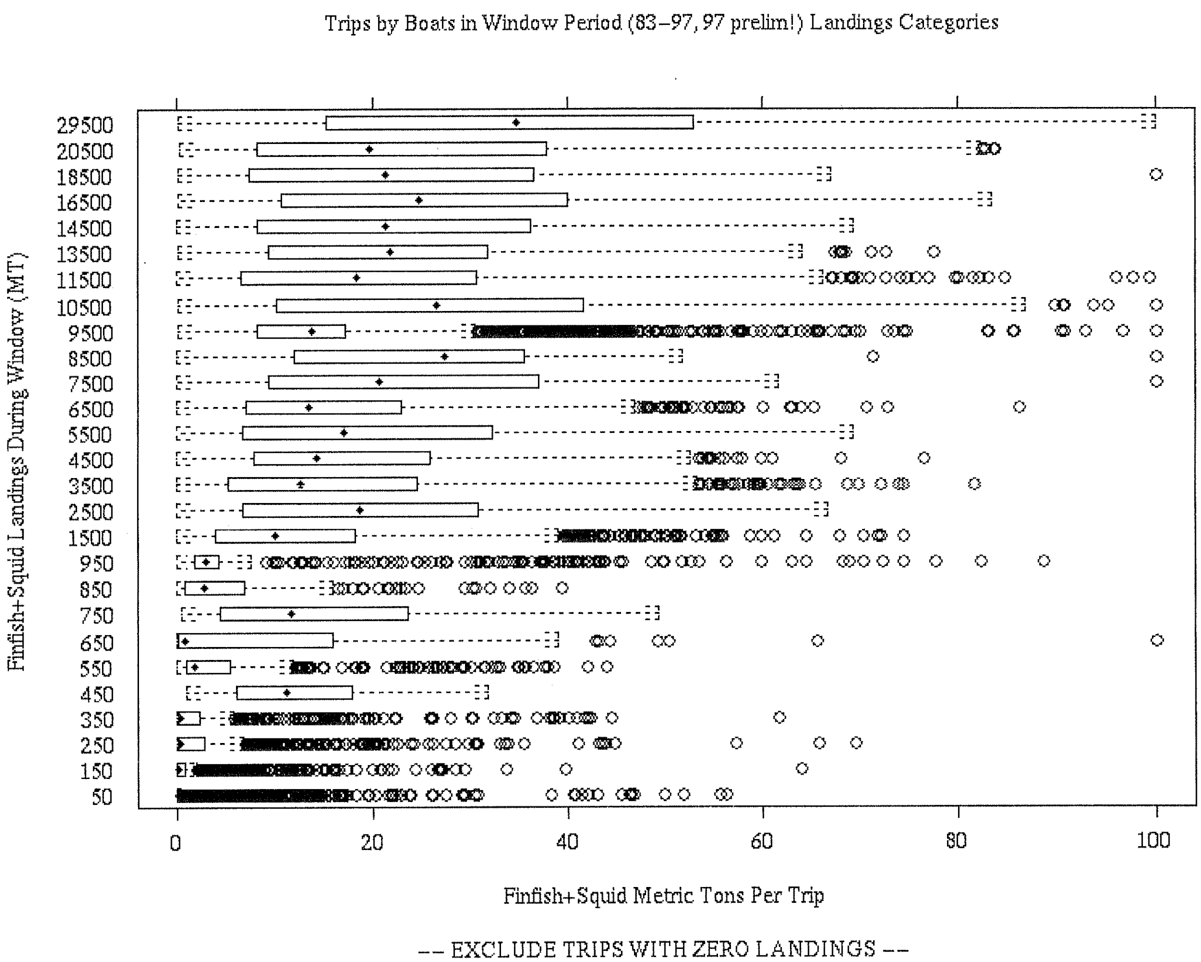

Figure 3.2-4

3.3 Dependence on Coastal Pelagic Species

There were very few vessels with large landings who relied solely on CPS finfish (Figure 3.3-1). Almost all were either squid specialists or harvested squid extensively. Vessels with the highest landings in the CPS fishery rely heavily on CPS revenues (particularly revenues from squid). There were 67 vessels with "large" (more than 800 mt of) CPS landings (finfish plus squid) during 1993 to 1996. In most cases, CPS finfish plus squid revenues accounted for more than 80% of total revenues for vessels with large landings (Figure 3.3-2).

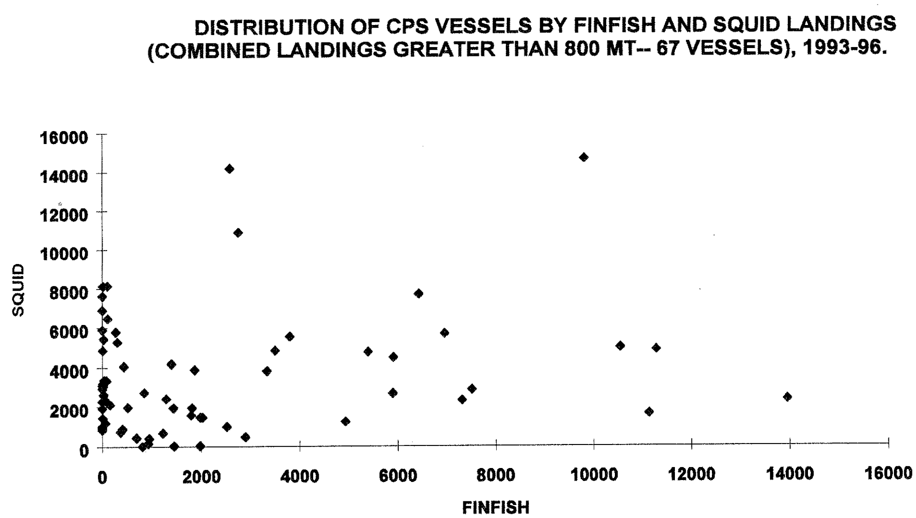

Figure 3.3-1

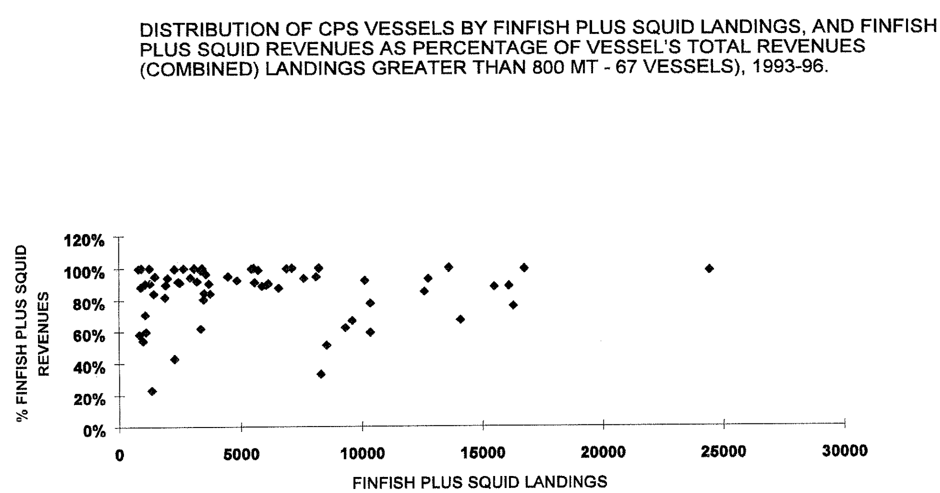

Figure 3.3-2

In contrast, there were 134 vessels with "medium" landings of finfish plus squid (greater than 20 mt but not more than 800 mt) during 1993 to 1996. Vessels with medium landings tended to specialize in either finfish or squid (Figure 3.3-3). Revenues from CPS finfish plus squid were a variable fraction of total revenues for vessels with medium landings (Figure 3.3-4).

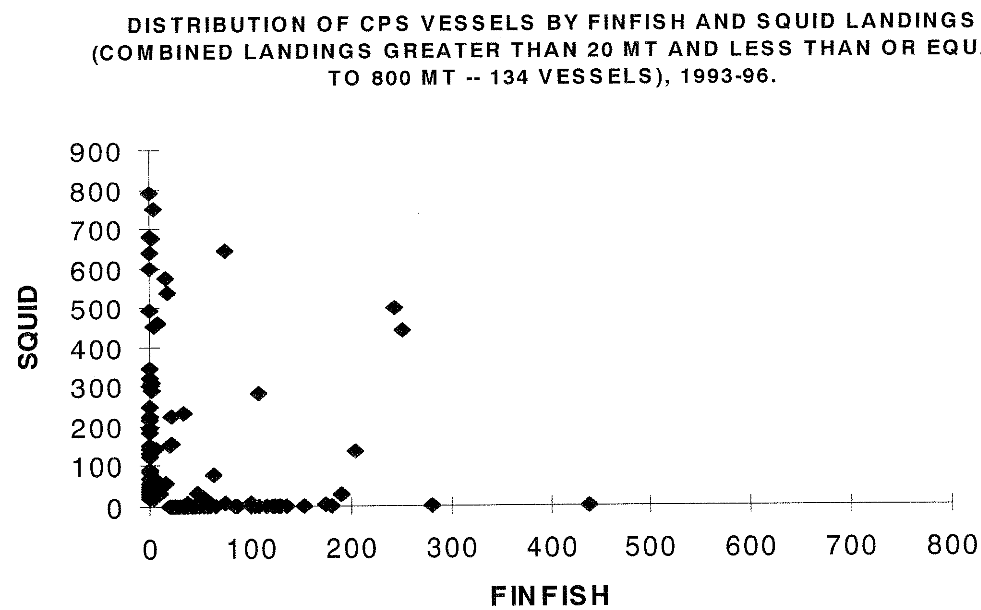

Figure 3.3-3

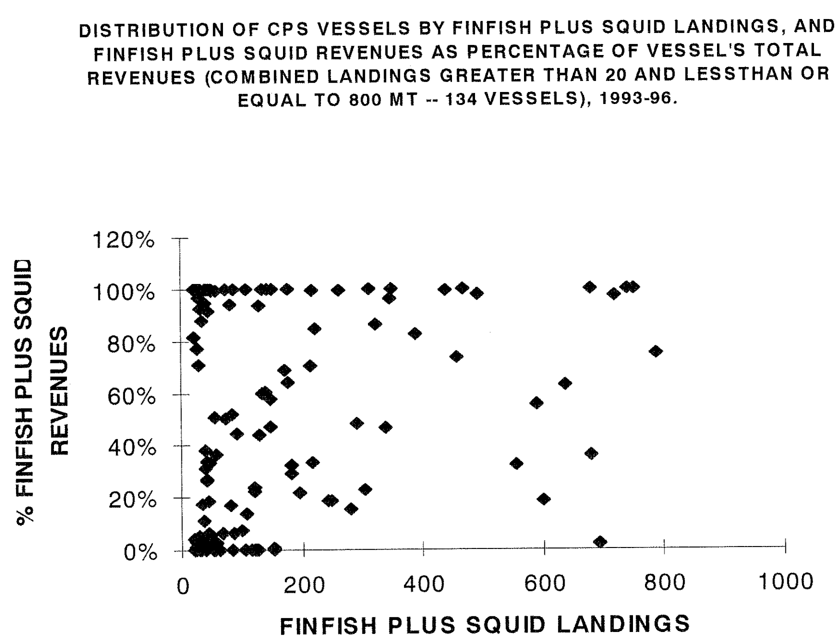

Figure 3.3-4

3.4 Reasons for Considering Limited Entry (Statement of the Problem)

Vessels currently participating in the CPS finfish fishery are capable of harvesting more CPS finfish than is available under current biomass conditions. Fisheries characterized by excess harvesting capacity are described as overcapitalized in terms of the number of vessels, and the amount of gear and equipment devoted to harvesting. As fisheries become overcapitalized, harvesting costs increase while catches remain the same. This situation represents an economically inefficient use of society's productive resources, and causes several problems for managers and the fishing industry when abundance declines and catches are reduced. As harvest capacity in the fisheries increases, problems arising from the need for more restrictive management measures and resolution of allocation issues become more acute. No relief from these problems will occur if harvest capacity continues to rise.

There were 640 vessels with CPS finfish landings for the period January 1, 1993 through November 5, 1997. Forty-one of these vessels, six percent, accounted for more than 95% of finfish landings for the five-year period (Table 3.8.7-1). Available information indicates that present participants could harvest at least as much CPS finfish as would be available under conditions of greater availability. Participants during the five-year period include 105 low-volume (landings of at least five mt but less than 200 mt of CPS finfish during the 1993 to 1997 period) and 63 high-volume producers (more than 200 mt of CPS finfish landings during the period). Low-volume producers could probably average about five mt per trip. Assuming five trips a week and a six-month season, these vessels could land (five mt/trip x five trips/week x 26 weeks/year) 650 mt of CPS finfish per boat per year. High-volume producers could probably average 50 mt per trip. Assuming five trips a week and a six-month season, these vessels could land (50 x 5 x 26) 6,500 mt per boat per year. On this basis, 105 low-volume and 63 high-volume producers could land about (68,250 + 409,500) 477,750 mt of CPS finfish per year. Thus, current capacity may be as much as 20% greater than the combined maximum sustainable yield (MSY) for anchovy, Pacific (chub) mackerel and sardine (about 400,000 mt per year)[1] These crude estimates of excess capacity are exaggerated to some extent because many present participants catch species other than CPS finfish, participate in the CPS fishery on a seasonal or intermittent basis, and are involved in other fisheries. Market squid landings, for example, average about 30,000 mt per year and utilize fleet harvesting capacity that might otherwise be in excess. Recent experience in the fishery and some crude calculations indicate that about 75 vessels would have sufficient harvesting capacity to take almost all of the CPS finfish likely to ever be available.

In addition to current CPS finfish participants, newcomers are likely to be attracted to the fishery, because of the expanding sardine biomass and squid fishery, and as competition in other Pacific Coast fisheries becomes more intense. In the latter instance, nearly all groundfish stocks are now fully harvested by domestic fishers in the Pacific coast groundfish fishery. As pointed out above, potential participants in the CPS finfish fishery consist of fishers leaving other West Coast and north Pacific fisheries that have grown increasingly more restrictive and overcrowded relative to available harvests.

In the Pacific Coast CPS finfish fishery, excess harvest capacity is likely to result in an increasing number and complexity of regulations. Accordingly, the Council will face increased pressure to balance the conflicting need to protect the resource with the need to provide sufficient allowable catch to sustain the fishery.

Increased number and complexity of regulations have many adverse impacts in such areas as fleet costs, resource utilization, safety, enforcement costs, and effectiveness. Moreover, there is a point beyond which additional regulations, which interfere with day to day vessel operations (e.g., trip limits or mesh size regulations), will not improve the Council's ability to accomplish its management goals. Pressures on industry arise not only from management measures which restrict operations, but also from increased competition for the allowable catches among larger numbers of vessels.

1/ The estimate 400,000 mt per year is the sum of estimated MSY for each stock reduced by a crude estimate of the fraction of the stock in U.S. waters. It is unlikely that all stocks would be abundant at the same time and that 400,000 mt of catch would be available in any one year.

3.5 Managing Harvest Capacity by Controlling Access to the Coastal Pelagic Species Finfish Fishery

Two manageable components of fleet harvest capacity (maximum potential harvest) are vessel fishing power (relative ability of a vessel to catch fish as determined by its size, gear and equipment crew and other productive inputs) and number of vessels.

Harvest capacity relates to a vessel's or fleet's ability to harvest fish. A vessel or fleet directly produces fishing effort which, when applied to a stock of fish, results in catch. The amount of effort produced depends on the number of vessels, their physical attributes, gear and equipment, crew and other inputs, and on the time and area fished. Hence, harvest capacity is linked to effort production which in turn corresponds to the size of the fleet and its use of available inputs.

Managing harvest capacity, therefore, entails controlling vessel effort production, the number of vessels, or both. As a first step, limiting access of vessels to the fishery may be particularly useful.

There are three basic approaches to controlling the number of vessels participating in the CPS finfish fishery (1) open access management; (2) limited entry; and, (3) individual transferable quotas (ITQs). The Council, Coastal Pelagic Species Plan Development Team (CPSPDT), Coastal Pelagic Species Advisory Subpanel (CPSAS), and other industry representatives discussed all three approaches to managing harvest capacity in the CPS fishery at length and a concerted effort was made to inform all participants about the benefits and problems associated with each.

Under open access (status quo in the CPS finfish fishery), no measures are taken to limit fishing effort or capitalization in the fishery. Open access fisheries tend to become overcapitalized, resulting in too much fishing effort (too many fishers with too much capital equipment producing too much effort in the pursuit of too few fish). Overcapitalization may be due to too many vessels in a fishery or to too much investment in capital equipment used on individual vessels. As a fishery becomes overcapitalized, economic efficiency is reduced and pressure to over harvest stocks increases (Wilen 1988; Townsend 1990). Other serious biological (resource depletion) and practical problems (short seasons, wastage, dangerous fishing practices) are typical of open access conditions and exacerbated by overcapitalization. Management of vessel access and fishing effort plays an important role, therefore, in the conservation and efficient exploitation of fishery resources.

Limited entry programs restrict the number of vessels having access to the fishery. Participants are issued licenses/permits which are usually transferable. Economic efficiency is promoted to the extent that more efficient fishers purchase permits from less efficient ones. However, limited entry programs are not completely effective in managing fishing effort and capitalization (Rettig and Ginter 1978; Townsend 1990) because vessel effort production can still be increased by expanding unregulated dimensions of effort (e.g., expanding hold size, increasing engine horsepower, or installing electronics). Reducing fleet size to an efficient level at the outset of a limited entry program is difficult because participants who would be excluded under the program typically oppose it.

ITQ programs involve transferable shares of an overall quota (Maloney and Pearse 1979; Copes 1986; Clark et al. 1988; Sissenwine and Mace 1992; Squires et al 1998). ITQs theoretically eliminate overcapitalization, inefficiency, and dangerous fishing practices associated with the "race for the fish;" but also engender practical problems with monitoring and enforcement.

ITQs are also generally acknowledged to be more costly to monitor and enforce than limited entry programs. For example, recurring costs for a proposed ITQ program for fixed gear sablefish were estimated at $1,133,000 to $2,174,000 per year (Council 1993) or 15% to 29% of the exvessel value of the CPS fishery in 1992 ($7,500,000, according to Thomson et al. 1993).

Under the Magnuson-Stevens Fishery Management and Conservation Act (Magnuson-Stevens Act) there is a moratorium on ITQs until October 1, 2000. This leaves two options available for controlling access to the fishery.

3.5.1 Option for Open Access Management (Status Quo)

This option would maintain open access management (status quo) in the CPS finfish fishery. The advantages of this option are that regulations and costs of limited entry are avoided and that operations of individual vessels and firms are not restricted by regulations.

If the status quo is adopted, an opportunity to implement a limited entry system in the CPS finfish fishery under favorable conditions would be lost. Another disadvantage of the status quo option is that open access management leads almost inevitably to overcapitalization and pressure on managers to allow high harvest levels. With open access, there is an increased likelihood for high mid-term and long-term management costs (to develop and implement other regulatory measures, e.g., trip limits[2]) associated with overcapitalized fisheries and depleted stocks. The collapse of the sardine fishery in the 1940s and 1950s and problems in the Pacific (chub) mackerel fishery during periods of poor recruitment suggest that problems linked with overcapitalization recur in the CPS fishery. The historical growth of the sardine fishery during the 1930s and 1940s and general experience with purse seine fisheries indicates that the CPS fishery may become overcapitalized quickly (faster than management could react) under a number of plausible scenarios (i.e., recovery of sardines, development of an offshore fishery for CPS, development of new markets for CPS).

According to Scofield (1938), the historical open access sardine fishery in California experienced a dramatic increase in fleet size as sardine landings increased prior to collapse of the fishery. The number of vessels increased from 150 in the 1930 to 1931 season, to 200 in 1933 to 1934, to over 300 in 1936 to 1937, with landings increasing from 200,000 tons to 400,000 tons to 700,000 tons. Fleet size peaked at 380 vessels in 1937 to 1938 as landings began to decline. The maximum allowable catch (MAXCAT) for sardine and anchovy recommended under the FMP will likely be 200,000 to 400,000 mt per year of which about 50% to 90% would be available in the U.S. It is difficult to predict the size of an open access fleet in the U.S. under conditions of high sardine and anchovy biomass when catches of all CPS might rise as high as 360,000 mt. Based on historical data, however, a fleet size of 175 vessels to 250 vessels seems plausible, particularly since the fleet would take species other than anchovy and sardine (e.g., mackerels, squid, bonito, and tuna).

3.5.2 Option for Limited Entry

This option would establish limited entry in the CPS finfish fishery by license limitation. A number of different suboptions for implementing a limited entry program were developed. These and other details may be modified, and are discussed more fully below:

- Permits are permanent subject to legal, performance, or other renewal requirements.
- Permits are assigned for use on one vessel at a time.
- A limited entry permit may not be used with a vessel unless it is registered for use with that vessel.
- Limited entry permits will be registered for use with a vessel and a registered vessel may be changed according to procedures outlined in the FMP and regulations.
- The vessel owner is responsible for maintaining the permit and any other documentation required on board each vessel with a permit to fish for CPS.
- Only a person eligible to own a documented vessel may be issued or may hold, by ownership or otherwise, a limited entry permit.
- No more than one limited entry permit will be issued for each qualifying vessel. The permit will be issued only to the current owner of the vessel, unless (1) The previous owner of a vessel qualifying for a permit has, by the express terms of a written contract, reserved the right to the permit, in which case the permit will be issued to the previous owner based on the catch history of the qualifying vessel; or (2) a vessel that would have qualified for a limited entry permit was lost before a permit was issued. In this case, the owner of the vessel at the time it was lost retains the right to the permit, unless the owner

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2/ In groundfish, trip limits are used primarily to obtain a year-round fishery under catch constraints. In CPS, trip limits might be used to limit fleet capacity and to distinguish between different types of fishing or different types of limited entry permits.

conveyed the right to another person by the express terms of a written contract.

- A person who owned a vessel that met the landing requirements and who reserved, by the express terms of a written contract, the right to a future limited entry permit on the basis of the catch history of that vessel, may receive a limited entry permit.
- Permits may be transferred to other owners for use with other vessels or used with other vessels under the same ownership subject to legal, performance or other requirements for transfer.
- Limited entry permits assigned to one vessel may be transferred to use on another only once during each calendar year.
- Application, renewal, and other fees may be charged by National Marine Fisheries Service (NMFS) to cover administrative costs.
- A limited entry permit expires on failure to renew the limited entry permit. Permits must be renewed every two calendar years.
- If the permit will be used with a vessel other than the one registered on the permit, a registration for use with the new vessel must be obtained from the Regional Director and placed aboard the vessel before the vessel is used to fish for CPS.
- If a vessel would have qualified for a limited entry permit but was lost before permits were issued, the vessel may be replaced within two years of the date of the loss, and the owner may obtain a permit for the new vessel.

3.5.3 Nature of the Interest Created

CPS limited entry permits confer a privilege to participate in the West Coast CPS fishery in accordance with the limited entry system established under this FMP and implementing regulations, or any future amendment to the FMP and implementing regulations. Future amendments to the FMP may modify or even abolish the limited entry system. The permits are also subject to sanctions including revocation, as provided by the Magnuson-Stevens Fishery Conservation and Management Act, 16 USC 1858(g) and 15 CFR part 904.

3.5.4 Notice of Date for Proposed Rule Making (Control Date)

The Council adopted November 5, 1997 as a *Federal Register* notice date for use in establishing a potential limited entry program for CPS finfish. This date precludes speculative fishing by vessels for the sake of obtaining a limited entry permit after the Council announced its intention to consider limited entry for the CPS finfish fishery.

3.5.5 Appeals Process

If an application for a permit is denied, the applicant may appeal the denial to the NMFS Regional Administrator.

The appeal must be in writing, state the action being appealed, and reasons. The appellant may request an informal hearing before a hearing officer and the NMFS Regional Administrator will decide if a hearing is required. If required, hearings will be carried out in a timely fashion (normally within 30 days of the receipt of sufficient information).

The NMFS Regional Administrator will decide the appeal in accordance with the criteria for limited entry permits specified in this FMP and implementing regulations. The NMFS Regional Administrator will consider the information submitted by the appellant, the summary record of the hearing and hearing officer's recommendation (if any) and other relevant information.

3.5.6 Underutilized Species and Limited Entry

CPS include underutilized species (e.g., jack mackerel offshore) that may be the subject of exploratory fishing under the terms of this FMP. In accordance with Council policy, vessels with a catch history during the exploratory phase that were involved in developing the fishery will be given priority if a limited entry system is developed or modified to accommodate fishing for the previously underutilized species.

Vessels already involved in developing a fishery for an underutilized species (i.e., vessels with a catch history or previous experimental fishing permit) should receive highest priority if a limited entry program is implemented for a previously underutilized species.

3.6 Goals and Objectives for Coastal Pelagic Species Finfish Limited Entry

The goals and objectives for the Pacific Coast CPS FMP are presented in section 1.0. The most important of these in the context of limited entry are:

1. Promote efficiency and profitability in the fishery.

2. Achieve optimum yield (OY).

3. Accommodate existing fishery segments.

4. Use resources spent on management of CPS efficiently.

Not all these objectives are complementary. It may be difficult to promote efficiency and profitability in the fishery and at the same time accommodate existing fishery segments. The challenge is to create a limited entry program which strikes a balance between increasing net returns from the fishery, achieving OY, accommodating participation by those with substantial investments in the fishery, and efficiently using management resources.

3.7 Achievement of Goals and Objectives and Need for Additional Measures to Reduce Capacity

The limited entry program adopted under this amendment to the Northern Anchovy FMP will not in itself immediately accomplish the goals and objectives the Council has established for the fishery. It is a first step that may slow or prevent the worsening of conditions which impede the Council from achieving the overall goals and objectives for the fishery. It may be reasonable to expect that the primary objective will be accomplished through this limited entry system (i.e., there will be an effective limit which reduces growth in the active fleet and results in less harvest capacity in the fishery than would have been present in its absence). The effectiveness of this first step will depend on identifying and achieving a fleet size that does not exceed the productive capacity of the CPS finfish stocks.

Establishment of this limited entry system will provide a starting point for any future programs which may be necessary to further reduce harvest capacity. To further reduce harvest capacity, a voluntary buyback program could be considered under section 312(b) of the Magnuson-Stevens Act. Future implementation of a CPS finfish ITQ program may also be considered as a means of further reducing harvest capacity, after the moratorium on IFQs in section 303(d) of the Magnuson-Stevens Act expires.

3.8 Limited Entry Options

There are a number of issues that need to be considered in the design and development of a limited entry program for CPS finfish species. These issues are discussed below, where options are presented and analyzed.

3.8.1 Species

Background

The Pacific coast CPS fishery targets Pacific (chub) mackerel, northern anchovy, jack mackerel, Pacific sardine, and market squid. From 1993 to 1997, there were 640 vessels with Pacific coast landings of CPS finfish. About 40 California round haul vessels based mainly in San Pedro, and to a lesser extent Port Hueneme and Monterey, have routinely accounted for well over 90% of total coastwide landings of mackerel and anchovy. These vessels have also been major participants in the sardine fishery since the moratorium on directed harvest was lifted in 1987. In addition to fishing for CPS finfish, many of these vessels also target market squid, Pacific bonito, bluefin tuna, and Pacific herring.

Options

Option 1 would establish a limited entry program for CPS finfish only. Option 2 would establish a CPS limited entry program for finfish and squid.

The Council chose Option 1.

Analysis

There appears to be excess capacity in the traditional CPS finfish fisheries; and there may be some long term benefits in a limited entry program for finfish only, especially if sardine biomass and harvests continue to increase and exvessel prices rise. However, given the nature of CPS finfish fisheries, growth in the sardine segment of the fishery could be short lived. A limited entry program for CPS finfish now would prevent excessive buildup of harvest capacity directed toward sardine, and future spillover into other finfish species and squid.

Since 1993 there has been a significant increase in the number of vessels landing squid (Figure 3.2-3). Although the squid harvest potential is not well known, there may be room for additional harvest capacity in this segment of the CPS fishery. A federal limited entry program for squid may not be necessary at this time. However, familiarity with open access fisheries indicates this situation could change quickly. California is currently implementing its own vessel licensing program for squid, which might serve as the foundation for a future coastwide squid limited entry program.

There is substantial overlap between fishing activity for squid and finfish. Vessels switch between finfish and squid based on availability, quotas, and markets. Recent increases in squid landings and revenues, participating vessels, and current experience in California suggests that it would be too difficult and controversial to identify and limit the number of vessels harvesting squid to a reasonable number at this time. Limited entry for finfish only would be relatively uncontroversial and could probably be extended, or a separate limited entry program developed, to include squid should the need arise in the future.

Recent data indicate that there are many vessels that specialize in squid, particularly among those vessels that had the highest CPS landings during 1993 to 1996, whereas vessels with large amounts of finfish landings during the period also had substantial landings of squid (Figure 3.3-1). Vessels with smaller CPS landings during the 1993 to 1996 period tended to be even more specialized in either finfish or squid (Figure 3.3-3). This suggests that there is an operational basis for separate finfish and squid limited entry programs, and that a finfish only limited entry program would circumvent excessive effort in the finfish segment of the CPS fishery.

3.8.2 Geographic Scope of Limited Entry for Coastal Pelagic Species

Background

The center of distribution for CPS and principal spawning grounds occur in the southern California bight and off northern Baja, California. CPS, particularly northern anchovy, Pacific (chub) mackerel, and sardine, increase their range when abundant and tend to be found farther offshore and to the north when abundance is high or unusually warm water conditions (El Niño) prevail. When abundance declines, the distribution of CPS stocks shrinks towards the center of their distribution in the southern California bight. The southern California bight is the most important spawning and nursery ground for jack mackerel but less is known about how the distribution of jack mackerel depends on abundance.

Most CPS species experience dramatic changes in abundance, even in the absence of a commercial fishery. However, they rarely fluctuate in the same direction simultaneously (i.e., when one species is low in biomass, this will be offset by another species being high in biomass). Consequently, availability of CPS is expected to vary considerably over time by individual species, but not for CPS finfish as a whole. When abundance is high or El Niño conditions occur, CPS fishing opportunities may exist outside the range of present participants. When abundance is lower and no El Niño conditions exist, CPS fishing opportunities will occur primarily off southern California in areas utilized by present participants. Thus, this option is a means to take advantage of fishing opportunities that might exist on northern fishing grounds in years when biomass is high or El Niño conditions exist. In years when biomass is low and environmental conditions are normal, CPS fishing opportunities are not expected to be available in northern areas and the open access fishery in northern areas would be effectively "turned off."

Options

Option 1 would establish a coastwide CPS finfish fishery limited entry program. Option 2 would establish a CPS finfish limited entry program for the fishery south of 39° N latitude (approximately Point Arena, California). Under Option 2 fishing north of 39° N latitude is not affected by limited entry requirements. CPS finfish fishing in the northern area would be managed as an open access fishery.

The Council chose Option 2.

Analysis

The Council considered a CPS limited entry program for the entire Pacific Coast. Almost all of Pacific Coast CPS harvests are from waters south of 39° N latitude (Pt. Arena, California). During both the heyday of the sardine fishery (1915 through 1945) and recent years, more than 99% of CPS finfish and squid taken coastwide were harvested south of 39° N latitude. CPS fishing in the northern area could be most effectively managed as an open access fishery when abundance is high and distributions extend to northern areas. This would not preclude effective management or future extension of limited entry in the north.

This option would establish a northern boundary to the license limitation fishery for CPS. Fishing north of 39° N latitude (approximately Pt. Arena, California) would not be affected by license limitation requirements, while fishing south of 39° N latitude would require license limitation permits. Vessels from northern California, Oregon, and Washington would probably not qualify for a permit under a coastwide limited entry program. Thus, this option would provide these vessels a means to take advantage of fishing opportunities in northern areas during periods of high biomass without increasing the number of permits in the CPS fishery and without increasing the number of boats and fishing pressure on spawning stocks off southern California during periods of low biomass.

Option 1 would improve economic efficiency by capping or reducing the number of vessels participating in the customary fishery, while allowing for additional vessels when the need arises in the north. There would be less impact on traditional fishing patterns and operations, and more effective use of management resources than under Option 2.

The principal disadvantage of this option is the possibility of overcapitalization and latent harvest capacity in northern areas resulting from increased fishing opportunities for sardine or jack mackerel that only occur periodically. If northern fisheries develop quickly, then it may be difficult to implement an effective limited entry system for northern grounds.

As a practical matter, determination of area fished would be based on landings of CPS finfish landed at ports north and south of 39° N latitude, the closest being Bodega Bay, California. Port of landing is assumed a reasonable proxy for area fished.

3.8.3 Area Specific Endorsements South of 39° N Latitude

Background

The state of California allocates the overall quota for Pacific sardine to participants in the northern and southern areas of the fishery, delimited at San Simeon Point (San Luis Obispo County, California). The state of California may also allocate the overall Pacific (chub) mackerel quota between the northern and southern areas of the fishery delimited at Pt. Sal (Santa Barbara County, California). Under the northern anchovy FMP, the overall reduction quota is allocated between the northern and southern areas of the fishery, delineated at Pt. Buchon (San Luis Obispo County, California). Division of the overall quotas into the northern and southern areas is primarily intended to prevent the larger southern CPS finfish fleet from taking the entire quota before the smaller northern fleet has a chance to fish. Thus, there is recognition of distinct northern and southern fleets in the CPS finfish fishery.

Options

Option 1 would not break the area south of 39° N latitude up into separate areas with separate limited entry permits. Option 2 would distinguish between northern and southern areas in the limited entry fishery south of 39° N latitude. The northern part of the area south of 39° N latitude might extend from Pt. Conception to 39° N latitude, while the southern area might extend from the Mexican border to Pt. Conception. Based on qualifying criteria (likely CPS landings in the northern and southern areas), boats could receive an endorsement to fish in one or both areas. Boats with southern area endorsements, for example, would not be able fish in northern grounds unless they also had a northern area endorsement.

The Council chose Option 1.

Analysis

The likely effect of separate north-south area endorsements would be to reduce the amount of harvest capacity in each area. This could lead to insufficient harvest capacity in the north during periods of intense northern expansions of the fishery, and encourage use of other inputs to increase effort production. The option might have conservation benefits because it would prevent boats with northern area permits from moving south as stock biomass declines and stock boundaries shift to the south (and *vice-versa*). A disadvantage would be additional administrative complexity and costs with separate sets of qualifying criteria and an increased monitoring and enforcement burden for permits in northern and southern areas. Separate north-south endorsements would probably eliminate harvesting options for some vessels and reduce their operational flexibility, which could make them less efficient in their overall harvesting operations.

3.8.4 Exclude Trips with Small Landings from Limited Entry

Background

Small quantities of CPS finfish species are caught by vessels targeting other species or engaged in other fisheries. The CPS finfish limited entry program could distinguish between exempted and nonexempted landings of CPS finfish based on an exempted trip limit and exclude exempted landings from limited entry requirements south of 39° N latitude (i.e., allow exempted landings by boats without a limited entry permit). Exempted trips should not be confused with open access fishing. The Council's intent in adopting an exempted trip limit would be to accommodate small landings of CPS finfish that occur mainly during fishing for other species and for specialized markets. It is not the Council's intention to establish an open access fishery that would operate "beside" the limited entry fishery for CPS finfish.

Options

The following options would define exempted landings at the outset of the CPS FMP. The definition of exempted landings used in limited entry for CPS finfish could be changed later using the socioeconomic framework process without amending the FMP.

Option 1 does not distinguish between exempted and nonexempted landings (all landings of CPS finfish require limited entry permits). Option 2 defines exempted landings as CPS finfish landings less than 0.5 mt per trip (landings less than 0.5 mt per trip are exempted from limited entry requirements). Option 3 defines exempted landings as CPS finfish landings less than one mt per trip (landings less than one mt per trip are exempted from limited entry requirements). Option 4 defines exempted landings as CPS finfish landings less than five mt per trip (landings less than five mt per trip are exempted from limited entry requirements). Option 5 would allow from one mt through five mt of exempted CPS finfish landings per trip (landings from one mt , but no greater than five mt per trip are exempted from limited entry requirements).

The Council chose Option 5, which allows the Council to define the level of exempted landings exempted from limited entry permits between one mt and five mt by regulation. This level will remain in place until the Council changes it by regulatory amendment.

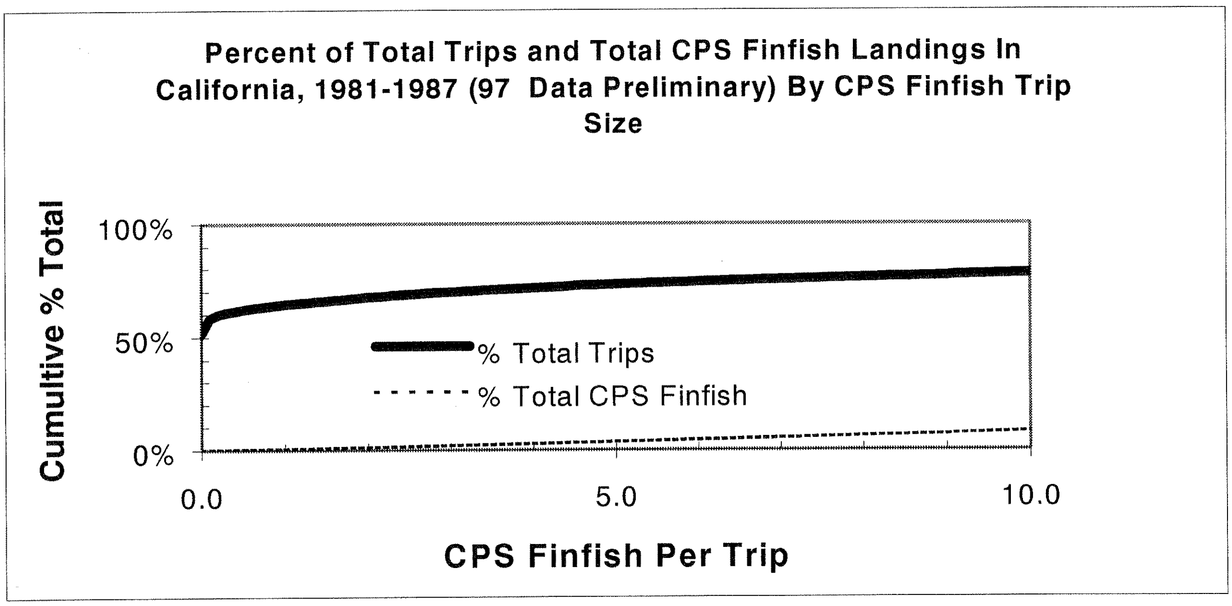


Figure 3.8.4-1

Analysis

Landings data from California for 1981 to 1997 (1997 preliminary) covering all of the more than 115,000 trips landing CPS finfish (by about 2,600 boats) show that many trips land very small amounts of CPS finfish (Figure 3.8.4-1). For example, 74,000 trips (64% of total trips) that individually landed less than 1 mt of CPS finfish contributed less than 4,400 mt (less than 0.5%) of the total CPS finfish catch (about 900,000 mt). There were 71,000 trips (62% of total trips) that individually landed less than 0.5 mt of CPS finfish and contributed less than 2,421 mt (0.3%) of total CPS finfish catch. Similarly, there were about 77,000 trips (67% of total trips) that individually landed less than two mt of CPS finfish and contributed only 9,200 mt (1.1%) of total CPS finfish catch.

Exempting small landings from limited entry requirements may be useful as a way to avoid wasting enforcement and management resources in dealing with catches of negligible size and of little biological or economic importance. A potential disadvantage is increased possibility of misreporting due to vessels that try to avoid exceeding the exempted trip limit.

Exempting small landings from limited entry requirements may reduce discard by vessels outside the limited entry fishery that take some CPS finfish while fishing for other species. However, as described above and in Figure 3.8.4-1, the total amount of fish taken during exempted trips is a small fraction (0.3% to 1.1%) of total CPS finfish landings.

Exempting small landings from limited entry requirements would allow managers to accommodate existing fishing practices. Small landings of CPS finfish currently occur often (62% to 67% of all trips landing any CPS finfish). However, it might be possible for amounts of catch landed to increase significantly if conditions change after limited entry is introduced. For example, if all of the 77,000 trips with less than two mt of CPS finfish during 1981 to1997 had actually landed two mt of CPS finfish, then total landings would have been increased by [(77,000 x 2) - 9,000]/17 = 8,500 mt per year.

It will probably be important to ensure that exempted catches are significantly smaller than typical trip sizes in the limited entry fishery to avoid undermining the value of limited entry permits. Trips as small as five mt of CPS finfish are common by vessels that would likely receive limited entry permits. Thus, two mt per trip (about half of five mt) should probably be viewed as an upper limit on the range of possible definitions for exempted landings in the CPS finfish fishery.

Anecdotal information suggests that there may be a few vessels that fish exclusively for limited, but highly specialized CPS finfish markets (e.g., dead bait). These vessels would typically land small amounts (< three mt) per trip and might fail to qualify for a limited entry permit based on total landings over the window period. If there were no exempted landings allowance, these vessels would have to obtain (purchase) limited entry permits in order to continue operating. With a minimal exempted landings allowance, these vessels would be faced with either having to obtain a limited entry permit, or making more, smaller volume trips. The former alternative would represent increased investment in the fishery, the latter alternative would likely result in less efficient operations. By allowing exempted landings of as much as two mt per trip these vessels could probably continue harvesting CPS finfish for specialized markets without investing in a limited entry permit, or an output induced increase in their operating costs.

3.8.5 Exclude Recreational Fishing from Limited Entry

Background

Pacific (chub) mackerel are the only CPS often taken by recreational anglers although they are not a major target species. During the period 1981 to 1994, the recreational catch of Pacific (chub) mackerel in southern California averaged 1,150 mt per year, and accounted for ten percent to 15% by weight of the total recreational catch. Pacific (chub) mackerel is also caught by anglers in northern California but in very modest amounts. The California recreational catch of Pacific (chub) mackerel is only two percent to three percent by weight of the total combined commercial and recreational catch.

Options

Option 1 would include recreational caught CPS finfish in a limited entry program. Option 2 would exclude recreational anglers from CPS finfish limited entry, although recreational harvest could still be restricted by quotas, area closures or any other type of management measure.

The Council chose Option 2.

Analysis

Recreational fisheries are typically managed to achieve resource conservation goals (outputs). Limited entry is primarily used to achieve economic goals, by controlling harvest capacity (inputs). Overcapitalization, in terms of excess numbers of anglers taking nontarget CPS finfish species, would not seem to be a major issue with respect to CPS management at this time. Moreover, it would be almost impossible to design a limited entry program to specifically reduce or cap the number of anglers, or recreational vessels, taking CPS finfish. In this context, limited entry would have to be applied to the marine angling population in general, which could have significant impacts on overall participation in marine recreational fisheries. The volume of business for firms dependent on marine recreational fishing (e.g., charter vessels) would be affected in this regard. On the other hand, limited entry in recreational fishing may be feasible if overcapitalization is in terms of too many recreational charter vessels.

By excluding recreational catches of CPS finfish from limited entry, no resources would be expended to manage harvesting capacity in the recreational fishery where the total catch of CPS finfish is trivial. This option maintains existing fishery segments and helps avoid discards. A recreational limited entry program would be unlikely to affect quantities of CPS finfish taken by anglers. Therefore, the impact on earnings and profitability in the commercial fishery would be minimal.

3.8.6 Exclude Live Bait Used for Sportfishing and Commercial Fishing from Limited Entry

Background

Live bait is defined as CPS species sold to anglers for live use in recreational or commercial fishing. Relatively small quantities of CPS finfish are harvested for use as live bait. Anchovy is the principal live bait species in southern and central California recreational fisheries. Sardine, mackerel and squid are also harvested for live bait but to a much lesser extent. There is a relatively small, stable fleet of vessels that harvest live bait for the major sportfishing markets in California. In northern California, Oregon, and Washington, CPS finfish are used almost exclusively as dead bait.

CPS species are also harvested for live bait in commercial albacore fisheries. Amounts harvested for this purpose are unknown but presumed to be very small.

Options

Option 1 would not require a limited entry permit for the capture and sale of CPS as live bait used in recreational fisheries or commercial fisheries (live bait landings of CPS are excluded from limited entry requirements). Option 2 would require a limited entry permit to participate in the CPS finfish live bait fishery.

The Council chose Option 1.

Analysis

CPS finfish are important as live bait in valuable recreational fisheries off southern and central California and, to a much lesser extent, off northern California, Oregon, and Washington. About 5,000 mt of CPS finfish (mostly anchovy) are harvested annually by about 18 vessels based in southern California and two vessels based in Oregon and Washington. Unlike other segments of the commercial CPS finfish fishery the live-bait segment is a low volume, high value business.

This segment of the CPS fishery is not currently or likely to become overcapitalized. Potential markets for live bait are thought to be strictly limited by the amount of sportfishing conducted near areas where live bait can be caught. No dramatic increases in demand for CPS as live bait are expecte. Therefore, with or without limited entry, there should not be any significant impacts on gross earnings and profitability in other sectors of the CPS finfish fishery due to less resource being available.

It is likely that most live-bait vessels would have sufficient window period landings of CPS finfish to qualify for a limited entry permit (live bait is not captured in the PacFIN system). However there may be some live-bait vessels that would have insufficient landings for the window period. These vessels might be able to operate under an exempted landing provision, otherwise they would have to acquire a limited entry permit to continue participation in the fishery.

The live bait fishery to supply commercial albacore fisheries is much smaller (approximately four vessels coastwide) and is also limited by the amount of pole and line albacore fishers in the area.

Under this option no resources would be expended to manage harvest capacity in a small and effectively market limited segment of the CPS fishery. In addition, this option would extend current practice and long standing arrangements in the fishery (live bait harvest is not subject to quota management in the existing FMP for northern anchovy). It maintains existing fishery segments, helps avoid discard, and uses resources spent on management of CPS efficiently. The live bait harvest would be subject to harvest control measures as required. For conservation purposes, live bait harvesting could still be managed by quota, allocation, mesh size regulations, or any other potential management measure.

3.8.7 Target Fleet Size

Background

Presently, there is excess harvesting capacity in the CPS finfish fishery which leads to declines in economic efficiency and increases the likelihood of biological overfishing. The limited entry program recommended by the Council would reduce harvesting capacity by eliminating some vessels from the CPS finfish fishery. In this regard there is some optimum or target fleet size which would best strike a balance between increasing net returns from the fishery, accommodating participation by those with substantial investments in the fishery and resource conservation.

Options

The options being considered by the Council identify a target CPS limited entry fleet size based on a proportion of total CPS finfish landings south of 39° N latitude during the window period. Option 1 would result in a limited entry fleet consisting of those vessels accountable for 80% of total CPS finfish landings during the window period. Option 2 would result in a limited entry fleet consisting of those vessels accountable for 85% of total CPS finfish landings during the window period. Option 3 would result in a limited entry fleet consisting of those vessels accountable for 90% of total CPS finfish landings during the window period. Option 4 would result in a limited entry fleet consisting of those vessels accountable for 95% of total CPS finfish landings during the window period. Option 5 would result in a limited entry fleet consisting of those vessels accountable for 99% of total CPS finfish landings during the window period.

The Council chose Option 5. While the Council recognized the optimal fleet size was likely smaller, Option 5 was chosen to be less disruptive in terms of displacing vessels from the fishery and to reduce impacts on existing fishing patterns and, therefore, on fishing communities. An integral part of the Council's choice of Option 5 was the presumed attrition in fleet size that would occur gradually through the nontransferability of permits as described in Section 3.8.14.

Analysis

Vessels with landings of CPS finfish south of 39° N latitude during the 1993 to 1997 window period were ranked in descending order based on their proportion of total window period landings. The number of vessels that would comprise the limited entry fleet at different proportions of total window period landings is shown in Table 3.8.7-1.

TABLE 3.8.7-1. Number of vessels (640) landing CPS finfish by landing area and minimum qualifying tonnage for different size CPS finfish limited entry fleets based on proportion of total **CPS finfish** landings south of 39° N latitude during the **five-year window period**, 1993-1997 (1997 preliminary).

	Total Number of Limited Entry Vessels					
	21	26	31	41	70	640[1]
Principal Landing Area	Number (%) by Principal Landing Area					
Washington	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (<1%)
Oregon	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	9 (<1%)
N. California	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	8 (<1%)
San Francisco	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (3%)	114 (18%)
Monterey/Santa Cruz	1 (5%)	5 (19%)	8 (26%)	10 (25%)	19 (27%)	119 (19%)
San Luis Obispo	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	18 (3%)
Ventura/Santa Barbara	3 (14%)	3 (12%)	3 (10%)	6 (15%)	14 (20%)	75 (12%)
Los Angeles/Orange	17 (81%)	18 (69%)	20 (64%)	25 (62%)	33 (47%)	200 (31%)
San Diego	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	92 (14%)
Other California	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)
% Total Landings of Finfish, 1993-97 (225,986 mt)[2]	80%	85%	90%	95%	99%	100%
% Total Landings of Finfish + Squid, 1993-97 (523,711 mt)[2]	59%	64%	67%	73%	85%	100%
Minimum Finfish Landings (MT), 1993 to 1997	3,629	2,420	1,818	862	100	.01
Vessels with no Squid landings, 1993 to 1997	0 (0%)	0 (0%)	1 (3%)	1 (3%)	5 (7%)	475 (74%)
Vessels with Squid Landings < 10 (MT), 1993 to 1997	0 (0%)	0 (0%)	1 (3%)	2 (5%)	11 (16%)	526 (82%)
Number of vessels 1997	21 (100%)	25 (96%)	29 (94%)	38 (92%)	60 (86%)	266 (42%)
Whose Last Year 1996	0 (0%)	0 (0%)	0 (0%)	1 (3%)	5 (7%)	99 (15%)
with Finfish and/or 1995	0 (0%)	1 (4%)	1 (3%)	1 (3%)	3 (4%)	79 (12%)
Squid Landings was: 1994	0 (0%)	0 (0%)	1 (3%)	1 (3%)	2 (3%)	100 (16%)
1993	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	96 (15%)

1/ The number of vessels having any CPS finfish landings during the window period, and therefore, accounting for 100% of the CPS finfish landings for the period.
2/ For the 640 vessels with finfish landings during the 1993 to 1997 period.

The proportion of total landings approach to determining fleet size targets those vessels that could be considered to constitute the core CPS finfish fleet, for inclusion in the CPS finfish limited entry program. The vessels included under this criteria would most likely represent the optimum harvest capacity in terms of quantities landed, given recent conditions of resource availability in the CPS finfish fishery. Also, because these different size fleets consist of those vessels accounting for the highest proportions of CPS finfish landings they are probably those with the greatest investments in the fishery, and are likely to be the most efficient harvesters in the fishery. Under Option 4, 41 vessels would make up the CPS finfish limited entry fleet. These 41 vessels are probably capable of harvesting more CPS finfish then they did during the five-year window period. Therefore, there are likely to be increased net benefits from the fishery by reducing the fleet to 41 vessels through limited entry. Under Option 5, 70 vessels would comprise the limited entry fleet. Reducing the fleet to 70 vessels is unlikely to result in the magnitude of efficiency gains that would be realized with a reduction to 41 vessels under Option 4. However, Option 5 would be less disruptive in terms of displacing vessels from the fishery, and in this sense would have less of an impact on existing fishing patterns and, therefore, on fishing communities.

Allowing too many vessels to qualify initially might require a subsequent buyback program to achieve the target fleet. Variability and uncertainties about landings and revenues will make industry sponsored buyback and permit consolidation options difficult. Landings levels and revenues may change dramatically from one year to the next and tend not to remain high for extended periods. This type of uncertainty about revenues makes long term planning and financial decisions difficult.

Low revenues in the CPS finfish fishery also make industry sponsored buyback and permit consolidation difficult. CPS finfish are typically low value per unit weight and support valuable fisheries only when landings levels are high. Low prices and frequency of low biomass conditions make it unlikely that there will be sufficient revenues in the fishery to support a vessel buyback program such as the one under consideration for groundfish. It also seems unlikely that there will be opportunities for single vessels to purchase and combine large numbers of permits from other vessels (as factory trawlers did in the Pacific whiting fishery).

The ability of vessels participating in the CPS finfish fishery to harvest alternate species reduces the need for procedures to reduce the size of the limited entry fleet. CPS finfish purse seine fisheries off California are flexible and accommodate significant changes in catch levels. When CPS finfish are unavailable or market conditions for CPS finfish are not favorable, CPS purse seine vessels tend to switch to alternative species such as market squid, tunas, herring, bonito, sharks, and swordfish.

3.8.8 Limiting Effort Beyond the Number of Vessels

Background

As discussed above, limiting the number of vessels participating in a fishery does not prevent those vessels from expanding their harvest capacity by increasing their fishing power. Therefore, limited entry might be accompanied by additional restrictions on a vessel's ability to improve its fishing power. One way this can be done is by placing endorsements on the limited entry permit with respect to the vessel's length, hold size, engine horsepower, or some other dimension of fishing effort. If, for example, a permit has a length endorsement, it can only be used on a vessel of the endorsed length. This prevents a permitted vessel from being replaced with a vessel of greater length. Thus fishing power is fixed in the dimension of vessel length. Without the length endorsement, a permitted vessel could be replaced with a vessel of greater length.

Options

Option 1 would not limit fleet harvest capacity beyond the number of vessels by restricting vessel length, hold size or some other dimension of fishing effort. Option 2 would limit fleet harvest capacity beyond the number of vessels by restricting vessel length, hold size, or other dimensions of fishing effort.

The Council chose Option 1. However, the Council's decision to limit transfer of limited entry permits after the first year effectively places limits on capacity, since it prevents replacement vessels of greater capacity.

Analysis

Option 1 would place no restrictions on harvest capacity other than the number of vessels. It would enable a permitted vessel to increase its use of other inputs in order to expand effort production and improve fish handling, which could advance economic efficiency and product quality. It would allow the fleet to become modernized to improve the quality and value of landings. In the case of a permit transfer, or vessel replacement, this option would not lock in existing technology. It would allow a second generation vessel of totally different design and effort producing capability.

As discussed below, the trip limit option would likely limit increases in an individual vessel's harvest capacity. Also, the 20 mt median landings per trip due to processor limits would serve to limit increases in an individual vessel's harvest capacity.

Option 2 would prevent harvesting capacity from expanding in other input dimensions, and more likely assure increased efficiency in the fishery. Overcapitalization due to input substitution would frustrate efforts to improve economic performance in the fishery by simply limiting entry. However, without knowledge of the input substitution possibilities, it is difficult to know what other inputs to limit. Moreover, limiting the use of other inputs may stymie innovation and the ability to modernize a vessel to meet changing market conditions.

3.8.9 Window Period

Background

The window period establishes a time frame during which potential permit holders would be qualified based upon total CPS finfish landings. The choice of a window period is somewhat arbitrary but it should be of sufficient length to reflect typical conditions in the fishery, but not too long that it would qualify vessels that have not been recently active in the fishery. Landings of individual CPS finfish species tend to vary by year, so it is desirable that total CPS finfish landings and vessel participation levels would be relatively consistent during the proposed window period.

Options

Option 1 is for a five-year window period (January 1, 1993 through November 5, 1997). Option 2 is for an eight-year window period (January 1, 1990 through November 5, 1997). The end date for both options is a notice date (also known as a control date) already adopted by Council for limited entry in the CPS fishery.

The Council chose Option 1.

Analysis

CPS finfish landings south of 39° N latitude were about 50,000 mt per year during the early 1980s and averaged about 40,000 mt during the proposed window period. Mackerel landings (Pacific [chub] mackerel plus jack mackerel) declined from about 50,000 mt per year during 1985 to 1989 to about 15,000 mt during 1992 and were between 2,000 mt to 20,000 mt per year during the recommended window period. Sardine landings increased throughout the proposed window period to about 30,000 mt per year. Northern anchovy landings have been low (generally less than 5,000 mt per year) since large scale reduction processing ceased in the early 1980s. Market squid landings (which would not be included in the limited entry program for CPS) increased to record levels during the 1993 to 1997 period.

The most significant events in the CPS fishery in the last two decades were (1) the cessation of the anchovy reduction fishery in the early 1980s (due to low prices); (2) a remarkable increase in sardine abundance (roughly 30 % to 40% per year) and landings beginning in the early 1980s; (3) recent decrease in Pacific (chub) mackerel landings (due to decreased biomass); and (4) recent increase in market squid landings. The demise of the anchovy reduction fishery happened more than a decade ago and is likely no longer important in making decisions about a window period for CPS finfish. The increase in sardine landings has largely offset the decrease in anchovy landings. Market squid were the economic mainstay of the fishery during the recommended window period, but squid probably would not be included in the potential limited entry program for CPS finfish. As described above, increased squid landings did not preclude harvest of CPS finfish.

A five-year window period appears long enough to capture vessels that have a history of catching CPS finfish (including vessels that may not participate in the CPS fishery intensively but intermittently) and short enough to make identification of "current" participants meaningful. Most importantly, a five year window period provides a wide range of flexibility in making decisions about the optimum size of a limited entry fleet. Depending on landings criteria, the number of vessels that get limited entry permits could range from zero to at most 811. Decisions about minimum landings requirements will likely be more important than decisions about the window period in potentially establishing a window period for limited entry in the CPS finfish fishery.

An eight-year window period might be necessary to identify and issue limited entry permits to vessels that were part of the CPS finfish fishery but had quit fishing for finfish to harvest squid exclusively prior to 1993. Fish ticket data show that this hypothetical class of vessels is very small or does not exist (Tables 3.8.7-1 and 3.8.9-1). The data show that ten vessels with principal landings areas in Los Angeles and Orange counties during 1990 to 1992 stopped catching finfish and squid altogether and did not switch to squid exclusively (Table 3.8.9-1). It is true that squid landings began to increase in 1993 (Table 3.8.9-2) and that many vessels increased their squid catches. However, increased squid catches were not at the expense or exclusion of finfish because squid fishing is seasonal and there were markets and finfish available along the entire central and southern California coast during each year of 1993 to 1997. Vessels in the CPS finfish fishery simply caught squid in addition to finfish, rather than instead of finfish. The eight-year window period option would likely give permits to too many vessels that have been inactive (no finfish, no squid) in the CPS fishery for periods of five years to eight years.

Compared to an eight-year window period, a five-year window period would result in a smaller fleet under any proportion of total landings criteria. Therefore, there are likely to be greater efficiency gains by using a five-year rather than an eight-year window period.

Additional information about the vessels switching from CPS finfish to squid and back again can be gleaned from examining the catch history of vessels in the CPS fishery on a boat-by-boat and year-by-year basis (Table 3.8.9-3). There is little evidence that vessels left the CPS finfish fishery to catch squid during 1990 to 1997.

TABLE 3.8.9-1. Number of vessels (1,103) landing CPS finfish by landing area and minimum qualifying tonnage for different size CPS finfish limited entry fleets based on **CPS finfish** landings south of 39° N latitude during the **eight-year window period**, 1990 to 1997 (1997 preliminary).

		Total Number of Limited Entry Vessels					
		23	28	35	48	85	1,103[1]
Principal Landing Area		Number (%) by Principal Landing Area					
Washington		0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	6 (<1%)
Oregon		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	46 (4%)
N. California		0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	24 (2%)
San Francisco		0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (5%)	250 (23%)
Monterey/Santa Cruz		1 (5%)	3 (11%)	6 (17%)	9 (19%)	19 (22%)	206 (19%)
San Luis Obispo		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	66 (6%)
Ventura/Santa Barbara		2 (8%)	3 (11%)	4 (11%)	7 (15%)	14 (16%)	113 (10%)
Los Angeles/Orange		20 (87%)	22 (78%)	25 (72%)	32 (66%)	43 (51%)	260 (24%)
San Diego		0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (4%)	131 (12%)
Other California		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)
% Total Landings of Finfish, 1990 to 1997 (358,331 mt)[2]		80%	85%	90%	95%	99%	100%
% Total Landings of Finfish + Squid, 1990 to 1997 (735,746 mt)[2]		59%	64%	71%	77%	89%	100%
Minimum Finfish Landings (MT), 1990 to 1997		4,923	3,724	1,956	888	141	.01
Vessels with no Squid landings, 1990 to 1997		0 (0%)	0 (0%)	1 (3%)	1 (2%)	8 (9%)	890 (81%)
Vessels with Squid Landings < 10 (MT), 1990 to 1997		0 (0%)	0 (0%)	1 (3%)	2 (4%)	17 (20%)	975 (88%)
Number of vessels	1997	21 (92%)	26 (92%)	31 (88%)	40 (84%)	64 (76%)	271 (25%)
Whose Last Year	1996	0 (0%)	0 (0%)	0 (0%)	2 (4%)	6 (7%)	102 (9%)
with Finfish and/or	1995	1 (4%)	1 (4%)	1 (3%)	1 (2%)	2 (2%)	84 (8%)
Squid Landings was:	1994	1 (4%)	1 (4%)	1 (3%)	1 (2%)	2 (2%)	103 (9%)
	1993	0 (0%)	0 (0%)	0 (0%)	1 (2%)	1 (1%)	108 (10%)
	1992	0 (0%)	0 (0%)	1 (3%)	2 (4%)	5 (6%)	198 (18%)
	1991	0 (0%)	0 (0%)	1 (3%)	1 (2%)	3 (4%)	79 (7%)
	1990	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (2%)	158 (14%)

1/ The number of vessels having any CPS finfish landings during the window period, and therefore, accounting for 100% of the CPS finfish landings for the period.

2/ For the 1,103 vessels with finfish landings during the 1990 to 1997 period.

TABLE 3.8.9-2. Number of vessels that landed CPS finfish or market squid or both, and anchovy, mackerel, sardine, and squid landings south of 39° N latitude, 1985 to 1997.

Year	Finfish Only Vessels	Squid Only Vessels	Finfish + Squid Only Vessels	Total Vessels	Anchovy Landings	Mackerel Landings	Sardine Landings	Total Finfish Landings	Squid Landings
1985	346	86	81	513	1638	37772	6	39415	11072
1986	270	76	71	417	1557	48809	388	50755	21294
1987	383	73	63	519	1467	46725	439	48632	19988
1988	387	77	68	532	1518	50864	1188	53571	37234
1989	473	60	57	590	2511	47713	837	51061	40937
1990	549	42	67	658	3259	40092	1664	45015	28449
1991	268	33	57	358	4068	32019	7587	43675	37723
1992	462	52	47	561	1166	19045	17954	38164	13117
1993	263	44	69	376	2003	12129	15347	29478	42894
1994	237	63	73	373	1859	10293	11644	23796	56002
1995	201	66	85	352	2016	8823	40256	51094	70375
1996	200	75	106	381	4505	9730	32553	46788	80430
1997	209	106	114	429	5778	20140	42816	68734	71046

TABLE 3.8.9-3 Number of CPS finfish and market squid trips (trips with finfish > 0 or squid > 0) on a vessel-by-vessel (one vessel per row) and year-by-year (one year per column) basis. The data shown are for 85 vessels that accounted for 99% of finfish landings under during 1990 to 1997 and all vessels in the table landed at least 141 mt of CPS finfish during 1990 to 1997. Vessels are listed in random order and not ranked by landings. For example, the vessel in the first row of the table landed CPS finfish during 1990 to 1992 and squid during 1990 but landed neither finfish nor squid during later years.

		YEAR								
VESSEL	LANDINGS	1990	1991	1992	1993	1994	1995	1996	1997	Grand Total
1	FINFISH	1	1	1	0	0	0	0	0	3
	SQUID	1	0	0	0	0	0	0	0	1
2	FINFISH	1	1	1	1	0	1	1	0	6
	SQUID	1	1	1	1	1	1	1	1	8
3	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	1	1	1	1	1	7
4	FINFISH	1	1	1	0	1	1	1	1	7
	SQUID	1	0	0	0	1	1	1	1	5
5	FINFISH	1	1	1	1	1	0	1	1	7
	SQUID	1	1	1	1	1	1	1	1	8
6	FINFISH	0	0	0	0	0	0	0	1	1
	SQUID	0	0	0	0	0	0	0	0	0
7	FINFISH	1	1	1	1	1	1	0	0	6
	SQUID	1	1	0	1	1	0	0	0	4
8	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
9	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
10	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	0	0	0	1	1	1	1	1	5
11	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	0	1	1	1	1	6
12	FINFISH	1	1	1	1	1	0	0	0	5
	SQUID	1	0	1	1	1	0	0	0	4
13	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	1	1	1	1	1	7
14	FINFISH	1	1	0	1	1	1	1	0	6
	SQUID	1	1	1	1	1	1	1	1	8
15	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
16	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	0	0	1	1	1	1	1	6
17	FINFISH	1	1	1	1	0	0	1	1	6
	SQUID	0	0	0	0	0	0	1	0	1
18	FINFISH	1	1	1	1	1	1	0	1	7
	SQUID	1	1	1	1	1	1	0	0	6
19	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
20	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
21	FINFISH	1	0	1	0	0	0	0	0	2
	SQUID	1	0	1	0	0	0	0	0	2
22	FINFISH	1	1	0	0	0	0	0	0	2
	SQUID	1	1	0	0	0	0	0	0	2
23	FINFISH	0	0	0	0	0	0	0	1	1
	SQUID	0	0	0	0	0	0	1	1	2

24	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	0	0	0	1	0	0	0	0	1
25	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
26	FINFISH	1	1	0	1	0	1	0	0	4
	SQUID	1	1	1	1	1	1	1	1	8
27	FINFISH	1	0	0	0	0	0	0	0	1
	SQUID	0	0	0	0	0	0	0	0	0
28	FINFISH	0	0	0	0	0	0	0	1	1
	SQUID	0	0	0	0	0	0	0	0	0
29	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	0	1	0	1	1	1	1	1	6
30	FINFISH	0	0	0	0	0	0	0	1	1
	SQUID	0	0	0	0	0	0	0	1	1
31	FINFISH	1	1	1	1	1	1	1	0	7
	SQUID	1	1	1	1	1	1	1	0	7
32	FINFISH	1	1	0	1	1	1	1	1	7
	SQUID	0	0	0	0	0	1	0	0	1
33	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
34	FINFISH	1	1	1	1	1	1	1	0	7
	SQUID	0	0	1	0	0	0	0	0	1
35	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	0	0	1	0	1	4
36	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
37	FINFISH	0	0	0	0	1	1	1	1	4
	SQUID	1	1	1	1	1	1	1	1	8
38	FINFISH	1	1	0	0	0	0	0	0	2
	SQUID	1	1	0	0	0	0	0	0	2
39	FINFISH	0	0	0	0	0	1	0	1	2
	SQUID	0	0	0	0	1	1	1	1	4
40	FINFISH	0	0	0	0	0	0	1	1	2
	SQUID	0	0	0	0	0	0	1	1	2
41	FINFISH	0	1	0	0	0	0	0	0	1
	SQUID	0	0	0	0	0	0	0	0	0
42	FINFISH	0	0	0	0	0	0	1	1	2
	SQUID	0	0	0	0	0	0	0	0	0
43	FINFISH	0	1	1	0	0	1	1	1	5
	SQUID	0	1	1	0	0	1	1	1	5
44	FINFISH	1	1	0	0	1	0	1	1	5
	SQUID	1	1	1	1	1	1	1	1	8
45	FINFISH	1	1	1	1	1	1	1	0	7
	SQUID	0	0	0	1	0	1	0	0	2
46	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	1	1	1	1	1	7
47	FINFISH	1	1	1	0	0	1	1	1	6
	SQUID	1	1	1	1	1	1	1	1	8
48	FINFISH	1	0	0	0	0	0	0	0	1
	SQUID	1	0	0	0	0	0	0	0	1
49	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
50	FINFISH	1	1	1	1	1	1	1	0	7
	SQUID	1	1	0	0	0	1	1	0	4

51	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	0	1	1	1	1	1	1	1	7
52	FINFISH	1	1	0	0	0	1	1	0	4
	SQUID	1	1	1	0	0	1	1	1	6
53	FINFISH	1	0	0	0	0	1	0	1	3
	SQUID	1	1	1	1	1	1	1	1	8
54	FINFISH	1	1	0	1	1	1	0	0	5
	SQUID	1	1	1	1	1	1	1	1	8
55	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
56	FINFISH	0	1	1	0	0	0	0	0	2
	SQUID	0	1	1	0	0	0	0	0	2
57	FINFISH	1	0	0	1	1	1	1	1	6
	SQUID	0	0	0	0	0	1	1	1	3
58	FINFISH	0	0	0	1	1	0	0	0	2
	SQUID	0	0	0	0	1	0	0	0	1
59	FINFISH	0	1	0	0	0	1	1	1	4
	SQUID	1	1	1	1	1	1	1	1	8
60	FINFISH	0	0	0	0	0	0	1	1	2
	SQUID	0	0	0	1	1	1	1	1	5
61	FINFISH	0	1	1	1	1	1	0	0	5
	SQUID	1	1	0	1	1	0	0	0	4
62	FINFISH	1	0	0	0	0	0	1	1	3
	SQUID	1	0	0	0	0	1	1	1	4
63	FINFISH	0	0	0	0	0	0	0	1	1
	SQUID	0	0	0	0	0	0	0	1	1
64	FINFISH	0	0	0	0	0	1	1	1	3
	SQUID	0	0	0	0	0	1	1	1	3
65	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	1	1	1	1	1	7
66	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	1	1	1	1	1	7
67	FINFISH	0	0	0	1	1	1	1	1	5
	SQUID	1	0	0	1	1	1	1	1	6
68	FINFISH	0	0	0	0	0	1	1	0	2
	SQUID	0	0	0	0	0	1	1	1	3
69	FINFISH	1	1	1	1	0	0	0	0	4
	SQUID	1	1	0	0	0	0	0	0	2
70	FINFISH	1	0	0	0	0	0	0	0	1
	SQUID	0	0	0	0	0	0	0	1	1
71	FINFISH	0	0	0	0	0	0	1	1	2
	SQUID	0	0	0	0	0	0	1	1	2
72	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	1	1	1	1	1	7
73	FINFISH	1	1	1	0	0	0	0	0	3
	SQUID	0	1	0	0	0	0	0	0	1
74	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	0	0	0	0	0	0	1	0	1
75	FINFISH	1	1	1	1	0	1	1	1	7
	SQUID	1	1	1	1	1	1	1	1	8
76	FINFISH	0	1	1	1	0	1	1	1	6
	SQUID	1	1	1	1	1	1	1	1	8
77	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8

78	FINFISH	1	1	1	0	0	0	1	0	4
	SQUID	0	0	0	0	0	0	0	0	0
79	FINFISH	1	1	1	0	0	0	0	0	3
	SQUID	0	1	1	0	0	0	0	0	2
80	FINFISH	1	1	0	1	0	0	1	1	5
	SQUID	1	1	1	1	1	1	1	1	8
81	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	1	1	1	1	1	1	8
82	FINFISH	1	0	0	0	0	0	1	1	3
	SQUID	0	0	0	0	0	0	1	1	2
83	FINFISH	0	0	0	0	0	0	1	0	1
	SQUID	0	1	0	0	0	0	1	0	2
84	FINFISH	0	0	0	0	0	0	0	1	1
	SQUID	0	0	0	0	0	0	0	0	0
85	FINFISH	1	1	1	1	1	1	1	1	8
	SQUID	1	1	0	1	1	1	1	1	7

3.8.10 Landings Qualifying Criteria

Background

Vessels would qualify for a CPS finfish limited entry permit based on some minimum quantity of CPS finfish landings, or CPS finfish and squid landings, or CPS finfish landings and/or squid landings during the five-year window period. Landings criteria would be based on total CPS finfish landings of all species since availability of CPS finfish is expected to vary considerably over time by individual species, but not for CPS finfish as a whole. Landings qualifying criteria apply only to the five-year window period (January 1, 1993 through November 5, 1997) since squid landings are not being considered in the context of a eight-year window period (January 1, 1990 through November 5, 1997).

Options

Option 1 would identify current participants and issue limited entry permits for CPS finfish based on CPS finfish (northern anchovy, Pacific sardine, Pacific [chub] mackerel and jack mackerel but no market squid) landings south of 39° N latitude (Bodega Bay and ports south) during the five-year window period. Option 2 would identify current participants and issue limited entry permits for CPS finfish based on CPS finfish plus market squid landings south of 39° N latitude with the restriction that CPS finfish landings during the five-year window period must be greater than zero. Option 3 would identify current participants and allocate limited entry permits for CPS finfish based on CPS finfish plus market squid landings south of 39° N latitude during the five-year window period, and would allow vessels without finfish landings to qualify.

The Council chose Option 1.

Analysis

The alternative of using finfish and squid landings (with the additional requirement that CPS finfish catch is greater than zero) increases the number of permits beyond the number necessary to catch finfish at the 99% cumulative harvest level, because finfish limited entry permits would be issued to squid specialists with very little finfish landings. In addition, it appears that some vessels that consistently catch modest amounts of CPS finfish with little or no squid landings might be squeezed out of the limited entry fishery for finfish by squid specialists with little or no finfish landings but large quantities of squid landings. If finfish or squid are used (i.e., finfish or squid landings could be zero), the number of permits is further increased, with permits being issued to vessels without finfish landings at the expense of vessels with finfish landings.

Numbers and other information about permits issued based on CPS finfish only and CPS finfish plus squid landings can be compared in Tables 3.8.7-1, 3.8.10-1 and 3.8.10-2. The Council has endorsed the idea of determining the size of the CPS limited entry fleet for finfish based on the number of vessels landing either 95% or 99% of total CPS finfish landings during the window period. Numbers of limited entry vessels based on finfish landings only (41 vessels for 95% and 70 vessels for 99% of total finfish catch, Table 3.8.7-1) are substantially smaller than numbers of vessels based on finfish plus squid landings (62 vessels for 95% and 89 vessels for 99% of total CPS finfish catch, Table 3.8.10-1). The differences are 21 vessels (for 95% of total finfish catch) and 19 vessels (for 99% of total finfish catch) or 51% and 27% of the recommended limited entry fleet. Most of the additional vessels operate primarily around Ventura/Santa Barbara counties where the squid fishery is intense and finfish markets are limited. Most are recent entrants to the CPS fishery attracted by strong markets and high prices for market squid. As described elsewhere, the CPS fishery for finfish is already overcapitalized and there is more than enough current harvest capacity to take quantities of CPS finfish likely to become available. There appear to be no benefits to increasing the size of the CPS finfish limited entry fleet by including squid in landings criteria used to qualify initial limited entry permits.

Using squid and CPS finfish landings to initially allocate CPS limited entry permits for finfish roughly doubles the amount of landings necessary to qualify for a CPS limited entry permit. Higher landings criteria with squid may exclude some vessels that harvest CPS finfish consistently. For example, if the CPS limited entry fleet were identified as vessels required to take 99% of CPS finfish landings during the window period, then either 70 vessels (based on finfish only, Table 3.8.7-1) or 89 vessels (based on finfish plus squid, Table 3.8.10-1) would receive permits. The qualifying criteria would be either 100 mt of finfish or 261 mt of finfish plus squid. Thus, at least two vessels operating in the San Francisco area and one boat operating in the San Diego county area, that would get permits based on CPS finfish only, would be excluded if permits were allocated based on CPS finfish plus squid.

Using CPS finfish plus squid landings for qualifying criteria without the requirement that CPS finfish landings be greater than zero would increase the number of vessels that qualify at the 95% and 99% proportion of total landing level by 75% and 44 % respectively from the case based on CPS finfish landings only during the five-year window period (Table 3.8.10-2).

The more vessels receiving limited entry permits, the greater the competition for the available quota. As competition intensifies, the greater the incentive for vessels to increase their harvesting capacity or fishing power in different input dimensions. This compromises the efficiency objective by encouraging excess harvesting capacity.

TABLE 3.8.10-1. Number of vessels (640) landing CPS finfish by landing area and minimum qualifying tonnage for different size CPS finfish limited entry fleets based on **CPS finfish (finfish > 0 mt) plus squid** landings south of 39° N latitude for the **five-year** window period, 1993 to 1997 (1997 preliminary).

		Total Number of Limited Entry Vessels					
		36	42	49	62	89	640[1]
Prinicipal Landing Area		Number (%) by Principal Landing Area					
Washington		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (<1%)
Oregon		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	9 (<1%)
N. California		0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	8 (<1%)
San Francisco		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	114 (18%)
Monterey/SantaCruz		5 (14%)	7 (17%)	8 (16%)	11 (18%)	19 (21%)	119 (19%)
San Luis Obispo		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	18 (3%)
Ventura/Santa Barbara		15 (42%)	18 (25%)	21 (43%)	26 (42%)	34 (38%)	75 (12%)
Los Angeles/Orange		16 (44%)	17 (70%)	20 (41%)	25 (40%)	35 (39%)	200 (31%)
San Diego		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	92 (14%)
Other California		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)
% Total Landings of Finfish + Squid, 1993 to 1997 (523,711 mt)[2]		80%	85%	90%	95%	99%	100%
% Total Landings of Finfish, 1993 to 1997 (225,986 mt)[2]		85%	88%	91%	95%	99%	100%
Minimum Finfish + Squid Landings (MT), 1993 to 1997		5,007	4,039	3,053	1,588	261	.01
Vessels with no Squid landings, 1993 to 1097		0 (0%)	0 (0%)	0 (0%)	1 (2%)	2 (2%)	475 (74%)
Vessels with Squid Landings < 10 (MT), 1993 to 1997		0 (0%)	0 (0%)	0 (0%)	1 (2%)	5 (6%)	526 (82%)
Vessels with Finfish Landings < 10 (MT), 1993 to 1997		3 (8%)	4 (10%)	5 (10%)	7 (11%)	12 (14%)	505 (79%)
Number of vessels	1997	36 (100%)	42 (100%)	47 (96%)	58 (93%)	77 (87%)	266 (42%)
Whose Last Year	1996	0 (0%)	0 (0%)	1 (2%)	2 (3%)	8 (9%)	99 (15%)
with Finfish and/or	1995	0 (0%)	0 (0%)	1 (2%)	1 (2%)	2 (2%)	79 (12%)
Squid Landings was:	1994	0 (0%)	0 (0%)	0 (0%)	1 (2%)	2 (2%)	100 (16%)
	1993	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	96 (15%)

1/ The number of vessels having any CPS finfish landings during the window period, and therefore, accounting for 100% of the CPS finfish landings for the period.

2/ For the 640 vessels with finfish landings during the 1993 to 1997 period.

TABLE 3.8.10-2. Number of vessels (811) landing CPS finfish or squid **(finfish or squid landings can be 0)** by landing area and minimum qualifying tonnage for different size CPS finfish limited entry fleets based on **CPS finfish plus squid** landings south of 39° N latitude for the **five-year window period** 1993 to 1997 (1997 preliminary).

		Total Number of Limited Entry Vessels					
		40	47	56	72	101	811[1]
Principal Landing Area		Number (%) by Principal Landing Area					
Washington		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6 (<1%)
Oregon		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	11 (1%)
N. California		0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)	13 (1%)
San Francisco		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	148 (18%)
Monterey/SantaCruz		7 (18%)	8 (17%)	8 (14%)	12 (17%)	19 (19%)	142 (18%)
San Luis Obispo		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	38 (5%)
Ventura/Santa Barbara		16 (40%)	20 (43%)	25 (45%)	35 (48%)	47 (47%)	121 (15%)
Los Angeles/Orange		17 (42%)	19 (40%)	23 (41%)	25 (35%)	34 (33%)	235 (29%)
San Diego		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	96 (12%)
Other California		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)
% Total Landings of Finfish + Squid, 1993 to 1997 (546,158 mt)[2]		80%	85%	90%	95%	99%	100%
% Total Landings of Finfish, 1993 to 1997 (225,986 mt)[2]		88%	90%	92%	96%	98%	100%
Minimum Finfish + Squid Landings (MT), 1993 to 1997		4,617	3,400	2,353	1,387	279	.01
Vessels with no Squid landings, 1993 to 1997		0 (0%)	0 (0%)	0 (0%)	1 (2%)	2 (2%)	541 (67%)
Vessels with Squid Landings < 10 (MT), 1993 to 1997		0 (0%)	0 (0%)	0 (0%)	1 (2%)	4 (6%)	640 (79%)
Vessels with no Finfish landings, 1993 to 1997		0 (0%)	0 (0%)	2 (4%)	7 (10%)	14 (14%)	171 (21%)
Vessels with Finfish Landings < 10 (MT), 1993 to 1997		3 (8%)	5 (10%)	10 (18%)	22 (30%)	26 (26%)	676 (83%)
Number of vessels	1997	40 (100%)	45 (96%)	52 (93%)	66 (92%)	86 (85%)	314 (39%)
Whose Last Year	1996	0 (0%)	1 (2%)	2 (3%)	3 (4%)	10 (10%)	134 (17%)
with Finfish and/or	1995	0 (0%)	1 (2%)	2 (3%)	2 (3%)	3 (3%)	106 (13%)
Squid Landings was:	1994	0 (0%)	0 (0%)	0 (0%)	1 (1%)	2 (2%)	129 (16%)
	1993	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	128 (16%)

1/ The number of vessels having any CPS finfish landings during the window period, and therefore accounting for 100% of the CPS finfish landings for the period.

2/ For the 811 vessels with finfish and/or squid landings during the 1993 to 1997 period.

3.8.11 Trip Limits

Background

An alternative to restrictions on inputs in limiting harvest capacity in the CPS finfish fishery beyond the number of vessels is trip limits, which are restrictions on outputs. Trip limits would guard against rapid expansion in the harvest capacity in the CPS fishery by transfer of CPS limited entry permits to much larger vessels (e.g., factory trawlers). Transfer of permits to much larger vessels could further expand capacity in the CPS fishery beyond the productive capacity of fully utilized CPS stocks, induce economic inefficiency, and preclude fishing by current participants. However, trip limits would not prevent vessels in need of modernization or replacement from doing so.

In this context, a trip could be defined as any activity (e.g., catching, landing, transporting or delivering) by a vessel that harvests CPS finfish with or without a limited entry permit; (i.e., a possession limit that applies to harvesting operations only). Also in this context, a trip limit should not be confused with trip limits used in other fisheries (e.g., groundfish) to lengthen the season without exceeding harvest guidelines or to manage bycatch.

Options

There are four options. Option 1 is a trip limit no larger than 125 mt; Option 2 is a trip limit no larger than 100 mt; Option 3 is a trip limit no larger than 75 mt; and Option 4 is no limit on the amount of CPS finfish carried, landed, transported or delivered. The trip limit would be defined in round weight equivalent units so that, for example, a vessel could not carry CPS products weighing less than 75 mt if they were derived from more than 75 mt of CPS in a fresh, round weight condition. There is no limit to the number of trips that might be made in one day; the time at which a trip starts and stops is not relevant. Trip limits would apply to management of the CPS fishery at the outset of limited entry because the trip limit could be changed later under the FMP framework process.

The Council chose option is Option 1.

Analysis

The Council has already decided not to place restrictions on permits and permit transfers based on vessel size, hold capacity, etc. at this time (see Section 3.8.8). A trip limit can be viewed as an output, rather than an input (e.g., vessel length) based approach to placing some limits on expansion of the limited entry fishery for CPS finfish. In lieu of more complex options involving hold capacity or vessel length limits, the trip limit approach is a low cost, objective, and easy means of discouraging growth in harvest capacity. In this situation, trip limits would inhibit inefficiencies related to harvesting capacity expanding along other input dimensions. However, to the extent vessels make more lower volume trips under a trip limit approach, there may be inefficiencies associated with suboptimal utilization of a vessel's harvest capacity.

Table 3.8.11-1 (below) shows the number of CPS finfish and squid trips, and amounts of CPS and squid landed, for trips in five trip size categories: one mt to 25 mt, 26 mt to 50 mt, 50 mt to 75 mt, 75 mt to 100 mt, and 100 plus mt per trip. The data shown are for landings during 1997 by 41 vessels with total CPS finfish landings that accounted for 95% of the total CPS finfish landings during 1993 to 1997. The 41 vessels represent the CPS limited entry fleet under the 95% of total landings, for the five-year window period criteria. For all species and species groups, the data show significant numbers of trips and landings in the one mt to 25 mt, 25 mt to 50 mt, and 51 mt to 75 mt trip sizes. In contrast, the number of trips and amounts of landings in trips of 75 to 100 and 100 plus mt per trip are very small. Thus, it appears that a trip limit of either 75 mt or 100 mt would have little impact on current operation in the fishery. However, a trip limit set too low might hinder renovation and the purchase and construction of new vessels. If more vessels were included in Table 3.8.11-1, then the number and fraction of trips in the small trip (zero mt to 25 mt) categories would probably increase but tons and fraction of tons landed would remain about the same because trips by vessels other than the 41 vessels in the table land small amounts of CPS.

Trip limits would not preclude development of offshore fisheries for underutilized species such as jack mackerel, because experimental and exploratory fishing is allowed (see above). Another advantage is that development of fisheries for underutilized species (e.g., jack mackerel) could be undertaken in a controlled way and with a reduced likelihood for allocation of harvest guidelines for fully utilized stocks (such as sardine and Pacific [chub] mackerel) between onshore and offshore sectors. Because a trip limit would be a possession limit that applies to harvesting operations only it would not effect motherships, that process but do not catch CPS finfish.

The purpose of these trip limits is to prevent sudden and large increases in the capacity of the CPS limited entry fishery. Unlike in other fisheries, they are not intended to lengthen the season or to manage bycatch. More restrictive trip limits could be implanted in the CPS fishery if required for similar purposes although this is unlikely because year-round fishing operations are not a goal of the CPS FMP. CPS fisheries are naturally seasonal and bycatch is seldom a problem. In addition, incidental catch is commonly managed in CPS fisheries using incidental catch allowances specified as an allowable fraction of total landings.

TABLE 3.8.11-1. Amounts of CPS finfish and squid landed per trip in California during 1997 by 41 vessels. The 41 vessels used to form the table landed had the highest CPS finfish landings and, as a group, accounted for 95% of total CPS finfish landings during 1993 to 1997.

SPECIES	TRIPS	%TOTAL TRIPS	LANDINGS (MT)	%TOTAL LANDINGS
ANCHOVY				
1-25 mt	161	65%	1,604	31%
26-50 mt	67	27%	2,442	47%
51-75 mt	20	8%	1,193	23%
All	248	100%	5,239	100%
SARDINE				
1-25 mt	519	40%	6,542	16%
26-50 mt	574	44%	20,872	52%
51-75 mt	173	13%	10,138	25%
75-100 mt	26	2%	2,088	5%
>100 mt	3	0%	314	1%
All	1,295	100%	39,954	100%
MACKEREL				
1-25 mt	528	63%	4,288	24%
26-50 mt	236	28%	8,547	48%
51-75 mt	69	8%	4,144	23%
75-100 mt	8	1%	645	4%
>100 mt	2	0%	207	1%
All	843	100%	17,830	100%
SQUID				
1-25 mt	607	49%	6,522	20%
26-50 mt	484	39%	16,846	52%
51-75 mt	124	10%	7,417	23%
75-100 mt	10	1%	801	2%
>100 mt	5	0%	823	3%
All	1,230	100%	32,409	100%
CPS FINFISH				
1-25 mt	1,208	51%	12,434	20%
26-50 mt	877	37%	31,861	51%
51-75 mt	262	11%	15,475	25%
75-100 mt	34	1%	2,733	4%
>100 mt	5	0%	520	1%
All	2,386	100%	63,023	100%
CPS FINFISH+SQUID				
1-25 mt	1,815	50%	18,956	20%
26-50 mt	1,361	38%	48,707	51%
51-75 mt	386	11%	22,892	24%
75-100 mt	44	1%	3,534	4%
>100 mt	10	0%	1,344	1%
All	3,616	100%	95,433	100%

3.8.12 Second Generation Permit Owners

Background

Second generation permit holders are people that obtain CPS limited entry permits from their original holders (i.e., persons or corporations that receive them initially based on CPS finfish landings during the window period). The purpose of this option would be to maintain and increase the percentage of owner-operators and reduce the level of permit ownership in the CPS limited entry fishery by corporations and partners.

Options

Option 1 would place no restrictions on "second generation" permit holders. Option 2 would require second generation permit holders to be on board CPS vessels when CPS finfish are landed, and to sign the resulting fish ticket (provisions would be made for skippers hired by second generation permit holders in the case of an emergency).

The Council chose Option 1.

Analysis

These options were developed assuming a limited entry program with unrestricted transferability of permits, as evidenced in the following analysis. However, since the Council chose a limited entry program that limits transfer of permits after the first year of the limited entry program, the options relating to second generation permit holders would only be applicable during the first year of the program.

Option 1 would allow the most flexibility in the transfer and use of limited entry permits. Unconstrained use by second generation permit holders would provide the greatest potential for efficiency gains in the fishery.

The scope of Option 2 is very broad because it would prevent or hinder (1) leasing of CPS permits by second generation permit owners; (2) use of hired skippers by second generation permit owners; (3) purchase of second generation permits by corporations and partnerships; (4) ownership of more than one permit; and (5) vertical integration in the fishery (corporations owning both vessels and processing equipment). The option would not affect use of permits by first generation owners (e.g., hired skippers could be employed) except that permit sales and changes to owners of corporations and partnerships would be restricted. Some provisions would be made for skippers hired by second generation permit holders in the case of an emergency.

Option 2 would probably reduce the value of a CPS limited entry permit as an asset or collateral, because transferability would be restricted. CPS limited entry permits would still have some value as a collateral, however, because a bank or corporation could be a second generation owner but would not be able to use the permit. In other words, a bank or corporation could own but not use a CPS limited entry permit.

During the period of transition to full ownership of limited entry permits by owner-operators, there would be two classes of permit holders: (1) initial recipients of CPS limited entry permits who could own multiple permits operated by hired skippers; and (2) second generation owners who purchased a permit from initial recipients and who must be on board a vessel at all times while fishing for CPS finfish (except as allowed under emergency conditions).

The definition of a "change" in the identity of a corporation or partnership may be important because many CPS vessels are owned by partners and some are owned by corporations. The following definition and language (originally developed for a West Coast ITQ sablefish fishery) may also be suitable for CPS.

> *"a change in the identity of a corporation or partnership will be deemed to occur with a change in the corporate or partner membership, except a change caused by the death of a member providing the death did not result in any new members. Additionally, membership is not deemed to change*

if a member becomes legally incapacitated and a trustee is appointed to act on his behalf, nor is membership deemed to have changed if the ownership of shares among existing members changes, nor is membership deemed to have changed if a member leaves the corporation or partnership. Changes in the ownership of publicly held stock will not be deemed changes in the ownership of the corporation."

If Option 2 were adopted, it will likely be necessary to amend the goals and objectives for the CPS plan to include the goal of increasing the number of owner-operators and avoiding vertical integration.

3.8.13 Permit Renewal Criteria

Background

Reducing the size of the limited entry fleet for CPS finfish through permit renewal criteria may be useful if the number of limited entry permits in the fishery is much larger than the number of vessels required or currently used to harvest the resource. Such options will be less useful if the limited entry fleet is of an appropriate size initially.

Options

Option 1 would not subject limited entry permits to renewal criteria. Option 2 would impose performance criteria for permit renewal (e.g., minimum landings, numbers of trips, or some other performance measure). Permitted vessels that fail to meet performance criteria for renewal would have their permits retired.

The Council chose Option 1.

Analysis

Option 1 does not ensure that vessels in the fleet stay active in the fishery. If permits were transferable, inactive vessels could transfer permits to vessels that become highly active, leading to a sudden surge in effort production and competition in the fishery. This could set off a proliferation of new, redundant investment in the fishery. However, since transfers are limited after the first year of the program, inactive vessels will not be able to transfer their permit to more active vessels. This scenario is intended to result in gradual attrition of the fleet size.

Option 2, the "use it or lose it" approach, was considered by Council for groundfish but rejected on the grounds that it might encourage additional fishing effort due to vessels fishing to avoid losing their permits. Another potential disadvantage of Option 2 is that development of performance criteria for renewing permits will likely be difficult and controversial whether undertaken at the outset of the limited entry program or at some later date. It is unlikely that vessels qualifying for limited entry permits under any of the proportion of total CPS finfish landings criteria and are currently active in the fishery would fail to meet renewal criteria. Thus, the number of vessels that might lose permits under Option 2 would likely be small, and significant efficiency gains due to fleet attrition from failing to meet performance criteria are doubtful.

Under both options, vessel owners would still be required to send in forms to renew permits as specified in section 3.5.2.

3.8.14 Permit Transfers

Background

Limited entry programs are primarily designed to address economic problems associated with excess harvest capacity or overcapitalization in open access fisheries. Nonetheless, the limited entry program proposed for the CPS finfish fishery has multiple objectives. In most cases significant economic benefits are realized by allowing unconstrained transfer of limited entry permits if the the initial allocation of permits is suboptimal. However in some cases, there may be social, income distributional, or other benefits of greater importance that can be realized by constraining permit transfer to maintain the initial allocation. In the latter cases, the initial allocation may be optimal in terms of preserving a particular pattern of fishing operations, or fishing community structure.

Options

Option 1 would allow CPS finfish limited entry permits to be transferred without constraints. Option 2 would prohibit the transfer of permits. Option 3 would fix the limited entry permit to the vessel and not allow transfer to another vessel except (1) if the permitted vessel is stolen, lost or no longer able to participate in a federally managed commercial fishery, provided application for the permit originates from the vessel owner who must place it on a replacement vessel of the same or less net tonnage within one year of disability of the permitted vessel, or (2) the permit is placed on a replacement vessel of the same or less net tonnage provided the previously permitted vessel is permanently retired from all federally managed commercial fisheries for which a permit is required. Option 4 would make permits fully transferable (as in Option 1) for one year following implementation of limited entry. After one year, transferability would be restricted as described for Option 3.

The Council chose Option 4: The limited entry permit is issued to the vessel. After the first year of the limited entry program, transfer of a permit to another vessel is not allowed unless the original permitted vessel is stolen, lost or no longer able to participate in a federally managed commercial fishery. Application for the permit transfer to a replacement vessel originates from the vessel owner who must place it on a replacement vessel of the same or less net tonnage within one year of disability of the permitted vessel. During the first year of the program, each permit may be transferred once.

Analysis

Without constraints on transfer, no one is prohibited from becoming a fisher. Under an open market for limited entry permits, permits would tend to be sold to fishers who use the most efficient harvesting techniques. Fishers who use the most efficient harvesting technology will be able to outbid less efficient competitors. Over time this should lead to efficiency gains and increased profitability through a reduction in fleet harvesting costs. A transferable permit can become a highly valued asset to its holder

Nontransferability or constrained transfer of permits may provide social benefits by maintaining existing patterns and conditions in the fishery. It would prevent consolidation of permits and the concentration of vessel ownership, and therefore, undue market power. Nontransferability can lead to ossification of the fleet if there are no opportunities to replace or sell vessels. Conversely, nontransferability could lead to more rapid attrition of the fleet. Nontransferability reduces the value of a permit as an asset.

Option 4 represents a compromise between full transferability and completely restricted transferability. This option was chosen in conjunction with the vessel fleet size option (see Section 3.8.7, above) for a fleet of 70 vessels. While the Council chose the fleet size option allowing 70 permits to accommodate current participants in the CPS fishery, it is clear that this fleet size is larger than required to efficiently harvest CPS finfish. Option 4 allows some modernization to occur while limiting growth of fishing capacity in the long term.

Option 4 constrains permit transfers by limiting the transfer of a permit to situations where the original vessel is lost, stolen, or no longer able to participate in federal fisheries. The replacement vessel must be of equal or lesser net tonnage. This prevents a large influx of larger, higher powered vessels into the fishery. However, Option 4 does allow permit holders to modernize and upgrade the permitted vessels. This fosters reduced operating costs through improved technology without an undue increase in fleet harvest capacity, and could lead to improvements in product quality.

Also under Option 4, permit transfers are allowed once in the first year of the program. Permit transfers during the first year may lead to improvements in economic efficiency due to purchase of permits by the most efficient operators, modernization and upgrading.

3.8.15 Procedures for Issuing New Limited Entry Permits in the Future

Background

The need to issue new limited entry permits in the future could arise if the number of permits becomes too low due to attrition, or in the case of a substantial increase in the abundance of CPS finfish resources and substantially enhanced markets. In this case, the limited entry fleet could increase beyond its current size. It might be desirable to make such permits temporary to accommodate subsequent contractions in the fishery.

Options

Option 1 would allow for issuing additional permits in the future under a framework that would be created when the process of developing options is initiated. Option 2 would allow issuance of additional permits to replace only those permits lost to attrition. Option 3 would not allow the issuance of additional permits in the future.

The Council chose Option 1, but changed the wording to "Allowance for issuance of new permits consistent with the parameters of a framework that may be developed in the future."

Analysis

Under Option 1, the fleet could be expanded to any desirable size through the issuance of new permits, and could include more vessels than initially qualify for limited entry permits. Under Option 2, new permits would only replace those lost to attrition and, therefore, the fleet could not expand beyond its initial size.

Under Options 1 and 2, any need for additional harvesting capacity in the form of more vessels, could likely be met without substantial new vessel construction. Tables 3.8.7.1, 3.8.9-1, 3.8.10-1, and 3.8.10-2 indicate a great degree of excess harvest capacity in the fishery. Thus, additional vessels could be brought into the fishery without incurring significant capital costs. However, the fishery would experience increased fixed and variable costs associated with additional vessels. Unless these added costs are offset by increased revenues from expanded resource availability and market demand, net revenues will decrease.

Transferability of CPS limited entry permits would have made procedures for issuing new limited entry permits less desirable. In that case, vessels that wanted to leave the CPS limited entry fishery could be expected to sell their permit to a vessel that wishes to participate in the limited entry fishery. However, the limited transferability provisions of the limited entry program make it important that there is a mechanism in the FMP to issue new permits in the future if there is a substantial increase in the CPS resource or extreme attrition in the fleet size.

3.8.16 Vessels under Construction, Conversion or Contract for Purchase

Background

Vessels intended for use in the CPS finfish fishery that were under construction, conversion or contracted for purchase during the window period might not qualify for a limited entry permit due to insufficient landings. Unlike vessels that were already participating in the CPS finfish or other fisheries, these vessels, because of their state of physical preparedness, may not have had an opportunity to participate in the CPS finfish fishery and make the necessary landings to qualify for a limited entry permit.

Options

Option 1 would not waive CPS limited entry landings requirements for vessels under construction, conversion or contracted for purchase during the window period. Option 2 would, upon review of the specific circumstances, allow an exception for vessels under construction, conversion or contracted for purchase during the window period.

Under Option 2, the owner of a vessel constructed or converted for use in the CPS finfish fishery qualifies for a CPS limited entry permit if the owner:

1. Submits, along with the application for a permit, receipts showing that $100,000 or more was invested during the window period for purchase or towards the conversion or construction of a vessel with a purse seine net having mesh size 1-3/8 inches or less, power blocks, and a seine winch; and

2. Uses the newly constructed or converted vessel before [insert notice date] to land coastal pelagic finfish species.

Analysis

The Council chose Option 1. Since limited entry permits will be transferable in the first year of the program, an owner of a vessel under construction may purchase a limited entry permit (Appendix B, Section 3.8.16).

Under the window period and landings options discussed above, the likely number of vessels that would qualify for a CPS finfish limited entry permit is known, and the corresponding harvest capacity could be ascertained. At this point the number of vessels that were under construction, conversion or contracted for purchase during the window period is unknown. Therefore, under a provision that would exempt vessels under construction, conversion or contracted for purchase during the window period from meeting CPS finfish minimum landings requirements, the ultimate limited entry fleet configuration is less certain, as would be fleet harvest capacity. Option 2 is likely to result in smaller efficiency gains than would be realized under Option 1.

3.9 Benefit-Cost Analysis

Benefit-cost analysis demonstrates that measurable economic benefits would accrue from a license limitation system that maintains capacity in the CPS finfish fishery at current or reduced levels. These benefits would be due to avoiding fixed costs associated with additional boats that would enter the fishery if availability of CPS, particularly sardine, improves. Fixed costs are for items such as maintenance, insurance, taxes, and moorage that stem from owning a vessel used in the CPS fishery. Fixed costs tend to be proportional to the number of vessels rather than to time spent fishing or landings. A problem arises if vessels participate in fisheries other than the CPS fishery. Fixed costs can be joint, or common in nature; (i.e., an input is a fixed cost, and is used to produce multiple outputs) (Terry et al. 1996). In this case, the annual cost of preparing a vessels to fish in the CPS fishery and other fisheries is a joint cost, which evokes the question of how much of this cost should be allocated to the CPS fishery.

License limitation may generate additional economic benefits not reflected in the benefit-cost analysis. Lack of cost data made it difficult to estimate economic benefits of license limitation in the CPS finfish fishery but benefits undoubtedly exist. Overcapitalization is only one way in which economic rent is dissipated in open access fisheries. Increases in fleet size also result in (1) decreased revenue per boat, as an increasing number of boats compete for a fixed allowable harvest, and (2) increased variable costs per boat as a result of increased congestion and excess mobility on the fishing grounds. As indicated by Wilen (1988), "the short-run fishing, moving and searching activities can be just as important as long-run capital configuration decisions in dissipating potential rents."

The benefit-cost analysis for this FMP focuses on fixed costs in operating existing boats. Additional costs would be incurred, and economic efficiency possibly reduced, if new boats were built for use in the CPS fishery.

REFERENCES

Clark, IN., P.J. Magor, and N. Mollet. 1988. Development and implementation of New Zealand's ITQ Management System. Mar. Res. Econ. 5: 325-349.

Copes, P. 1986. A Critical Review of the Individual Quota as a Device in Fisheries Management. Land Econ. 62: 278-291.

Maloney, D.G. and P.H. Pearse. 1979. Quantitative Rights as an Instrument for Regulating Commercial Fisheries. J. Fish. Res. Board Can. 36: 859-866.

PFMC, 1993. Draft Individual Quota (IQ) program. Appendix A, B, and C to Amendment 8 of the Pacific Coast Groundfish fishery Management Plan (August 26, 1983). Pacific Fishery Management Council, Portland, OR.

Rettig, R.B., and J.C. Ginter (eds.). 1978. Limited Entry as a fishery Management Tool. Univ. of Washington Press, Seattle, WA.

Scofield, W.L. 1938. Sardine Oil and Our Troubled Waters. Calif. Fish and Game 24: 210-223.

Sissenwine, M.P., and P.M. Mace. 1992. ITQs in New Zealand: The era of Fixed Quota in Perpetuity. Fish. Bull., U.S. 90: 147-160.

Squires, D., H. Campbell, S. Cunningham, C. Dewees, R.Q. Grafton, S. Herrick, Jr., J. Kirkley, S. Pascoe, K. Salvanes, B. Shallard, B. Turris, and N. Vestergaard. 1998. Individual Transferable Quotas in Multispecies Fisheries. Marine Policy. 22:2 135-159.

Terry, J., G. Sylvia, D. Squires, W. Silverthorne, J.Seger, G. Munro, R. Marasco, D. Larson, J. Kirkley, L. Jacobson, S. Herrick, J. Gauvin, A. Buss Gautam, S. Freese and R. Baldwin. 1996. Fixed Costs and Joint Cost Allocation in the Management of Pacific Whiting - A Workshop Report. NOAA-TM-NMFS-SWFSC-234.

Townsend, R.E. 1990. Entry Restrictions in the Fishery: a Survey of the Evidence. Land Econ. 66: 359-378.

Thomson, C.J., T. Dickerson, G. Walls, and J. Morgan. 1991. Status of the California Coastal Pelagic Fisheries in 1990. NMFS, SWFSC Admin. Rep. LJ-93-14.

Wilen, J.E. 1988. Limited Entry Licensing: A Retrospective Assessment. Mar. Res. Econ. 5: 313-324.

4.0 OPTIMUM YIELD, MAXIMUM SUSTAINABLE YIELD CONTROL RULES, AND OVERFISHING DEFINITIONS FOR THE COASTAL PELAGIC SPECIES FISHERY

This section analyzes options related to harvest regulation in the Coastal Pelagic Species (CPS) fishery. The options include definitions of optimum yield (OY), maximum sustainable yield (MSY) control rules, definitions of overfishing, and definitions of overfished stocks. These criteria must be defined and linked to measurable indicators of stock status (e.g., exploitation rates and biomass levels) for any CPS stock that is Actively managed under this fishery management plan (FMP). Requirements for Monitored stocks are similar.

A framework process and criteria for choosing between Active management and Monitored management are described in Section 1.2 of this appendix. Active management is for stocks with significant fisheries that might be overfished without regulation of harvest levels and periodic stock assessments. Monitored management is for stocks not regulated by harvest guidelines or quotas, because they are lightly exploited and at little risk of overfishing, or not well enough understood to Actively manage. As described in Section 2 of this Appendix, Pacific sardine and Pacific (chub) mackerel will be Actively managed at the outset of this FMP while northern anchovy, jack mackerel, and market squid will be Monitored.

The distinction between Actively managed and Monitored stocks enables managers and scientists to concentrate their efforts on stocks and segments of the CPS fishery that need the greatest attention and where greatest benefits are expected. Complete stock assessments are not necessary at this time for northern anchovy and jack mackerel and not currently possible for market squid. In addition, stock specific MSY control rules, overfishing and overfished stock definitions are also not needed (i.e., anchovy and jack mackerel); because fishing mortality is low, or technically difficult (i.e., market squid); because too little is known about the stock. As explained in Section 2 of this Appendix, this approach is compatible with the goals and objectives of the CPS FMP. In particular, it prevents overfishing, fosters effective monitoring, and uses resources spent on management of CPS efficiently.

4.0.1 Definition of Optimum Yield

As defined in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), OY is a decisional mechanism for resolving multiple conservation, social, and economic goals. According to the Magnuson-Stevens Act, OY must be less than or equal to MSY. Determination of OY involves consideration of ecological, economic, and social factors; but biological factors and sustainability are most important.

OY for a CPS stock is defined to be the level of harvest which is less than or equal to acceptable biological catch (ABC) estimated using a MSY control rule, consistent with the goals and objectives of this FMP, and used by the Council to manage the stock. ABC is a prudent harvest level calculated based on an MSY control rule (see below). As described below, MSY control rules for CPS must provide levels of stock biomass that are the same or higher than traditional F_{MSY} constant harvest rate MSY policies, while also supplying relatively high and consistent levels of catch. OY based on ABC and an MSY control rule for CPS will always be at least as effective in maintaining a healthy stock and fishery as catches from the F_{MSY} policy, because the F_{MSY} policy, among all candidate MSY control rules, is a lower bound.

This definition of OY provides the Council with maximum flexibility for setting harvest levels consistent with the Magnuson-Stevens Act and good fishery management practices, because catch levels can be set at any level between zero and the ABC from the MSY control rule. Flexibility in defining and specifying OY is important, because of the numerous and potentially conflicting conservation, social, and economic goals for management of CPS. An alternative would be to define OY as being equal to MSY, but this would prevent the Council from reducing harvest levels to accommodate ecological or economic factors not included in the MSY control rule used to calculate ABC.

This definition of OY is consistent with the Magnuson-Stevens Act and the goals and objectives of the CPS FMP. In particular, it promotes full fishery utilization based on ecosystem-based principles while achieving maximum benefits.

4.0.2 Definition of Maximum Sustainable Yield, MSY Control Rules and Acceptable Biological Catch

MSY is a central theme in the Magnuson-Stevens Act and important in specifying and developing harvest policies and MSY control rules for the CPS fishery.

The original theoretical definition of MSY as a constant level of catch should not be applied in the CPS fishery, because biomass and productivity of most CPS change in response to environmental variability on annual and decadal time scales. For example, the theoretical, deterministic equilibrium MSY catch level for Pacific sardine under favorable environmental conditions may be greater than the biomass of an unfished stock under unfavorable environmental conditions (Jacobson and MacCall 1995). Any reasonable level of MSY as a constant catch will result in low biomass levels and risk to the stock during unproductive periods when abundance tends to decline.

The more modern definition of MSY as a level of catch obtained from multiplying current biomass times a fishing mortality rate F_{MSY} is more applicable to CPS, because catch is increased when biomass is high and decreased when biomass is low. F_{MSY} is the theoretical fishing mortality rate that provides the highest level of average catch over the long term. Linking catches with biomass (i.e., catches reduced when biomass falls) reduces risk to the stock and increases biomass and catch over the long term. The definition of MSY in the National Standards for the Magnuson-Stevens Act (Sec. 600.310.c.1) as the "largest long-term average catch or yield that can be taken under prevailing ecological and environmental conditions" is similar.

For CPS, an MSY control rule is defined to be a harvest strategy that provides biomass levels at least as high as the F_{MSY} approach while also providing relatively high and relatively consistent levels of catch. By definition, candidate MSY control rules for CPS take the F_{MSY} policy as a lower bound in terms of biomass and catch. This means that any candidate MSY control rule must provide biomass levels that are at least as high as those from the F_{MSY} policy while also providing relatively high and consistent levels of catch.

The definition of an MSY control rule for CPS is compatible with National Standard 1, but more conservative and more general. According to National Standard 1 (50 CFR §600.210) an MSY control rule is "a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY." Similarly, MSY stock size in National Standard 1 "means the long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate units, that would be achieved under an MSY control rule in which the fishing mortality rate is constant." The definition of an MSY control rule for CPS is more general, because it includes the definition in National Standard 1. The definition for CPS is more conservative, because the focus for CPS is oriented primarily towards stock biomass levels at least as high as the MSY stock size. In the definition for CPS, "relatively high and consistent catch levels" are important, and MSY is used as a lower bound. The primary focus on biomass, rather than catch, is appropriate for CPS, because most species (Pacific sardine, northern anchovy, and market squid) are very important in the ecosystem for forage. MSY control rules for CPS (e.g., for sardine) are superior to the F_{MSY} approach in economic, social, and ecological terms. However, the F_{MSY} approach serves as a lower bound (with respect to biomass and catch) in their definition, and adjustments can be made to account for stock biomass, precision of biomass estimates and data, statistical characteristics in recruitment patterns (e.g., runs of years with good or bad recruitment), and other characteristics of the stock and fishery.

The MSY control rule, definition of overfishing, definition of overfished stocks, and rebuilding programs (see below) are integral parts of the harvest policy and MSY control rules for CPS. All parts of the harvest policy should be based on terms and variables that are objective and measurable. In addition, MSY control rules for CPS should normally include a rebuilding program for stocks that may become overfished (see below).

As described in the framework section of the CPS FMP, all aspects of harvest policies for CPS including the MSY control rule, definition of overfishing, definition of overfished stocks, and rebuilding criteria can be modified using framework procedures without amending the FMP.

The approach to defining MSY as ABC calculated using an MSY control rule is consistent with the Magnuson-Stevens Act, goals and objectives of the CPS FMP, and the best available science and data for CPS stocks. In particular, it promotes full fishery utilization based on ecosystem based principles, helps achieve OY, provides adequate forage for dependent species, prevents overcapitalization during periods of high ecosystem productivity, and provides rebuilding during periods of lower ecosystem productivity.

4.0.3 Definition of Overfishing

By definition, overfishing occurs in a CPS fishery whenever fishing occurs over a period of one year or more at a rate that is high enough to jeopardize the capacity of the stock to produce MSY on a continuing basis if applied in the long term. Overfishing in the CPS fishery is "approached" whenever projections indicate that the overfishing will occur within two years. The definition of overfishing is in terms of a fishing mortality or exploitation rate. Depending on the exploitation rate, overfishing can occur when CPS stocks are at either high or low abundance levels. According to National Standard 1 and the Magnuson-Stevens Act, the Council must take action to eliminate overfishing when it occurs and avoid overfishing when exploitation rates approach the overfishing level.

In operational terms, overfishing occurs in the CPS fishery whenever catch exceeds ABC by a significant amount and overfishing is approached whenever projections indicate that fishing mortality or exploitation rates will exceed the ABC level within two years. The definition of an overfished stock should be an explicit part of the MSY control rule for CPS stocks.

As described above, the ABC exploitation rate based on an MSY control rule will be at least as conservative as F_{MSY} so that ABC harvest rates (or harvest rates in slightly in excess of the ABC harvest rate) will be less than the definition of overfishing and will not lead to overfishing.

As described in the framework section of the CPS FMP, definitions of overfishing for CPS can be modified using framework procedures without amending the FMP.

The definition of overfishing for CPS is compatible with the Magnuson-Stevens Act and with the goals and objectives of the CPS FMP. In particular, it promotes full fishery utilization based on ecosystem based principles, helps achieve OY, provides adequate forage for dependent species, and prevents overfishing.

4.0.4 Definition of an Overfished Stock

By definition, an overfished stock in the CPS fishery is a stock at a biomass level low enough to jeopardize the capacity of the stock to produce MSY on a continuing basis. An overfished condition is approached when projections indicate that stock biomass will fall below the overfished level within two years. Council must take action to rebuild overfished stocks (i.e., rebuilding programs, see below) and to avoid overfished conditions in stocks with biomass levels approaching an overfished condition.

The term "overfished" is somewhat misleading for CPS stocks, because low biomass conditions may result from either overfishing, unfavorable environmental conditions, or both acting in concert. Experience with CPS stocks around the world indicates that overfished low biomass conditions usually occur when unfavorable environmental conditions and high fishing mortality rates occur at the same time. Management measures for overfished CPS stocks do not, however, depend on whether low biomass was due to excess fishing or unfavorable environmental conditions, because reductions in fishing mortality are required in either case.

The definition of an overfished stock will normally be an explicit part of the MSY control rule for CPS stocks. As described in the framework section of the CPS FMP, definitions of overfished stocks for CPS can be modified using framework procedures without amending the FMP.

The definition of overfished stocks for CPS is compatible with the Magnuson-Stevens Act and with the goals and objectives of the CPS FMP. In particular, it promotes full fishery utilization based on ecosystem-based principles, helps achieve OY, provides adequate forage for dependent species, and prevents overfishing.

4.0.5 Rebuilding Programs

Management of overfished CPS stocks must include a rebuilding program that can, on average, be expected to result in recovery of the stock to MSY levels in ten years. It is impossible to develop a rebuilding program that would be guaranteed to restore a stock to the MSY level in ten years, because CPS stocks may remain at low biomass levels for more than ten years even with no fishing. The focus for CPS is, therefore, on the average or expected time to recovery based on realistic projections. If the expected time to stock recovery is associated with unfavorable ecosystem conditions and is greater than ten years, then the Council and U.S. Secretary of Commerce (Secretary) may consider extending the time period as described in National Standard 1.

Rebuilding programs for CPS will normally be an integral part of the MSY control rule and are designed to reduce the risk of overfishing, but they may be developed or refined further in the event that biomass of a CPS stock reaches the overfished level.

As described in the framework section of the CPS FMP, rebuilding programs for CPS can be modified using framework procedures without amending the FMP.

This definition is from the Magnuson-Stevens Act and compatible with the goals and objectives of the CPS FMP. In particular, it promotes full fishery utilization based on ecosystem-based principles, helps achieve OY, provides adequate forage for dependent species, and prevents overfishing.

4.1 Maximum Sustainable Yield Control Rules

As specified in the Magnuson-Stevens Act and described above, MSY control rules are used to calculate ABC for CPS stocks. To conform to requirements of the Magnuson-Stevens Act, harvest policies and MSY control rules for CPS must include an upper bound for harvest rates that serves as a definition of overfishing. MSY control rules for CPS must also include a biomass threshold that triggers reductions in fishing mortality rates when biomass declines to low levels. In addition, MSY control rules or harvest policies for overfished CPS stocks should include a rebuilding program that is expected to result in recovery of overfished or depressed stocks to levels that can support MSY within ten years (on average). The definitions of overfishing and overfished status must be explicit and based on objective and measurable criteria. MSY control rules for CPS must be explicitly risk-averse and designed to minimize the probability of low biomass conditions that jeopardize the stock's capacity to produce MSY. Greater uncertainty regarding a stocks status should result in more conservative harvest levels.

MSY control rules in the CPS fishery may vary depending on the nature of the fishery, management goals, assessment and monitoring capabilities, and available information. Under the framework management approach used for CPS, it is not necessary to amend the CPS FMP in order to develop or modify MSY control rule or definitions of overfishing.

Many CPS stocks are important as forage (e.g., Pacific sardine and northern anchovy) for a wide range of predators including other fish, birds, and marine mammals. Ecosystem considerations are important elements of the goals and objectives for the CPS FMP. MSY control rules for CPS should, therefore, help reduce the frequency of low biomass conditions and overfished stocks and facilitate recovery of overfished stocks to the extent possible. Biomass criteria are particularly important in developing MSY control rules for CPS such as Pacific sardine and northern anchovy which are key forage species in the California Current ecosystem.

The main use of an MSY control rule for Actively managed stocks is to provide managers with a tool for setting and adjusting harvest levels on a periodic basis while preventing overfishing and overfished stock conditions. All Actively managed stocks must have stock-specific MSY control rules, a definition of overfishing, and a definition of an overfished stock.

The main use of an MSY control rule for a Monitored stock is to help gauge the need for Active management. MSY control rules and harvest policies for Monitored CPS stocks may be more generic and simple than those for Actively managed stocks with significant fisheries. Any stock supporting catches approaching the ABC or MSY level should be Actively managed unless there is too little information available or other practical problems.

As described in the framework section of the CPS FMP, MSY control rules for CPS can be modified under the framework procedures without amending the FMP.

4.1.1 Default Maximum Sustainable Yield Control Rule and Overfishing Specifications

The Council may develop stock-specific MSY control rules and overfishing specifications for Monitored stocks as described in the framework section of this FMP, or it may use the default definition given below. The default MSY control rule is intended to be flexible, because the best choice for a Monitored stock will depend on the circumstances of the fishery, importance of the stock as forage, and data available. The default MSY control rule itself can be modified under framework management procedures to accommodate new procedures, changes in the nature of the fisheries, or new data.

The default MSY control rule (intended primarily for a stocks that are Monitored) sets ABC for the entire stock (U.S., Mexico, Canada, and international fisheries) equal to 25% of the best estimate of the MSY catch level. Overfishing occurs whenever the total catch (U.S., Mexico, Canada, and international fisheries) exceeds ABC for the stock by a significant amount or whenever fishing occurs at a rate that is high enough to jeopardize the capacity of the stock to produce MSY. Overfishing of a Monitored CPS stock is "approached" whenever projections or estimates indicate that the overfishing will occur within two years.

In making decisions about Active management, Council may choose to consider ABC in U.S. waters. ABC in U.S. waters is ABC for the entire stock prorated by an estimate of the fraction of the stock in U.S. waters (see below). There may be no benefits to Actively managing the U.S. segment of a CPS fishery if fishing mortality in the U.S. is small and while fishing is occurring outside the jurisdiction of U.S. authorities. Active management may not be effective if U.S. catches are small and overfishing is occurring in Mexico, Canada, or in international waters outside the jurisdiction of federal authorities.

The default definition of an overfished stock in the CPS fishery is a stock at a biomass level low enough to jeopardize the capacity of the stock to produce MSY on a continuing basis. An overfished condition is approached when projections indicate that stock biomass will fall below the overfished level within two years. Council should take action to rebuild overfished stocks (i.e., rebuilding programs, see below) and to avoid overfished conditions. However, as described above, Active management may not be effective if U.S. catches are small and overfishing is occurring in Mexico, Canada, or in international waters outside the jurisdiction of federal authorities.

4.1.1.1 Analysis

The MSY control rule and overfishing specifications applied to Monitored stocks (default or otherwise) are intended to be conservative benchmarks used to manage stocks with small fisheries at very little risk of overfishing. They function as conservative benchmarks that help managers make decisions under the framework management process about moving stocks to the Actively managed category (if catches increase or are projected to increase to significant levels) or to the Monitored category (if catches decrease or are projected to decrease to low levels). Of course, managers might promote a stock to the Actively managed category for reasons other than increased harvest levels.

As described in the framework section of the FMP, the Council should promote monitored stocks to Active management whenever overfishing (according to the conservative default benchmark) occurs or is projected to occur. In this context, "overfishing" implies that a stock likely requires an Active management approach. It does not necessarily imply that harvest levels that are too high, because the MSY control rule used for Monitored stocks will normally be conservative.

The general approach, default MSY control rule, and default overfishing specifications for Monitored stocks are compatible with the Magnuson-Stevens Act and with the goals and objectives of the CPS FMP. In particular, they achieve OY, prevent overfishing, and use resources spent on CPS efficiently.

4.1.2 MSY Control Rule and Overfishing Specifications

The principal MSY control rule utilized for the California CPS fisheries was developed for Pacific (chub) mackerel, and it was designed to continuously reduce the exploitation rate as biomass declines (Parrish and MacCall). The general formula used is:

$$H = (\text{BIOMASS-CUTOFF}) \times \text{FRACTION}$$

H is the harvest target level, CUTOFF is the lowest level of estimated biomass at which directed harvest is allowed and FRACTION is the fraction of the biomass above CUTOFF that can be taken by the fishery. BIOMASS is generally the estimated biomass of fish age one or more at the beginning the season. The purpose of CUTOFF is to protect the stock when biomass is low. The purpose of FRACTION is to specify how much of the stock is available to the fishery when BIOMASS exceeds CUTOFF. It may be useful to define any of the parameters in this general MSY control rule so they depend on environmental conditions or stock biomass. Thus, the MSY control rule could depend explicitly on the condition of the stock or environment.

The formula generally uses the estimated biomass for the whole stock in one year (BIOMASS) to set harvest for the whole stock in the following year (H), although projections or estimates of BIOMASS, abundance index values, or other data might be used instead. BIOMASS is an estimate only, it is never assumed that BIOMASS is a perfect measure of abundance. Efforts to develop a harvest formula must consider probable levels of measurement error in BIOMASS which typically have CVs of about 50% for CPS.

The general MSY control rule for CPS (depending on parameter values) has a number of important characteristics that tend to make it compatible with the Magnuson-Stevens Act and useful for CPS that are important as forage. If the CUTOFF is greater than zero, then the harvest rate (H/BIOMASS) declines as biomass declines (Figure 4.1.2-1). By the time BIOMASS falls as low as CUTOFF, the harvest rate is reduced to zero. The CUTOFF provides a buffer of spawning stock that is protected from fishing and available for use in rebuilding if a stock becomes overfished. The combination of a spawning biomass buffer equal to CUTOFF and reduced harvest rates at low biomass levels means that a rebuilding program for overfished stocks may be defined implicitly. Moreover, the harvest rate never increases above FRACTION. If FRACTION is approximately equal to F_{MSY}, then the MSY control law harvest rate will not exceed F_{MSY}.

The general MSY control rule formula given above contains constant F policies like F_{MSY} (set FRACTION=F_{MSY} and CUTOFF=0) as special cases. The formula also contains constant escapement policies as special cases (set FRACTION=1 and CUTOFF to the desired level of escapement). Thus the general formula for MSY control rules in CPS includes policies used to manage most of the world's fisheries.

CPS stocks may be distributed over very large areas when abundant, and it may be difficult to obtain biomass estimates for the entire stock when abundance is high. Under these conditions, BIOMASS may be a regional estimate. When BIOMASS is a regional estimate, parameters in the MSY control rule have the same meaning, but adjusted values may be required.

The CUTOFF may also be used to define overfished stocks in the CPS fishery, but other or additional biomass thresholds may also be used. Recovery of the stock to biomass levels above the definition of overfishing should be relatively rapid, because there is no directed fishing on overfished stocks. In addition, biomass levels less than CUTOFF should be rare, because no directed fishing is generally allowed for stocks with biomass below the CUTOFF.

In addition to the CUTOFF and FRACTION parameters, it may be advisable to define a maximum harvest level parameter (MAXCAT) so that total harvest specified by the harvest formula never exceeds MAXCAT. MAXCAT is used to guard against extremely high catch levels due to errors in estimating biomass, to reduce year-to-year variation in catch levels, and to avoid overcapitalization during short periods of high biomass and high harvest. MAXCAT also prevents the catch from exceeding MSY at high stock levels and spreads the catch from strong year classes over a wider range of fishing seasons. Although catch from the general MSY control rule for CPS increases with biomass, the harvest rate itself will decline as biomass increases to high levels (Figure 4.1.2-2).

As described above, overfishing occurs whenever the catch exceeds ABC calculated using the MSY control rule by a significant amount. A stock is overfished whenever the biomass falls below some other threshold (see below). The biomass threshold used to define overfishing may be equal to or different from CUTOFF.

Other general types of control rules may be useful for CPS, and this FMP does not preclude their use as long as they are compatible with National Standards and the Magnuson-Stevens Act.

4.1.2.1 Analysis

The general MSY control rule for setting harvest levels in the CPS fishery is simple and flexible and can be modified to suit the conditions in any particular fishery. It is similar to formulas currently used by the State of California to manage Pacific (chub) mackerel (MacCall et al. 1985) and Pacific sardine (Hill et al. 1997) as well as by the Council to manage anchovy and Pacific whiting (similar in life history to CPS).

The general formula makes sense for highly variable stocks like CPS, because high harvest rates take advantage of periods when biomass and productivity are high. When biomass and productivity are low, in contrast, low harvest rates protect long term productive capacity and help to rehabilitate the stock.

The MSY control rule accommodates definitions of overfishing for overfished stocks since overfishing is defined as catches that exceed ABC. The general rule is compatible with requirements to identify overfished stocks, because fishing can be precluded at any biomass level. The general rule implicitly defines rebuilding programs for stocks that are overfished or at low biomass levels, because exploitation rates decline (and approach zero) as biomass fall to the CUTOFF or definition of overfishing (whichever is higher).

4.1.3 Harvest Levels for U.S. Fisheries

Management of transboundary stocks is one of the most difficult problems in management of CPS. Ideally, transboundary CPS stocks would be managed cooperatively by the U.S., Canada, and Mexico on the basis of common policy. Effective management of CPS may be difficult without a cooperative agreement, because total catch levels are likely to be too high. At present, there are no indications that a cooperative management agreement with Mexico or Canada will be established.

In the absence of a cooperative management agreement, the default approach in the CPS FMP sets harvest levels for U.S. fisheries by prorating the total target harvest level according to the portion of the stock resident in U.S. waters or estimating the biomass in U.S. waters only. In practice, this approach is similar to managing the U.S. and Mexican portions of a stock separately since harvest for the U.S. fishery in a given year depends ultimately on the biomass in U.S. waters.

Other approaches that may be developed in future are not precluded by this default. If the portion of the stock in U.S. waters cannot be estimated or is highly variable, then other approaches may be used. It may be more practical, for example, to use a high CUTOFF in the MSY control rule to compensate for stock biomass off Mexico or Canada.

Depending on circumstances, there are a number of ways in which harvest levels for U.S. fisheries could be calculated. The approaches differ mainly in the order of calculations. For example, if CUTOFF is 100,000 mt, FRACTION is 20%, the current total biomass is 200,000 mt and the portion of the stock in U.S. waters is 35%, then the total target harvest level would be 0.2 x (200,000 - 100,000) = 20,000 mt, and the harvest level for the U.S. fishery would be 0.35 x 20,000 = 7,000 mt. If biomass in U.S. waters only (measured by a special survey confined to U.S. waters) was 100,000 mt, then total biomass could be estimated as 100,000 / 0.35 = 286,000 mt, and harvest levels calculated as before. Other essentially equivalent approaches are also possible.

4.1.3.1 Analysis

The primary advantage of prorating the total target harvest level to obtain harvest guidelines or quotas for U.S. fisheries is that U.S. fisheries can be managed unilaterally in a responsible manner that is consistent with the Magnuson-Stevens Act. Mexican landings are not considered explicitly when harvest levels for U.S. waters is determined, so U.S. fishers are not penalized directly for Mexican harvests. Harvest in U.S. waters does, however, depend on current biomass, so U.S. harvest will be reduced if the stock is depleted by fishing in either Mexico or the U.S.

A disadvantage in prorating total harvest by the portion in U.S. waters is that biomass estimates, based on U.S. and Mexican fishery data, for the whole stock may be required. It is possible that Mexican fishing data might not be available at some future date, but experience indicates that serious problems with data availability are unlikely.

The most serious disadvantage in prorating ABC for the stock in U.S. waters is that the portion of each stock in U.S. waters has to be estimated. Portion in U.S. waters may be more difficult than total biomass to estimate, because the portion of CPS stocks in U.S. waters varies with season and is affected by a number of variables. During the winter and spring, water temperatures are cool, and stocks move south to spawning areas off southern California and Mexico. During the summer and fall, when water temperatures are highest, CPS move north and away from Mexico. The amount of seasonal movement depends on the species, environmental conditions (warm water encourages movement to the north), biomass levels (sardine may undertake northern feeding migrations when biomass is high), and age composition (large old fish tend to move farther north).

If it proves too difficult to estimate the portion in U.S. waters, then other approaches to adjusting ABC for stock biomass outside of U.S. waters may be employed. For example, it may be more practical to use an MSY control rule with a high CUTOFF than to try and estimate the portion of the stock in U.S. waters. It is also possible that surveys could be conducted in U.S. waters to estimate the biomass actually occurring there.

It is likely that estimates of the portion of CPS stocks in U.S. waters will be controversial. Managers and scientists may decide to choose, as a matter of policy and based on limited information, a season on which to base estimation of portion in U.S. waters and calculation of harvest levels for U.S. fisheries. A number of different estimates of the portion in U.S. waters may have to be reconciled, and the decision about which estimate to use or how estimates are to be combined may result in a policy decision. Managers may choose estimates of the portion in U.S. waters strategically if bilateral discussions about allocating CPS between the U.S. and Mexico develop. If the U.S. and Mexico do not agree on the portions in U.S. and Mexican waters for a particular stock, then too much harvest may occur.

Prorating total harvest by the portion in U.S. waters will not protect CPS stocks against high combined U.S. and Mexican harvest rates if harvest rates are too high in Mexico, but harvest in U.S. waters will automatically decrease if biomass decreases. In any given year, combined U.S. and Mexican harvest rates may be higher than desirable, and biomass and fishery yields may be reduced due to too much fishing. Another disadvantage is that U.S. fisheries may be preempted by large scale fisheries in Mexican waters since relatively conservative management of U.S. fisheries may result only in higher Mexican harvests.

4.1.3.2 Portion in U.S. Waters and Available Data

Estimates of the portion in U.S. waters for most stocks will likely be based on California Cooperative Fishery Investigation (CalCOFI) and fish spotter data. CalCOFI data are quantitative collections of eggs and larvae made during the spawning season at a regular grid of sampling stations from 1951 to the present time (Hewitt 1988). Surveys made during the spawning season when adults are generally at the southern end of their distribution, therefore, have a south bias. The current sampling pattern is confined to the California Bight, but a more extensive sampling pattern that extended farther north and into Mexican waters was carried out during 1951 through 1985. From time to time, cooperative transboundary surveys are conducted by U.S. and Mexican scientists that provide useful information about CPS eggs, larvae, and spawning biomass on both sides of the border (Arenas et al. 1996). Fish spotter data are collected by pilots in small planes that are employed by the fishery to locate fish schools (Lo et al. 1992). Fish spotters fly over Mexican waters during the summer while searching for tuna, but seldom fly north of Pt. Conception.

Estimates of the distribution of CPS larvae between the U.S. and Mexico based on CalCOFI larval data for 1951 through 1985 are given below. CPS spawn mostly during the winter and spring, so portions from CalCOFI data are treated as winter-spring estimates of the portion of CPS stocks in U.S. waters.

CalCOFI (Winter-Spring) Larval Distribution

Species	United States	Mexico
Pacific (Chub) Mackerel	55%	45%
Jack Mackerel	54%	46%
Pacific Sardine	31%	69%
Northern Anchovy	65%	35%

The portions are based on larval abundance north and south of CalCOFI line number 100, which corresponds approximately to the U.S.-Mexican border and are subject to the following caveats:

1. The seasonal and spatial distribution of CalCOFI sampling effort has varied over the years in response to changes in survey objectives and budgets (Hewitt 1988). During years of diminished sampling effort, surveys have generally concentrated in those months and areas where spawning activity was most likely to occur. The estimates of larval distribution described above were based on raw rather than seasonally adjusted data, and it is not known whether this results in any systematic bias.

2. The portions probably underestimate the true proportion of jack mackerel larvae in U.S. waters, because (a) CalCOFI surveys have generally not extended far enough north or offshore to cover the full range of the jack mackerel resource. The offshore range of jack mackerel tends to diminish as one moves from the northern to southern end of the range, so the surveys probably "missed" a larger proportion of the larvae present in U.S. waters than in Mexican waters; and (b) An unknown portion of the larvae sampled in Mexican waters likely originated in U.S. waters, since jack mackerel larvae exhibit a marked tendency to drift southward on the California Current.

3. The Pacific sardine distribution described in the table pertains to years during which the biomass was very low. The proportion of sardine larvae and spawning biomass in U.S. waters would be higher in medium to high biomass years. Results, for example, of a cooperative U.S./California/Mexico daily egg production survey indicated that most of the biomass of spawning sardine was in U.S. waters during 1994 (Lo et al. 1996). Sardine biomass was much higher in 1994 then when historical CalCOFI data were collected.

4. CalCOFI data for U.S. and Mexican waters from surveys off both countries were collected primarily before the late 1970s when water conditions were cool and most CPS had a more southerly distribution. Water temperatures along the coast increased after the late 1970s (MacCall and Prager 1988) and have remained high (Roemmich and McGowan 1995). It is likely that proportions of CPS in U.S. (and Canadian) waters have increased as proportions in Mexican waters have decreased.

Estimates of the portion of CPS stocks in U.S. waters from CalCOFI data are probably reliable for the central stock of northern anchovy and Pacific (chub) mackerel during the winter and spring when spawning occurs. Portions for jack mackerel and Pacific sardine, as indicated above, likely underestimate the portion in U.S. waters under current biomass and environmental conditions.

Estimates of the average distribution of CPS between the U.S. and Mexico based fish spotter data for 1964 through 1992 are given below. Fish spotters seldom enter Mexican waters during the winter and spring when CPS are most abundant in southern areas and search effort in Mexican waters has been limited in recent years. Portions in the table are, therefore, best thought of as summer-fall estimates.

Fish Spotter (Summer-Fall) Distribution

Species	United States	Mexico
Pacific (Chub) Mackerel	84%	16%
Jack Mackerel	75%	25%
Pacific Sardine	87%	13%
Northern Anchovy	98%	02%

Portions based on fish spotter data were obtained by calculating average relative abundance for each CPS in each of six regions using log-normal linear models (Lo et al. 1992). The boundary between regions 2 and 3 in the north and region 5 in the south corresponds approximately to the border between the U.S. and Mexico.

Following the notation and approach in Lo et al. (1992), average relative abundance in region r (Ir) is:

$$I_r = d_r P_r A_r$$

where Ir is relative abundance in region r, dr is the density in positive flights, Pr is the proportion of positive flights, and Ar is the area searched. The terms for density (dr) and proportion positive (Pr) were calculated from main effects for regions estimated using the log-normal linear models. Interactions between season and region (which would account for seasonal migration) were not included, because insufficient data were available to estimate all of the required interaction parameters. Area searched (Ar) was approximated as the number of unique blocks searched by fish spotters during 1963 to 1992. Corrections to eliminate bias due to log transformation in Lo et al. (1992) were not used in order to simplify calculations. Regions 5 and 6 were combined, because there was too little data to obtain parameter estimates for region 6 from the log-normal linear models. The portion of each CPS stock in U.S. waters shown in the table above was calculated as the sum of Ir for region one through three (U.S. only) divided by the sum of Ir for region one through region six (Mexico+U.S.).

Portions based on fish spotter data are subject to the following caveats:

1. The portions probably underestimate the proportion of jack mackerel in U.S. waters, because fish spotters do not sample the entire northern and offshore range of jack mackerel.

2. The Pacific sardine distribution described in the table pertains mostly to years during which biomass was very low. The proportion of sardine in U.S. waters would be higher in medium to high biomass years.

"Best" estimates of portions of most CPS in U.S. waters during the whole year are averages of the CalCOFI estimates for winter through spring and the fish spotter estimates for summer through winter (see below). The best estimates for Pacific sardine (87%) are based on fish spotter data only since the average for fish spotter and CalCOFI (59%) seems too small for the stock as a whole under current conditions. The State of California assumed that the portion of sardine in U.S. waters was 59% in setting California quotas for 1998, but the proportion was applied to a regional biomass estimate that included sardine off the area between Baja California and San Francisco only. The 59% figure is probably a reasonable estimate of the fraction of sardine biomass in U.S. waters based on the region surveyed.

It is not possible at the present time to estimate the portion of any CPS in U.S. waters on an annual basis, and it is unlikely that estimates of portion of CPS in U.S. waters could be updated frequently.

Best Estimates of Average Distribution

Species	United States	Mexico
Pacific (Chub) Mackerel	70%	30%
Jack Mackerel	65%	35%
Pacific Sardine[1]	87%	13%
Pacific Sardine[2]	59%	41%
Northern Anchovy	82%	18%

1/ Whole stock.
2/ Southern region only.

The best estimate for the central stock of northern anchovy based on CalCOFI and fish spotter data (82%) is larger than the 70% value assumed in the Northern Anchovy Fishery Management Plan (Council 1983) which was based on CalCOFI data only. These estimates should be refined as additional data become available or conditions in the fishery change. In particular, the estimate for Pacific sardine should be reevaluated if the biomass of the stock continues to increase or declines, and the best estimate for jack mackerel should be reevaluated if a significant fishery develops. Both should be reevaluated if new data become available. The southern stock of northern anchovy does not enter U.S. waters, and the northern stock does not enter Mexican waters.

4.1.4 Analysis of MSY Control Rules by Simulation

As described below for Pacific sardine, MSY control rule options are best analyzed using a species and fishery-specific simulation model. The general approach is to simulate the stock and fishery over a long period of time and using a large number of MSY control rule parameter values (e.g., CUTOFF, FRACTION, and MAXCAT). The purpose of the simulations is generally not to find the combination of CUTOFF, FRACTION, and MAXCAT that is "optimal" (Ruppert et al. 1984). Instead, results are typically used to find MSY control rules and parameters that give good results for most measures of performance (MacCall et al. 1985).

Simulation models used to explore MSY control rule options should be as realistic as possible. Each model should be based on results and parameter estimates from recent stock assessments and include a realistic degree of density dependence and year-to-year variability in production or recruitment. Simulated biomass estimates should include realistic amounts of measurement error. Current conditions in the fishery can be used to initialize simulations.

4.1.4.1 Measures of Performance

A number of measures of performance are useful in simulation analysis of MSY control rule options for CPS (see below). The value of each performance measure can be computed for each MSY control rule option or combination of control rule parameters based on simulation results. The list of performance measures given below is not exhaustive, and other performance measures may be desirable in any given situation. In addition, not all measures may be useful in all analyses.

Performance Measure

1. Average catch.
2. Standard deviation of catch.
3. Average biomass.
4. Standard deviation of biomass.
5. Percent of years with no catch.
6. Percent of years with biomass > specified level.
7. Average log catch.
8. Median catch.
9. Average log midyear biomass.
10. Median biomass.

Average catch is used as a traditional measure of long-term fishery performance (e.g., MacCall et al. 1985). Catches in any given year might be much larger or smaller than average. Catch variance, catch standard deviation, and catch coefficient of variation (CV) are measures of expected variability in annual landings over many years (Hall et al. 1988). Catch standard deviation is the expected difference in biomass units between the average catch and catch in any given year. Catch CV is the expected difference in between the average catch and catch in any given year expressed as a percentage of average catch. Average midyear biomass and percent years with biomass greater than some specified level may be included, because some CPS (i.e., anchovy and sardine) are important as forage for fish, mammals, and birds (including the endangered brown pelican and least tern). Average midyear biomass measures average abundance of forage for CPS predators. Percent of years with no catch measures the frequency of years in which target harvest is expected to be zero, because biomass was below the CUTOFF.

Average log catch and average log midyear biomass are "risk averse", downward curving (or convex, Figure 4.1.4.1-1) measures of fishery performance. Convex performance measures like log catch or log biomass are called "risk averse," because a manager who believes in them won't try to increase catch (or biomass) if there is an equal chance that it will actually decrease by the same amount as a result of his or her actions (Keeney and Raiffa 1976). Median catch and biomass are the catch and biomass levels that are "in the middle" in the sense that they are larger than 50% and smaller than 50% of catch or biomass levels that occur during all years. Log catch or median catch and log biomass of median biomass are similar and correspond if log catch is normally distributed (back-transformed average log catch equals median arithmetic catch if log catch is normally distributed). Average log catch is often used in fisheries to measure the performance of harvest policies and management options (Deriso 1985; Hightower 1990; Hilborn 1985; Mendelssohn 1982; Parma and Deriso 1990), but is more difficult to understand than median catch.

Average log catch or midyear biomass and median catch or biomass are all useful measures of fishery performance over both the long and short term. Logarithms fall off rapidly as catch or biomass declines (Figure 4.1.4.1-1) so low levels of catch and biomass get a very low performance score. Thus, a harvest policy that gets a high score for average log catch, median catch, average log biomass, or median biomass must result in relatively high catch or biomass levels that are fairly constant over the long term. Over the short term, risk averse measures like log catch reflect the fact that fishery profits eventually level off or fall as catches increase due to lower prices and increasing costs. Similarly, log biomass reflects the fact that ecological benefits of increased biomass eventually fall off as predators become satiated.

From another point of view, median biomass or catch might be of interest to managers and members of the fishing industry who are more concerned with keeping biomass or catch high in most years than with high average catch. It is possible to have high average catches when the catches in most years and median catch are low. The following simple example illustrates the potential differences between mean and median catches and the choices managers must make in choosing policies that have high average or median catch.

Year	Catch for Policy 1	Catch for Policy 2
1	100	20
2	0	20
3	0	20
Median	0	20
Average	33	30

In the example, three year simulations gave an average catch of 33 for policy 1 and 30 for policy 2. Yet, a manager might choose policy 2 (with a lower mean catch), because the catches were more consistent from year to year (i.e., median catch is higher for policy 2).

There are mathematical relationships between the median, average, and average of log transformed catch or biomass values under some circumstances. Average log catch and median catch, for example, would correspond exactly if log catch was normally distributed (back-transformed average log catch equals median arithmetic catch if log catch is normally distributed). Similarly, median catch and average catch would correspond exactly if catches were normally distributed. However, neither log catch nor catch are normally distributed under most MSY control rules (e.g., because of MAXCAT). The relationship between median, average and mean log transformed values is therefore distorted (Figure 4.1.4.1-2).

4.2 Pacific Sardine

Pacific sardine have recently increased in abundance (Deriso et al. 1996) after collapsing to very low levels in the 1960s (MacCall 1979; Murphy 1966). Sardine are a variable stock that undergoes extended periods of low and high biomass even in the absence of fishing (Soutar and Isaacs 1968; Baumgartner et al. 1992).

Considerable effort has recently gone into developing indices of abundance for sardine and new stock assessment models that use all available data (Barnes et al. 1992; Deriso 1983; Deriso et al 1996). As a result, credible stock assessment models (but with some problems described below) and biomass estimates are available. The precision of sardine biomass estimates for the most recent year tends to be low with coefficient of variations (CVs) of about 50%.

4.2.1 Current Management

Pacific sardine are currently managed by California Department of Fish and Game (CDFG) with technical assistance and data from National Marine Fisheries Service (NMFS). State regulations allow a directed sardine fishery in years when sardine spawning biomass exceeds 18,200 mt (20,000 short tons). In recent years, California sardine quotas have been set using a formula identical to the preferred option in *Amendment 7 to the FMP for Northern Anchovy* (which was rejected by NMFS) and is also included in this amendment as a status quo option (see below).

One third of the total California sardine quota is allocated to boats operating north of San Simeon Point (San Luis Obispo County, California), and two thirds is allocated to boats operating to the south. On October 15, the total remaining state-wide quota is reallocated 50/50 to the northern and southern areas. Tolerance limits for sardine (similar to incidental catch allowances in this FMP) are used to manage incidental catch and may be, by law, 15% to 45% by weight in each delivery.

4.2.1.1 Special Issues in Sardine Management

The sardine stock has increased since the early 1980s while the U.S. fishery was tightly regulated. Mexican harvests have recently increased, however, and may be sufficient to eliminate the sardine recovery even in the absence of a U.S. fishery. A small sardine fishery has developed recently in British Columbia, but is conservatively managed and unlikely to result in overfishing.

Sardine are important as forage to a large number of birds, marine mammals, and fish predators (including endangered species) although few data are available, because of the scarcity of sardine, until recently. Decisions about harvest formula options and the definition of overfishing for sardine must, therefore, consider sardine as forage. Forage and ecosystem-related goals and objectives are included in this FMP.

Of all CPS, sardine productivity is most strongly affected by environmental variation. Favorable and unfavorable periods or “regimes” for sardine tend to occur in cycles of about 60 years (Baumgartner et al. 1992). This means that periods of low abundance for sardine are probably inevitable, even in the absence of a fishery. Sensitivity to environmental regimes makes choice of MSY control rule parameters, especially CUTOFF and FRACTION, more difficult.

Monitoring and assessment efforts in recent years have been hampered by a new problem that is, ironically, a product of success in rehabilitating the sardine stock. As biomass of the sardine stock has increased, its range (which currently extends from Baja California to British Columbia) has grown beyond the fishery and survey monitoring programs in the Southern California Bight. The stock has, literally, begun to "outgrow" resources available to managers for data collection and monitoring. The most recent stock assessment for sardine (Hill et al. 1998) includes speculative estimates of sardine abundance outside the range of the surveys and fishery that are comparable to the estimated biomass within the area covered by the surveys and fishery. This means that recent stock assessments likely underestimated coast wide sardine biomass.

Use of Pacific sardine and northern anchovy for bait in West Coast fisheries makes management of CPS fisheries more complex. Fisheries for live and dead bait are small and market-limited, but essential to valuable recreational party and charter boat fisheries (and some private boats) on the West Coast that target gamefish, rockfish, and salmon. No fishtickets are collected when live bait is "landed" (estimates of landings are extrapolated from voluntary logs kept by a subset of live bait catchers). The live bait fishery generally takes less than 5,000 mt per year (mostly northern anchovy, but with increasing amounts of Pacific sardine in recent years) and is strictly market-limited, because the party and charter boat fishery is market limited. Sardine tend to be rare when anchovy are abundant and vice versa. Thus, the live bait catch is expected to be mostly sardine when sardine are abundant and mostly anchovy when anchovy are abundant. Based on this information , it is reasonable to assume that 2,000 mt per year is an upper bound on the amount of anchovy or sardine that would be caught and marketed as live bait under low biomass conditions.

Fishtickets are available for dead bait landings, but there is uncertainty about disposition (e.g., there is considerable inaccurate and misreporting so that it is difficult to distinguish between landings for human consumption, other uses, and dead bait). In the late 1980s and early 1990s, nonreduction anchovy landings averaged less than 2,000 mt per year. It seems likely, therefore, that less than 2,000 mt of CPS (anchovy and sardine) are landed and used on the West Coast each year as dead bait. Live bait is not exported and cannot be held in storage for extended periods of time. Dead bait, in contrast, is exported and can be kept in freezers for extended periods of time.

4.2.2 Simulation Model

The simulation model used to evaluate MSY control rules for sardine is described in Jacobson and Parrish (in prep.). A summary of its essential features is given below.

For MSY control rule analysis, the performance measures listed above were computed for each control rule and set of FRACTION, CUTOFF, and MAXCAT parameters over 1,000 simulated years. Each thousand year simulation was begun from the estimated stock biomass in 1996. Random numbers affecting errors in simulated biomass estimates, sea surface temperatures, and sardine recruitment were the same in all simulations. This means that random elements in the simulation were the same for all MSY control laws and parameter sets tested.

The model was based on a simple biomass dynamic model for sardine age one and older (Jacobson et al. 1994). The assumed instantaneous natural mortality rate M was 0.4 yr^{-1} and the instantaneous growth rate G was 0.1 yr^{-1} . The growth rate G was a biomass at age weighted average of $G_a=\ln(w_{a+1}/w_a)$ for ages one through five. The weights used to compute the average were proportional to the equilibrium biomass at age with zero fishing mortality. Recruits to the simulated stock at age one were assumed to weigh 80 g. All sardine age one and older were assumed to be fully vulnerable to the fishery and sexually mature.

The simulation model used a Ricker (1975) recruitment model based on sardine spawning biomass and mean sea surface temperatures at Scripps Pier, California (Jacobson and MacCall 1995). Natural variability in the stock-recruitment relationship was included by assuming log normally distributed random errors in the spawner-recruit relationship with standard deviation 0.91 (equal to the standard deviation of residuals from the Ricker model fit to actual data). Temperature data and reproductive success in the simulations were related functionally and autocorrelated so that years of good and bad recruitment success occurred in regimes of approximately a decade. The lag 1 correlation in the simulated temperature data (0.75) was approximately the same as in the actual three season temperature data (0.71). In addition, a weak 60-year cycle in simulated three season temperatures was included, because scale data for sardine indicates cycles in abundance of about 58 years (Baumgartner et al. 1992). Simulated mean three season temperature data were realistic and similar to actual data.

Simulated biomass estimates used to set quotas in the model were imprecise. Measurement errors for biomass estimates used in the simulations to set quotas were lognormally distributed with arithmetic scale CV equal to 60%. Recent sardine biomass estimates for 1997 had an arithmetic scale CV of about 50% (Hill et al. 1998), so a CV for errors in biomass estimates from stock assessments of 50% was assumed in simulations.

Catches in the simulation model were determined by applying the MSY control rule to the biomass estimate. The "quota" catch (based on the MSY control rule) was assumed to be taken exactly by U.S. and Mexican fisheries except when biomass fell to such a low level that a fishing mortality rate larger than 1.0 yr^{-1} would have been required. In addition to the quota catch, 2,000 mt of sardine per year were assumed to be taken as live bait as long as the estimated stock biomass was at least 50,000 mt (50,000 mt was treated as a default definition of an overfished stock). Biomass was never allowed to fall below five mt (a crude estimate of minimum stock size during the 1960s), and recruitment was never allowed to exceed 45 million one-year-old sardine (roughly twice the maximum estimated number of sardine recruits). The constraints on minimum biomass and maximum recruitment had little effect on results.

Changes in growth and fecundity of sardine in response to changes in biomass and environmental factors were not included in the simulation, because too little information was available. This omission was unfortunate, because recent work (Deriso 1993) indicates that variation in growth and fecundity is dramatic in sardine and effects trends in biomass. Recent growth rates, for the period when sardine biomass was low and increasing, were used in simulations. The simulation sardine stock may be more resistant to overexploitation than the real sardine stock, because relatively high recent growth rates were assumed constant over time in simulations.

The simulation model was "validated" by comparing simulated biomass levels to actual biomass estimates for 1935 through 1990. Actual landings, growth rate, and temperature data were used in the historical simulations. Historical biomass estimates and simulated biomass trajectories were similar. In addition, 1,000 year series of simulated biomass levels with no fishing were examined and appeared reasonable.

Results from the simulation model for sardine seemed to be reasonable, but results should not be regarded as precise. The model is most useful for finding patterns in simulated results that can be used to find good MSY control rule options and to evaluate the relative difference among options (e.g., mean catch is higher for option 1 than for option 2). It is not useful for estimating or predicting exact quantities (i.e., biomass next year or average catch over the next decade).

4.2.3 Simulation Model Results

Two types of MSY control rules were investigated for sardine. The first type of MSY control rules used constant FRACTIONs (i.e., FRACTION did not change from year to year). In the second type, FRACTION was a time varying estimate of the MSY exploitation rate estimated from sea surface temperature data (see below) that changed over time. For comparison, a deterministic equilibrium estimate and a stochastic estimate of F_{MSY} were also calculated.

4.2.3.1 Deterministic Equilibrium F_{MSY}

Deterministic equilibrium F_{MSY} was a "lower bound" for the set of potential MSY control rules for Pacific sardine. Deterministic equilibrium F_{MSY} is a traditional approach in which the F_{MSY} fishing mortality rate (or the associated harvest rate) is found that maximizes catch in a hypothetical deterministic stock at equilibrium. In this context, "deterministic" means no stochastic variation in recruitment, constant (i.e., average) spawner recruit parameters and no errors in biomass estimates. "Equilibrium" means after many years when the catch and stock biomass has come to equilibrium and stopped changing.

An estimate of the deterministic equilibrium F_{MSY} for Pacific sardine was calculated by running the simulation model for 1,000 years with a series of constant FRACTIONS between 0.0 and 0.6, with CUTOFF fixed at zero, MAXCAT equal to 100 million tons (effectively infinite), constant average sea surface temperatures at Scripps Pier (17.0° C), and no stochastic variation in biomass estimates or recruitment. The catch and biomass after 1,000 years were the equilibrium values associated with the FRACTION level. The FRACTION level with the highest catch was the harvest rate associated with deterministic equilibrium F_{MSY}.

As described above, the harvest rate associated with deterministic equilibrium F_{MSY} harvest rate was estimated in the simulation model with stochastic variation "turned off." We evaluated its potential performance in a stochastic sardine stock, however, by calculating performance measures (e.g., average catch and biomass) for the deterministic equilibrium F_{MSY} in the simulation model with stochastic variation "turned on."

As shown in Figure 4.2.3.1-1, deterministic equilibrium F_{MSY} for sardine corresponds to a harvest rate (FRACTION) of 8.8% yr^{-1}. Based on the (unrealistic) deterministic model used for calculations, equilibrium catch is 82 thousand mt yr^{-1} and equilibrium biomass is 933 thousand mt. Performance of the deterministic equilibrium F_{MSY} control rule in a more realistic stochastic model is described below.

4.2.3.2 Stochastic F_{MSY}

Stochastic F_{MSY} was the value of FRACTION that maximized average catch in the stochastic simulation model with a CUTOFF of zero and MAXCAT equal to 100 million tons (effectively infinite). Stochastic MSY was calculated by determining the average catch over a thousand years for a series of constant FRACTION values between 0.0 and 0.6. The FRACTION level with the highest catch was the harvest rate associated with stochastic F_{MSY}.

As shown in Figure 4.2.3.1-1, stochastic F_{MSY} for sardine corresponds to a harvest rate (FRACTION) of 12% yr^{-1}. Based on the stochastic model, the average catch at the FRACTION for stochastic F_{MSY} is 180 thousand mt yr^{-1} and the average biomass is 1,408 thousand mt. The differences between the deterministic equilibrium estimate (F_{MSY}=8.8% yr^{-1} with a catch of 82 thousand mt yr^{-1} at a biomass of 933 thousand mt) and stochastic estimate (F_{MSY}=12% yr^{-1} with a catch of 180 thousand mt yr^{-1} at a biomass of 1,408 thousand mt) illustrates the importance of considering stochasticity in management of Pacific sardine.

4.2.3.3 Simulation Model and Results for MSY Control Rules With Constant FRACTION

Simulations with constant (the same during all simulated years within a run) control rule parameters were run with FRACTION ranging from zero to one and with CUTOFF and MAXCAT ranging from zero to 1 million mt. Figures 4.2.3.3-1 to 4.2.3.3-10 give performance measures over the range of FRACTION and CUTOFF levels for MAXCAT values of 100 to 1,000 million mt in steps of 100 thousand mt.

FRACTION was the most important parameter in simulations with the default MSY control rule and most parameter values. Results also show that CUTOFF and MAXCAT can also be important, however, particularly when FRACTION is high. There were wide ranges of parameter values that gave similar results for most parameter values. For example, with MAXCAT=100 in Figure 4.2.3.3-1, there was a wide range of CUTOFF and FRACTION levels that gave average catches between 100 thousand mt and 150 thousand mt per year. Relationships among the performance variables were complex and illustrate the tradeoffs Council must make in choosing a MSY control rule to manage sardine.

MSY is central to Magnuson-Stevens Act requirements. It is, therefore, useful to identify and compare performance of MSY control rule options for sardine that maximize average catch, average log catch, median catch, and minimize the fraction of years with no catch. These options can also be compared to the performance of the status quo control rule used currently for sardine (FRACTION=20%, CUTOFF=50 thousand mt, MAXCAT=400 thousand mt), the deterministic equilibrium F_{MSY} (FRACTION=8.8%, CUTOFF=0, MAXCAT not defined) and stochastic F_{MSY} (FRACTION=12%, CUTOFF=0, MAXCAT not defined) control rules (Table 4.2.3.3-1).

One very surprising result from the simulation model for sardine is that control rule policies that maximize catch, and median catch are "pulse fishery" scenarios that have high FRACTIONs (45% to 100%), high CUTOFFs (975 thousand mt to 1000 thousand mt), and MAXCATs that range from moderate to large (300 thousand mt to 1,000 thousand mt). These options give the highest average catch, but shut the fishery down, (because estimated biomass < CUTOFF) during 37 years to 47 years out of a hundred and give highly variable catches. They are called pulse fishery scenarios, because the fishery operates intensively during pulses that are separated by years with no fishing. Thus, these policies maximize catch, but are not "sustainable" in the sense that the fishery must be often closed. They are of little interest to managers who require some fishing in every year to stabilize revenues and costs.

An important result is that the status quo control rule currently used for sardine performs relatively poorly in terms of both catch and biomass variables. Poor performance in simulations with the status quo control rule is due to the relatively high FRACTION in combination with the relatively low CUTOFF and high MAXCAT.

TABLE 4.2.3.3-1. Performance variables for various MSY control rules with constant FRACTION values. Biomass values are in thousand mt. All control rules except deterministic equilibrium F_{MSY} were evaluated in a stochastic model (see Table 4.2.5-1).

	Maximum Average Catch Policy ("Pulse Fishery")	Maximum Average Log Catch Policy	Maximum Median Catch Policy	Minimum Percent Years With No Catch Policy	Status Quo Policy	Deterministic Equilibrium F_{MSY} Policy in a Deterministic Model (Unrealistic)	Stochastic F_{MSY} Policy
MSY Control Rule Parameter							
FRACTION	45%	10%	100%	many	20%	8.8%	12%
CUTOFF	1,000	0	975	many	50	0	0
MAXCAT	1,000	300	300	many	400	Infinite	Infinite
Performance Variable							
Average Catch	208	159	173	many	151	170	176
Standard Deviation Catch	306	98	142	many	137	153	180
Average Biomass	1,307	1,754	1,675	many	936	1,756	1,332
Std. Dev. Biomass	15	45	30	many	27	44	38
Average Log Catch	3.19	4.79	3.74	many	4.33	4.78	4.66
Average Log Biomass	6.97	7.17	7.16	many	6.24	7.21	6.76
Percent Years With Biomass >400K mt	94%	91%	94%	many	61%	93%	80%
Percent Years With No Catch	47%	0%	37%	0%	5%	0%	0%
Median Catch	16	142	298	many	103	127	123
Median Biomass	1,049	1,449	1,324	many	598	1,499	1,049

4.2.3.4 Simulation Model and Results with FRACTION Dependent on Temperature

It is important to remember that sardine productivity changes substantially in response to long term environmental variation. Favorable conditions for sardine are characterized by warm sea surface temperatures in the Southern California Bight while unfavorable conditions are characterized by cold sea surface temperatures (Barnes et al. 1992). This means that the best MSY control rule in a particular year might depend on ocean conditions. Any single MSY control rule that seems to perform well for sardine over the long term or under "average" condition might actually be too aggressive (too much catch) during periods with unfavorable conditions and too conservative (too little catch) during favorable periods.

In principle, it is possible to adjust MSY control rules for sardine (including all parameters, the definition of overfishing, and the definition of an overfished stock) to account for variations in productivity and carrying capacity due to climate variability. As shown above, FRACTION is probably the most important harvest policy parameter for sardine. Jacobson and MacCall (1995) fit spawner-recruit models to sardine data and estimated F_{MSY} (similar to FRACTION) as a function of average three season sea surface temperatures. The policies explored in this section are based on Jacobson and MacCall (1985) and include FRACTION levels that depend on average three season sea surface temperatures.

The sardine simulation model was modified to evaluate options for making the MSY control rule for sardine depend on ocean conditions. The same basic MSY control rule formula was used in the modified simulation model (i.e., $H = (BIOMASS\text{-}CUTOFF) \times FRACTION_t$ with $H < MAXCAT$), except that $FRACTION_t = F_{MSY,t}$ where $F_{MSY,t}$ was the deterministic equilibrium F_{MSY} corresponding to the mean three season sea surface temperature for year t. Thus, $FRACTION_t$ changed in each year as a function of the temperature that affected recruitment to the fishery in that year.

Deterministic equilibrium $F_{MSY,t}$ values were calculated for a range of average three-season sea surface temperatures at Scripps Pier. The calculations were based on the spawner-recruit relationship in Jacobson and MacCall (1995) and the same assumptions as in the sardine simulation model. To conform without simulation model and current sardine biology, $F_{MSY,t}$ calculations were based on 1+ sardine biomass and recruitment at age one (rather than 2+ biomass and recruitment at age two as in Jacobson and MacCall 1995). Results (Figure 4.2.3.4-1) confirm the estimate of deterministic equilibrium F_{MSY} at average sea surface temperatures described above. In addition, they support the hypothesis in Jacobson and MacCall (1995) that the deterministic equilibrium F_{MSY} is zero under cold water conditions.

For convenience in simulations, the mathematical relationship between $F_{MSY,t}$ and average three surface temperatures between 16.6°C and 18.0°C ($F_{MSY,t}$ < 0 at lower temperatures) was approximated by a regression equation (R^2=100%, Figure 4.2.3.4-2):

$$FMSY = 0.248649805\,T^2 - 8.190043975\,T + 67.4558326$$

where T is the average three-season sea surface temperature at Scripps Pier, California during the three preceding seasons. The range of predicted $F_{MSY,t}$ for 16.6°C to 18°C was 0-0.62 yr^{-1}. In simulations, $F_{MSY,t}$ at temperatures < 16.6°C were zero. The warmest observed three-season temperature at Scripps Pier was 18.1°C which corresponds to $F_{MSY,t}$=0.88 yr^{-1}. In simulations, $F_{MSY,t}$ never exceeded this value.

Average temperatures in years t-1 to t-3 were used in the simulations to estimate $F_{MSY,t}$ and FRACTION in year t, because managers could not know the temperature for the same year in which a harvest guideline or quota was being set. This type of "measurement error" in sea surface temperature data is unavoidable likely unimportant, because average three-season temperatures tend to be similar from one year to the next. Another type of error due to using an equilibrium estimate of $F_{MSY,t}$ in place of FRACTION may be more important, because environmental conditions in the simulation model and actual stock vary over longer periods of time (see above). In practice, the exploitation rate used by managers will always be wrong to the extent that environmental conditions change as cohorts age. These are topics for future research,

As described above, the range of $F_{MSY,t}$ values based on historical temperature data was 0-0.88 yr^{-1}, and the corresponding range of observed average three-season sea surface temperatures was 16.1°C to 18.1°C. Based on historical temperature data, temperatures and $F_{MSY,t}$ values might range from maximum to minimum values over periods as short as a decade (Figure 4.2.3.4-3). To eliminate drastic swings in FRACTION (which could be disastrous to the fishing industry) and to avoid very large short term harvests during productive periods with high biomass (that might result in overcapitalization), $F_{MSY,t}$ harvest rates in simulated control rules were constrained to two alternate ranges. In one set of simulations, the range for $F_{MSY,t}$ (ten percent to 30%) was centered on the status-quo FRACTION=20%. In the second set of simulations, the range for $F_{MSY,t}$ (five percent to 25%) was centered on 15%, which is close to the stochastic F_{MSY}=0.12 yr^{-1} described above. The ranges used to constrain $F_{MSY,t}$ and FRACTION values were, in effect, additional parameters in the control rules that we evaluated by simulation.

Potential advantages in using a temperature-dependent FRACTION were evaluated by comparing performance over a range of CUTOFF and MAXCAT values for FRACTION = 20% and $FRACTION_t = F_{MSY}$ ($F_{MSY,t}$ constrained to ten percent to 30%, graphs not shown). For most performance measures, there were combinations of CUTOFF and MAXCAT where FRACTION=20% outperformed $FRACTION_t=F_{MSY}$ and vice-versa. Control rules with $FRACTION_t=F_{MSY}$ tended to perform better than control rules with FRACTION=20% as the harvest rule became more aggressive (i.e., had lower CUTOFF and higher MAXCAT values). Over the range of MAXCAT and CUTOFF values generally considered for sardine, results for control rules with $FRACTION_t= F_{MSY,t-1}$ were almost always better.

Control rule options for sardine can also be compared by plotting average catch versus average biomass, and median catch versus median biomass for all three types of control rules (constant FRACTION in the range five percent to 30%, temperature-dependent FRACTION in the range ten percent to 30%, and temperature-dependent FRACTION in the range five percent to 25%). For each type of control rule, runs with a wide range of other control rule parameter values (CUTOFF zero mt to 400 thousand mt and MAXCAT zero mt to 400 thousand mt) were plotted (Figure 4.2.3.4-4). Results suggest a very wide range of options for MSY control rules that would provide both high catches and relatively high sardine biomass.

4.2.4 Ancillary Options

Options not directly linked to the MSY control rule for sardine (including options for defining an overfished sardine stock and handling the live bait fishery) are described below.

4.2.4.1 Biomass Threshold Definition for Overfished Stocks

These options specify operational definitions of an overfished sardine stock. The operational definitions are all in terms of biomass thresholds. The underlying conceptual definition of an overfished stock based on National Standard 1 is given in Section 4.0.4.

Option 1 does not define a biomass threshold for sardine. Fishing at the ABC level calculated using the MSY control rule (or a reduced level designed to rebuild the stock) is allowed at all biomass levels.

Option 2 defines an overfished sardine population as one with an 1+ stock biomass on July 1 of 50,000 mt or less. No directed fishing is allowed in any year or season while the stock is overfished. The Council is required to minimize fishing mortality on an overfished stock to the extent practical and to undertake a rebuilding program which may be implicit to the MSY control rule or explicit.

Option 3 defines an overfished sardine population as one with an 1+ stock biomass on July 1 of 100,000 mt or less. No directed fishing is allowed in any year or season when the stock is overfished. The Council is required to minimize fishing mortality on an overfished stock to the extent practical and to undertake a rebuilding program which may be implicit to the MSY control rule or explicit.

4.2.4.1.1 Options and Analysis

The Council chose Option 2. The operational definition of an overfished stock in Option 2 (50,000 mt) is the same as the CUTOFF parameter in the control rule currently used by California to manage the sardine fishery. Thus, Option 2 is essentially status quo.

The 50,000 mt threshold definition of an overfished stock should have little effect on expected catches or biomass, because the MSY control rule options for sardine (see below) have CUTOFF parameters with 50,000 mt as a lower bound (see below). Thus, fishing is expected to be precluded at estimated stock biomass levels as low as 50,000 mt based on the MSY control rule alone. The 50,000 mt threshold does, however, provide an extra margin of protection for the stock, because the MSY control rule could not be changed to allow fishing at lower biomass levels without changing the definition of overfishing.

The 50,000 mt threshold definition for an overfished sardine stock is more conservative than required under the Magnuson-Stevens Act. A 100,000 mt threshold definition of an overfished stock is more conservative yet and would preclude even small amounts of catch at biomass levels that have supported the California fishery in recent years while the stock was increasing at about 40% per year, on average.

None of the overfished stock options would not be enough, in themselves, to ensure rebuilding of an overfished stock in less than ten years on average. Rebuilding programs would be implemented implicitly in the MSY control rule or explicitly by the Council when a stock becomes overfished.

Both the 50,000 mt and 100,000 mt thresholds are biomass levels that can be measured to a reasonable level of precision by a variety of methods.

4.2.4.2 Live Bait Harvest Between the Definition of Overfishing and CUTOFF

These options concern operation of the small but important live bait fishery for sardine at biomass levels between the definition of an overfished stock and the CUTOFF. The options are relevant only if the Council adopts a threshold definition for an overfished sardine stock and a CUTOFF that is higher than the overfished stock threshold. The question addressed by these options is whether the live bait fishery should be allowed to operate when estimated biomass falls below the CUTOFF (and other directed fishing is precluded), but is still above the definition of an overfished stock.

Option 1 does not allow the live bait fishery to harvest sardine when the estimated sardine biomass is lower than the CUTOFF, but above the threshold definition of overfishing.

Option 2 allows the live bait fishery to harvest sardine when the estimated sardine biomass is lower than the CUTOFF, but above the threshold definition of overfishing. This option does not prevent the Council from undertaking any measure authorized under this FMP that may be necessary to manage the live bait fishery and sardine stock. The live bait fishery could, for example, be managed by harvest guideline or quota, season or gear restrictions at any point under the framework management process.

4.2.4.2.1 Options and Analysis

The Council chose Option 2. As described above, the live bait fishery is small, but economically important, because it supplies necessary bait to valuable recreational fisheries along the West Coast. The live bait fishery is market limited and is unlikely to increase in size. Sardine catch in the live bait fishery is expected to be less than 2,000 mt per year and is likely to be much smaller when stock biomass is low and other species (e.g., anchovy) are available. Option 2 does not preclude the Council's ability to close or manage the live bait fishery under normal procedures or any conditions if the need arises. All of the MSY control rule options discussed below were simulated assuming a constant live bait catch of 2,000 mt per year.

4.2.5 Maximum Sustainable Yield Control Rule Options for Sardine

There were an infinite number of options that would meet the requirements of the Magnuson-Stevens Act. A number of secondary considerations were, therefore, used to narrow the range of potential options for further consideration. In particular, options for the sardine MSY control rule for sardine were chosen to :

1. Give comparable or higher biomass and catch than the status quo and deterministic equilibrium F_{MSY} control rules (this is a restatement of a key requirement in the Magnuson-Stevens Act and National Standards). Biomass and catch were measured in terms of both averages and medians.
2. Give an expected or "average" time of ten years or less for rebuilding an overfished stock (this is a restatement of a key requirement in the Magnuson-Stevens Act and National Standards).
3. Minimize the percentage of years with no catch due to estimated biomass less than the CUTOFF (in simulations, CUTOFF was assumed to be larger than or equal to the threshold definition of an overfished stock).
4. Minimize changes in control rule parameters from the status quo.
5. Have relatively low CUTOFF and high FRACTION values.
6. Have MAXCAT high enough to allow substantial harvests and revenues in the U.S. fishery when sardine are abundant without risk to the stock, without generating extreme variability in ABC levels, and without encouraging overcapitalization during short periods of very high catch levels.

In priorities 1 through 3 listed above, biomass gets higher priority than catch, because sardine are a key forage species in the California Current Ecosystem utilized extensively by fish, bird, and marine mammal predators that include endangered and threatened species.

Priorities 4 through 6 address priorities suggested by the CPS Advisory Subpanel. They stem from an interest in maintaining a predictable and consistent flow of catch and revenues over time. The pulse fishery control rule that maximized average catch (see above) was excluded as an option on this basis, because the variance in catch and percent years with no fishery were unacceptably high, and the median catch was very low.

Thirteen options (options A through M) for the sardine MSY control rule were developed (Table 4.2.5-1, Figures 4.2.5-1 and 4.2.5-2). In all options, sardine biomass used in the control rule to specify harvest levels in season t beginning July 1 is the estimated biomass at the beginning of season t-1.

TABLE 4.2.5-1. MSY control rule options for Pacific Sardine. All options evaluated in a stochastic model.

	Option A (Status Quo)	Option B	Option C	Option D	Option E	Option F	Option G	Option H	Option I	Option J	Option K	Option L (Stochastic F_{MSY})	Option M (Determ. Equil. F_{MSY} in a Stochastic Model)
Overfishing Definitions													
Overfishing Rate	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC
Overfished Threshold (mt)	50	50	50	50	50	50	50	50	50	50	50	50	50
Control Rule Parameters													
FRACTION	20%	F_{MSY} (10-30%)	20%	F_{MSY} (10-30%)	F_{MSY} (10-30%)	F_{MSY} (5-25%)	F_{MSY} (5-15%)	F_{MSY} (5-15%)	F_{MSY} (5-25%)	F_{MSY} (5-15%)	F_{MSY} (10-30%)	12%	8.8%
CUTOFF	50	50	100	100	100	100	100	100	100	150	50	0	0
MAXCAT	400	400	400	400	300	400	400	300	300	200	200	Infinite	Infinite
Performance Measure													
Average Catch	151	159	165	171	165	177	179	169	169	145	141	180	170
Std. Dev. Catch	137	140	140	143	113	143	133	105	112	67	72	180	153
Mean Biomass	936	964	1,073	1,091	1,280	1,216	1,543	1,665	1,400	1,952	1,516	1,408	1,784
StdDev Biomass	27	27	29	28	34	32	39	42	37	49	43	39	43
Mean Log Catch	4.33	4.46	4.44	4.54	4.64	4.62	4.77	4.80	4.70	4.76	4.65	4.72	4.77
Mean Log Biom	6.24	6.37	6.50	6.59	6.75	6.74	7.06	7.15	6.89	7.34	6.87	6.89	7.24
Percent Years Biomass>400	61%	64%	70%	73%	79%	81%	90%	92%	84%	96%	79%	84%	93%
Percent Years No Catch	5%	2%	7%	4%	3%	2%	1%	0%	1%	0.5%	1%	0%	0%
Median Catch	103	104	119	121	148	131	140	156	158	182	188	128	127
Median Biomass	598	600	700	748	898	850	1,248	1,349	1,048	1,648	1,099	1,500	1,049

4.2.5.1 Analysis

As described above, the control rule that maximizes average catch is a pulse fishery approach with a very high CUTOFF, MAXCAT, and FRACTION that was not included as an option, because the percentage of years with no catch was very high (47%). To develop options that were not pulse fisheries, but gave relatively high catch and biomass levels, it was necessary to reduce the CUTOFF and MAXCAT levels. In addition, it is necessary to reduce FRACTION and/or make it temperature-dependent (Figures 4.2.5-1 and 4.2.5-2).

The deterministic equilibrium F_{MSY} Option M (with parameters chosen based on a deterministic model) performed surprisingly well in the more realistic stochastic model. It had nearly the highest average biomass and relatively high average catch levels. Median biomass was also high, but median catch was relatively low. Option M performed well in terms of biomass, because of the low FRACTION (8.8% per year).

As described above, deterministic equilibrium F_{MSY} (Option M) is the lower bound on the family of acceptable MSY control rules for sardine. The goal was to find options that performed as well or better in terms of biomass and catch levels. Based on these criteria, options A through F (which include the status quo Option A and several variations on the status quo) are not recommended. Options G through L, which include stochastic F_{MSY} (Option L) and temperature-dependent control rules seem to give biomass and catch levels that are comparable to deterministic equilibrium F_{MSY} levels. Two factors make it difficult to choose amongst options G through L in terms of performance (but see discussion of the CUTOFF below). The first factor is uncertainty in results from the simulation model. The second factor is uncertainty about which performance variables are most important to policy makers (e.g., average biomass or median biomass). Options G through L are, in effect, designed to maximize different performance variables or combinations of performance variables.

In making decisions about MSY control rules for sardine, it is important to remember that results from the simulation model may overstate potential benefits of a temperature-dependent MSY control rule, because the nature of the relationship between the environment and sardine productivity is uncertain in the real world, but assumed known with certainty in the simulation analyses. This is a topic for future research.

4.2.5.2 The CUTOFF for Sardine

The simulation model demonstrates that it is possible to obtain good results "on average" with a CUTOFF of 50 thousand mt, but it is important to remember sardine productivity changes substantially in response to decadal scale environmental variation. An ABC harvest rate based on any MSY control rule might be too high in some years during unproductive conditions and too low in some years during productive conditions. The CUTOFF parameter used in MSY control rules for sardine and options for adjusting FRACTION based on environmental conditions tend to mitigate this problem, because the ABC harvest rate (catch/biomass) is reduced as biomass declines. These benefits from CUTOFF increase with larger CUTOFF values.

In considering the importance of the CUTOFF parameter in simulations for sardine, it is important to remember that (1) simulation and other analyses (Jacobson and MacCall 1995; Soutar and Isaacs 1974) indicate that low sardine biomass levels may occur even in the absence of a fishery; and (2) the simulation analysis assumed that the whole stock is managed according to the MSY control rule (i.e., harvests in U.S. and Mexican waters do not exceed the ABC harvest level calculated using the MSY control rule). CUTOFF levels in the sardine fishery may be very important in the short term while sardine biomass is low or if lack of cooperative management with Mexico or Canada results in over harvest and increased frequency of low sardine biomass levels.

A simple compound interest model is one way to appreciate the importance of CUTOFF for sardine, particularly in rebuilding overfished stocks. During 1983 through 1996, a period of favorable environmental conditions, sardine biomass increased at an average rate of about 30% per year. The actual rate of biomass production was probably higher (about 40%), because some fishing occurred. Spawning biomass in 1983 was about 5,000 mt, and biomass in 1997 was about 500,000 mt. The average biomass under MSY control rule options G through L in Table 4.2.5-1 are all around 1.5 million mt. For the sake of discussion, assume that the MSY biomass for Pacific sardine is about 1.5 million mt.

Results (Table 4.2.5.2-1) from the simple compound interest simulation model assuming various levels of biomass in 1983 and a compound interest rate of 40% show how much larger current biomass (estimated to be about 500 thousand mt in 1997) might have been if a management measure similar to CUTOFF had been used in managing the historical sardine fishery.

The compound interest model analysis (Table 4.2.5.2-1) also shows how important CUTOFF is in rehabilitation programs for overfished sardine stocks. Note that a stock starting at five thousand mt (in effect, CUTOFF=5,000 mt) is not rebuilt to its MSY biomass level after fourteen years under high productivity conditions with no fishing. In contrast, stocks starting at 50, 100, and 400 thousand mt are rebuilt in ten, eight, and four years. The model demonstrates that "seed stocks" of 50,000 mt to 100,000 mt are likely required to achieve MSY biomass levels for sardine in ten years, even under very productive conditions. CUTOFF and threshold overfishing levels of 50,000 mt to 100,000 mt or higher would probably have increased the probability of a ten-year period of recovery in the actual sardine stock. Given that some fishing would occur as a real sardine stock was rebuilt, a CUTOFF of at least 100,000 mt might be necessary to accommodate the ten years to MSY biomass requirement in the National Standards.

4.2.5.3 Recommended Options

The CPS FMP Development Team recommends Options G through K in Table 4.2.5-1, because they give biomass and catch levels comparable or better than the deterministic equilibrium F_{MSY} Option L, and because they all have CUTOFFs greater than 50,000 mt. Options with CUTOFF = 50,000 mt might not include an implicit rebuilding program for overfished stocks that meets the ten years to MSY biomass requirement in the National Standards. As shown in the compound interest rate simulation model (see above), ten years might be required to rebuild the sardine stock from a 50,000 mt CUTOFF with no fishing. More than ten years might be required if fishing is carried out while the stock is rebuilding. It is important to remember, however, that an implicit rebuilding program is not required under the Magnuson-Stevens Act nor the National Standards. If an option with CUTOFF=50,000 mt were adopted and if the stock became overfished, it would still be possible for Council to develop an explicit rebuilding program that would meet all legal requirements.

TABLE 4.2.5.1-1. Simple compound interest model for sardine assuming 40% increase per year. The assumed MSY biomass levels are in *italics and bold.*

	Start at 5,000 mt	Start at 50,000 mt	Start at 100,000 mt	Start at 400,000 mt
1983	5,000	50,000	100,000	400,000
1984	7,000	70,000	140,000	560,000
1985	9,800	98,000	196,000	784,000
1986	13,720	137,200	274,400	1,097,600
1987	19,208	192,080	384,160	***1,536,640***
1988	26,891	268,912	537,824	
1989	37,648	376,477	752,954	
1990	52,707	527,068	1,054,135	
1991	73,789	737,895	***1,475,789***	
1992	103,305	1,033,052		
1993	144,627	***1,446,273***		
1994	202,478			
1995	283,470			
1996	396,857			
1997	555,600			

4.3 Pacific (Chub) Mackerel

Pacific (chub) mackerel are a mainstay of the current CPS fishery and are fully utilized by fisheries in the U.S. and Mexico. Recent biomass estimates for Pacific (chub) mackerel are uncertain, because reliable indices of relative abundance are not available for tuning virtual population analyses used to assess the stock (Jacobson 1993). In contrast, historical estimate of Pacific (chub) mackerel biomass at low and moderate biomass levels (Yaremko et al. 1997) are reliable, because of convergence in virtual population analysis abundance estimates (Pope 1972). Work is currently underway to develop indices of abundance for Pacific (chub) mackerel and refine assessment models.

4.3.1 Current Management

Pacific (chub) mackerel are currently managed by the state of California. If the estimated biomass is greater than 135,000 mt, then the U.S. commercial catch is not restricted by a quota. If the biomass is between 18,200 mt and 135,000 mt, then a quota for U.S. fishers equal to 30% of the biomass above 18,000 short tons is applied. If the biomass is below 18,200 mt, commercial fishing in the U.S. stops. Thus, the status quo for Pacific (chub) mackerel is similar to a CUTOFF of 18,200 mt and FRACTION of 30%. Current regulations focus on U.S. harvests because they were developed when Mexican catches of Pacific (chub) mackerel were insignificant. In the last few years, however, catches in the U.S. and Mexico have been roughly equal and the same stock is exploited by fisheries in both countries.

4.3.2 Options

The only option for MSY control rule parameters in the Pacific (chub) mackerel fishery is a modification of the status quo. The net effect of the modification, which involves allocating total harvest between the U.S. and Mexico and limiting catches at high biomass levels, is a more conservative harvest policy. An essentially status quo approach is recommended, because the current approach is based on an analysis of historical biomass estimates (MacCall et al. 1985) that is still considered valid. It is not possible to substantially improve the analysis of historical data at this time, because recent biomass estimates are uncertain, and because staff time to conduct the analysis is not available. Improvements should be possible once a satisfactory index of relative abundance and stock assessment model are developed.

4.3.3 Recommended Option

A CUTOFF and definition of overfishing at 18,200 mt and FRACTION of 30% are recommended for Pacific (chub) mackerel. Under this option, overfishing is defined as any fishing in excess of ABC calculated using the MSY control rule. An overfished stock is defined to be one whose estimated or projected biomass is 18,200 mt or less. Fishing mortality must be reduced to the extent practical in overfished stocks. No MAXCAT is defined, because MAXCAT was not included in MacCall et al.'s (1985) simulation analysis, and because the U.S. fishery appears to limited to about 40,000 mt per year by markets. The option differs from the status quo in that a target harvest level is defined for the entire stock (not just the U.S. portion), and the target harvest level is defined for biomass levels above 135,000 mt. The recommended definition of overfishing for Pacific (chub) mackerel (18,200 mt) is lower than for sardine, because mackerel are not important as forage and there is little need to maintain a forage reserve.

The advantages of this option are that it is consistent with current management and provides a good balance between the fishery and protecting the long term productivity of the stock. A disadvantage is that harvest guidelines or quotas for U.S. fishers will be lower than recent quotas set by CDFG after harvest levels are prorated by the portion in U.S. waters. Total target harvest levels, U.S. harvest levels, and annual exploitation rates over a range of biomass levels are given in Table 4.3.3-1.

The option recommended for Pacific (chub) mackerel is consistent with the goals and objectives listed in the FMP. In particular, it attempts to manage CPS throughout their range (despite the lack of a management agreement with Mexico), achieves OY, prevents overfishing, and uses resources spent on management of CPS efficiently.

TABLE 4.3.3-1. Summary of total harvest, U.S. harvest, and annual exploitation rates for a range of Pacific (chub) mackerel biomass levels under the recommended MSY control rule and definition of overfishing option. Biomass and harvest levels are in mt. The annual exploitation rate differs from FRACTION (25%), because FRACTION is applied to the biomass minus the CUTOFF.

Biomass	Total Harvest	U.S. Catch*	Annual Exploitation Rate
10,000	0	0	zero percent
20,000	540	378	three percent
30 000	3,540	2,478	12%
40,000	6,540	4,578	16%
50,000	9,540	6,678	19%
60,000	12,540	8,778	21%
70,000	15,540	10,878	22%
80,000	18,540	12,978	23%
90,000	21,540	15,078	24%
100,000	24,540	17,178	25%
200,000	54,540	38,178	27%
400,000	114,540	80,178	29%
500,000	144,540	101,178	29%
600,000	174,540	122,178	29%

* Assuming 70% of stock in U.S. waters

4.4 Monitored Stocks

Northern anchovy (northern and central subpopulations), jack mackerel, and market squid will be Monitored at the outset of the CPS FMP. Default MSY control rule and overfishing specifications are recommended for use with these Monitored stocks.

MSY catch and biomass estimates used to calculate ABC and overfishing definitions based default MSY control rule parameters are summarized below. Details are given on a species-by-species basis in the sections that follow. As for other CPS, MSY catch should be viewed as a rough indicator of stock productivity and long-term average harvest potential rather than as a management goal, because stock size and potential catches may vary dramatically from year to year (Beddington and May 1977).

Recommended ABC levels and overfishing definitions for Monitored species based on the default MSY control rule

Species and Stock	ABC for Entire Stock	ABC in U.S. Waters
Northern Anchovy (Northern Subpopulation)	25% of MSY catch (MSY catch not available)	not available
Northern Anchovy (Central Subpopulation)	31,000 mt yr^{-1}	25,000 mt yr^{-1}
Jack Mackerel	48,000 mt yr^{-1}	31,000 mt yr^{-1}
Market Squid	25% of MSY catch (MSY catch not available)	not available

The recommended ABC and overfishing definitions for CPS stocks that are Monitored are compatible with the Magnuson-Stevens Act and with the goals and objectives of the CPS FMP. In particular, they promote full fishery utilization based on ecosystem based principles, help achieve OY, provide adequate forage for dependent species, and prevent overfishing.

4.4.1 Northern Anchovy-Central Subpopulation

MSY for northern anchovy in the central subpopulation is estimated to be 123,000 mt per year at a total biomass level of about 733,000 mt (Conrad 1991). The recommended default MSY control rule gives an ABC for the entire stock equal to 25% of 123,000 mt or 31,000 mt.

Data in Section 4.1.3.2 indicate that about 82% of the stock is resident in U.S. waters. ABC in U.S. waters is, therefore, 82% of 31,000 mt or 25,000 mt.

Northern anchovy (central subpopulation) support negligible amounts of fishing at this time, but the stock is important as forage for many predators. A stock assessment model, catch (U.S. and Mexico), and abundance data (from CalCOFI surveys and fishspotters) are available (Jacobson et al. 1994). It would, therefore, be advisable to assess the status of the central subpopulation of northern anchovy on some periodic basis.

4.4.2 Northern Anchovy-Northern Subpopulation

The northern subpopulation of anchovy ranges from San Francisco north to British Columbia with a major spawning center off Oregon and Washington that is associated with the Columbia River plume. The northern subpopulation supports small, but locally important, bait fisheries and is likely an important source of forage to local predators, including depleted and endangered salmonid stocks.

The recommended default MSY control rule gives an ABC for the entire stock equal to 25% of MSY catch, but MSY catch has not been estimated. The portion of the northern subpopulation of northern anchovy resident in U.S. waters is unknown. It is likely that some biomass occurs in Canadian waters off British Columbia. ABC is U.S. waters cannot be calculated at this time.

Spawning biomass estimates for an area off Oregon and Washington during 1975 through 1976 based on the "Smith Larva Method" (Smith 1972) ranged from 737,000 mt to 1,005,263 mt (Richardson 1981). These estimates, based on abundance of anchovy larvae, are too high, because anchovy were erroneously assumed to spawn only once per season. Estimates of spawning biomass from the Smith Larva Method for the central subpopulation during 1964 through 1966 (Smith 1972), were about 8.6 times larger on average than more recent estimates (Lo and Methot 1989). Thus, an educated guess for spawning biomass in the northern subpopulation during 1975 through 1976, based on estimates from the Smith Larva Method and a correction factor of 8.6, is 87,000 mt to 116,000 mt. Landings of anchovy in Oregon and Washington are small (generally less than 60 mt/year) and small relative to the revised estimates of spawning biomass. However, anecdotal information and limited published accounts (Bentley et al. 1994) indicate that biomass of anchovy in the northern subpopulation may have declined in recent years.

Given the likely importance of northern anchovy in the northern subpopulation to predators, it is recommended studies currently underway to estimated biomass and productivity be continued.

4.4.3 Jack Mackerel

Although there is little evidence of subpopulations, small jack mackerel (10 cm to 30 cm FL, and up to eight years of age) are most abundant in the Southern California Bight, where they are often found near the mainland coast and islands and over shallow rocky banks. Ages 0.5 through eight are harvested by the inshore fishery off southern California. Older, larger fish (50 cm to 60 cm FL and 16 years to 30 years) range from Cabo San Lucas, Baja California, to the Gulf of Alaska, where they are generally found offshore in deep water and along the northern coastline. Large fish rarely appear in southern inshore waters. Fish of intermediate lengths (30 cm to 50 cm TL; nine years to 15 years of age) were recently found in considerable numbers around the 200-mile limit of the U.S. exclusive economic zone off southern California (SWFSC 1991).

Estimates of average potential yield (a proxy for MSY, see Gulland 1970 and MacCall and Stauffer 1983) are ranges stratified by area and age. Potential yield of jack mackerel is not meant to be an estimate of sustainable harvest but, rather, an interim limit for catches while data sufficient for management are accumulated.

Recommended ABC levels for jack mackerel was calculated by age/area from mid-range potential yield values. Data in Section 4.1.3.2 indicate that about 65% of the stock is resident in U.S. waters and ABC in U.S. waters was prorated accordingly. If jack mackerel catches increase and become significant, managers will have to decide whether to address management of different age groups and areas independently. The question does not need to be addressed at this time, because catches are low (generally less than 2,000 mt per year since 1990).

Ages (Years)	Potential Yield (thousand mt)	ABC (thousand mt)	ABC in U.S. Waters (thousand mt)
0-8	95-191	36	23
9-15	22-45	8	5
16-30	11-24	4	3
Total	128-260	48	31

4.4.4 Market Squid

The recommended default MSY control rule gives an ABC for the entire stock equal to 25% of MSY catch, but MSY catch has not been estimated. The portion of the market squid stock resident in U.S. waters is unknown. It is likely that some biomass occurs in Mexican waters off Baja California and Canadian waters off British Columbia. ABC is U.S. waters cannot be calculated at this time.

Monitored management is the preferred option for market squid, because of variability and recent low landings, current conditions in the fishery, and uncertainty about squid productivity. Historically, market squid landings in California were modest and too small to affect abundance (Appendix A, sections 1.5.4-1.5.5). Squid landings increased briefly to record levels in the late 1990s as new markets with higher prices developed in Asia, but declined to current low levels following the 1997/1998 El Niño and onset of poor economic conditions and markets in Asia. It is not known whether the markets are likely to recover in the near future and support a significant fishery for market squid.

Basic information about life history and fisheries biology is not yet available for market squid (Appendix A, Section 1.5). Biologists have no information about the stock's size and productivity. In addition, there is no reliable information about growth and maturity that could be used to manage yield or spawning biomass per recruit. Fishing grounds in shallow water (50 m) spawning grounds are known, but the total area of squid spawning grounds (which extend to over 800 m depth) is uncertain so that the potential benefits of area closures are impossible to gauge. With no information about current biomass or productivity and uncertain markets, it is impossible to judge potential benefits of arbitrary precautionary limitations on catch levels that are recommended by Restrepo et al. (In press).

Scientific research currently underway, improvements to squid port sampling, and the moratorium on new squid permits under California state law (Appendix A, Section 1.5.5) constitute a plan for stock assessment and close monitoring of fishing effort that will make it possible to manage the market squid fishery if conditions change and Active management is required. CDFG is using funds provided by industry under the state license moratorium plan to develop port sampling programs and to coordinate a focused and intensive three year research program involving state, federal, and academic biologists. Studies underway involve port sampling, age and growth, reproductive biology, stock structure, distribution and habitat utilization, location of fishing areas, characteristics of spawning areas, and means to measure and track trends in squid abundance. State law directs CDFG to develop and recommend fishery management options to the state legislature for the squid fishery management in the year 2001.

Council makes decisions about Active and Monitored management for CPS annually based on socioeconomic framework management procedures (Section 2.2.1.2). State managers under state law and federal managers under this FMP can be expected to manage the fishery intensively when sufficient data indicate a need.

Council and state authorities will continue to monitor squid landings while research continues. If landings increase or a biological risk to the stock develops, Council can be expected to promote squid to Active management quickly under the "point of concern" framework management procedures (Section 2.2.1.2).

Figure 4.1.2-1. General MSY control rule formula for CPS with no MAXCAT (CUTOFF=10% Virgin Biomass, FRACTION=20%). Note that harvest rate is always less than FRACTION and declines with biomass.

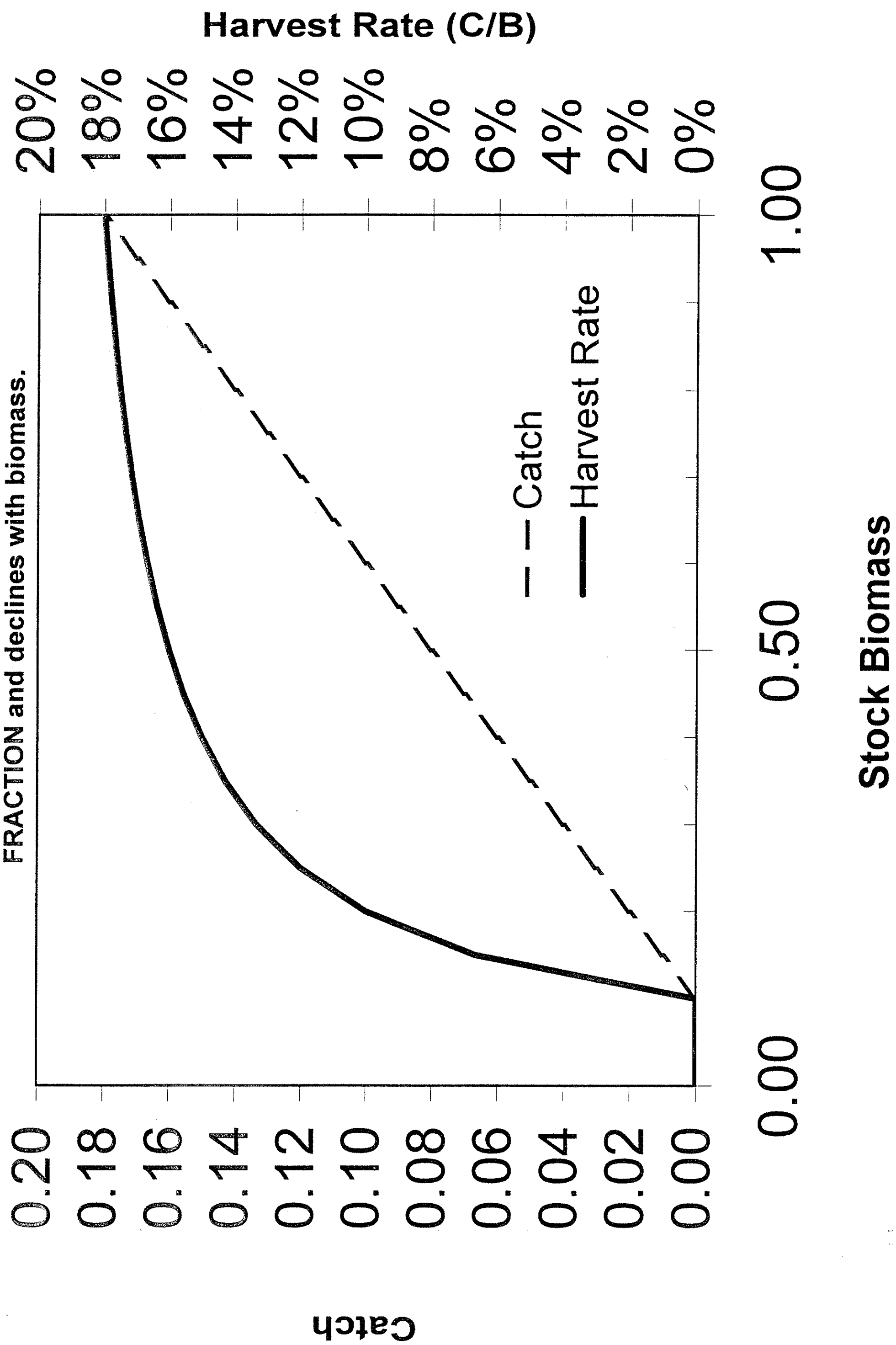


Figure 4.1.2-2. General MSY control rule formula for CPS with MAXCAT=0.10. Note that catch increases with biomass up to MAXCAT, the harvest rate is always less than FRACTION and declines at both high and low biomass levels.

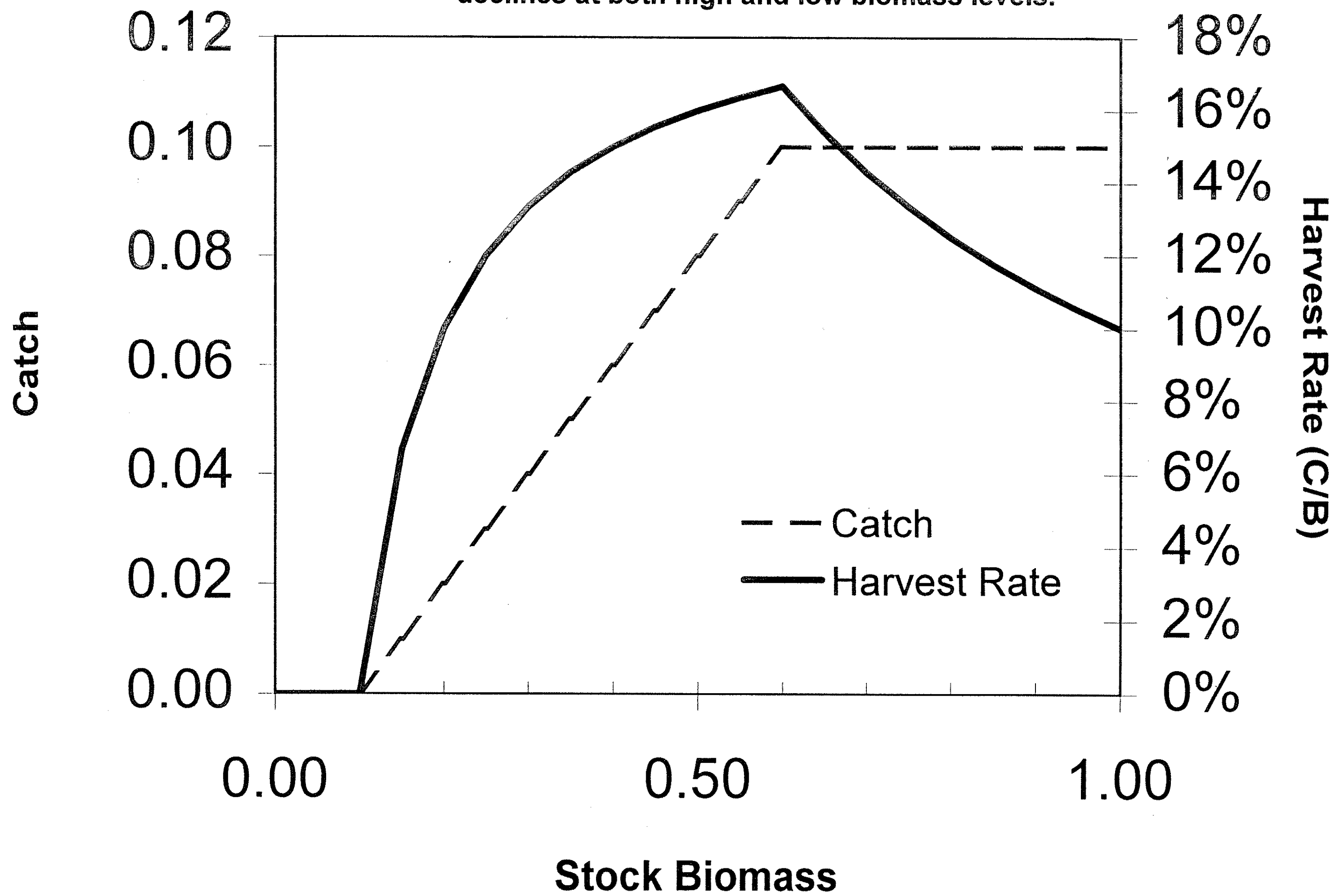


Fig. 4.1.4.1-1. Log catch and log biomass are "convex", risk averse performance measures.

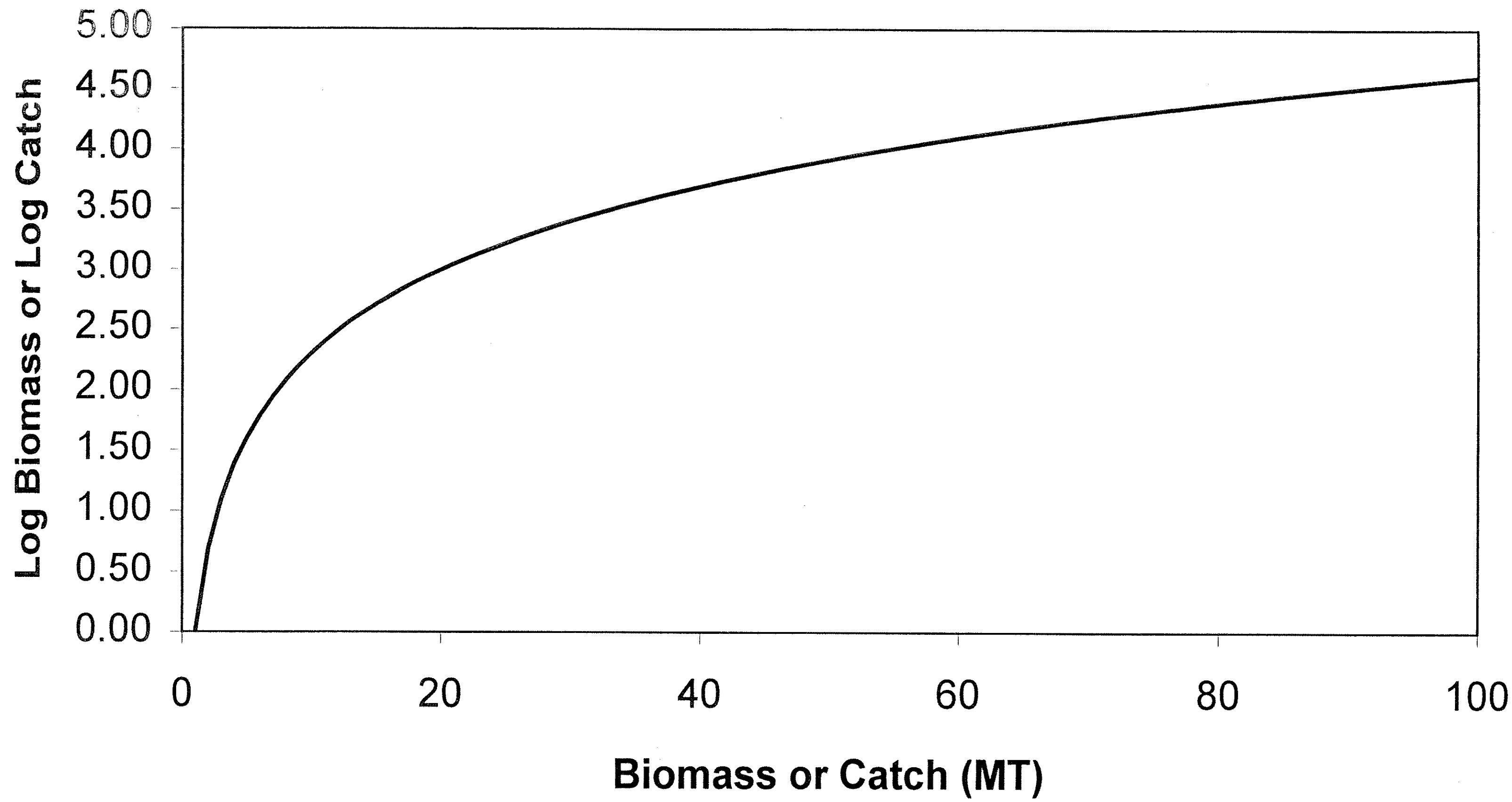


Figure 4.1.4.1-2. Simulated Catches from an MSY Control Rule

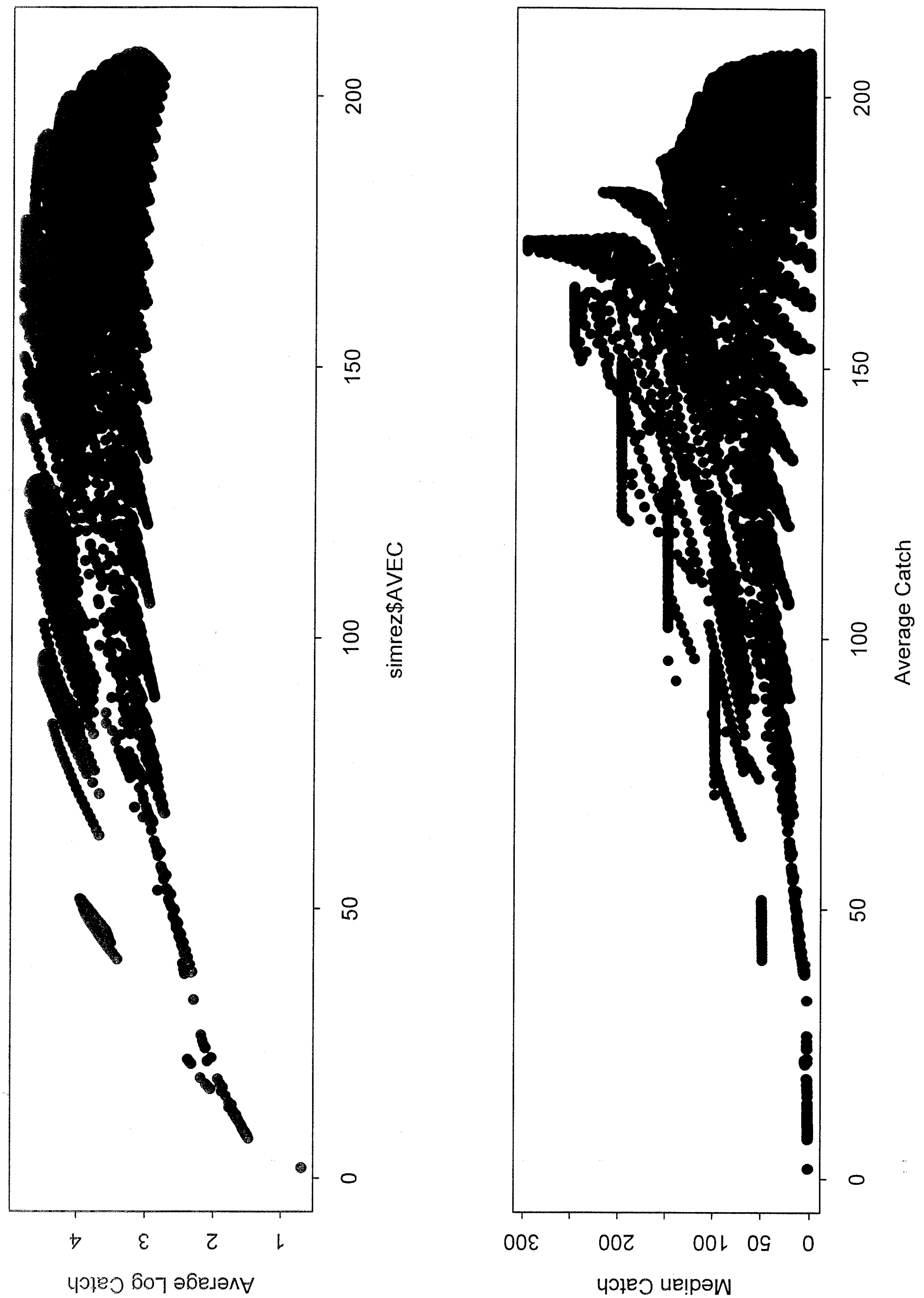


Figure 4.2.3.1-1. Deterministic equilibrium Fmsy (evaluated in a deterministic model) and stochastic Fmsy (evaluated in a stochastic model) for Pacific sardine.

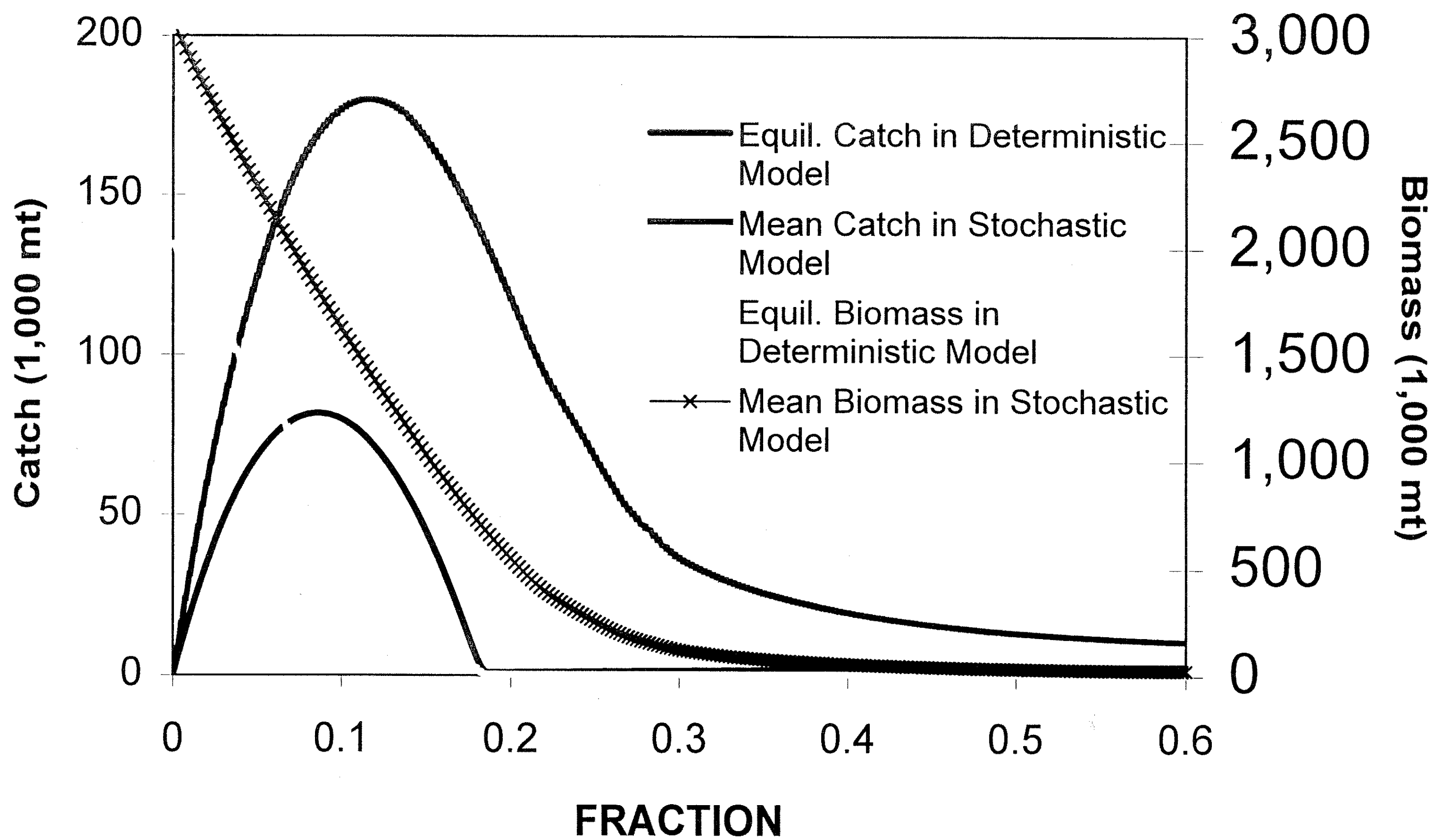


Fig. 4.2.3.3-1. Average Catch - Constant Fraction MSY Rule

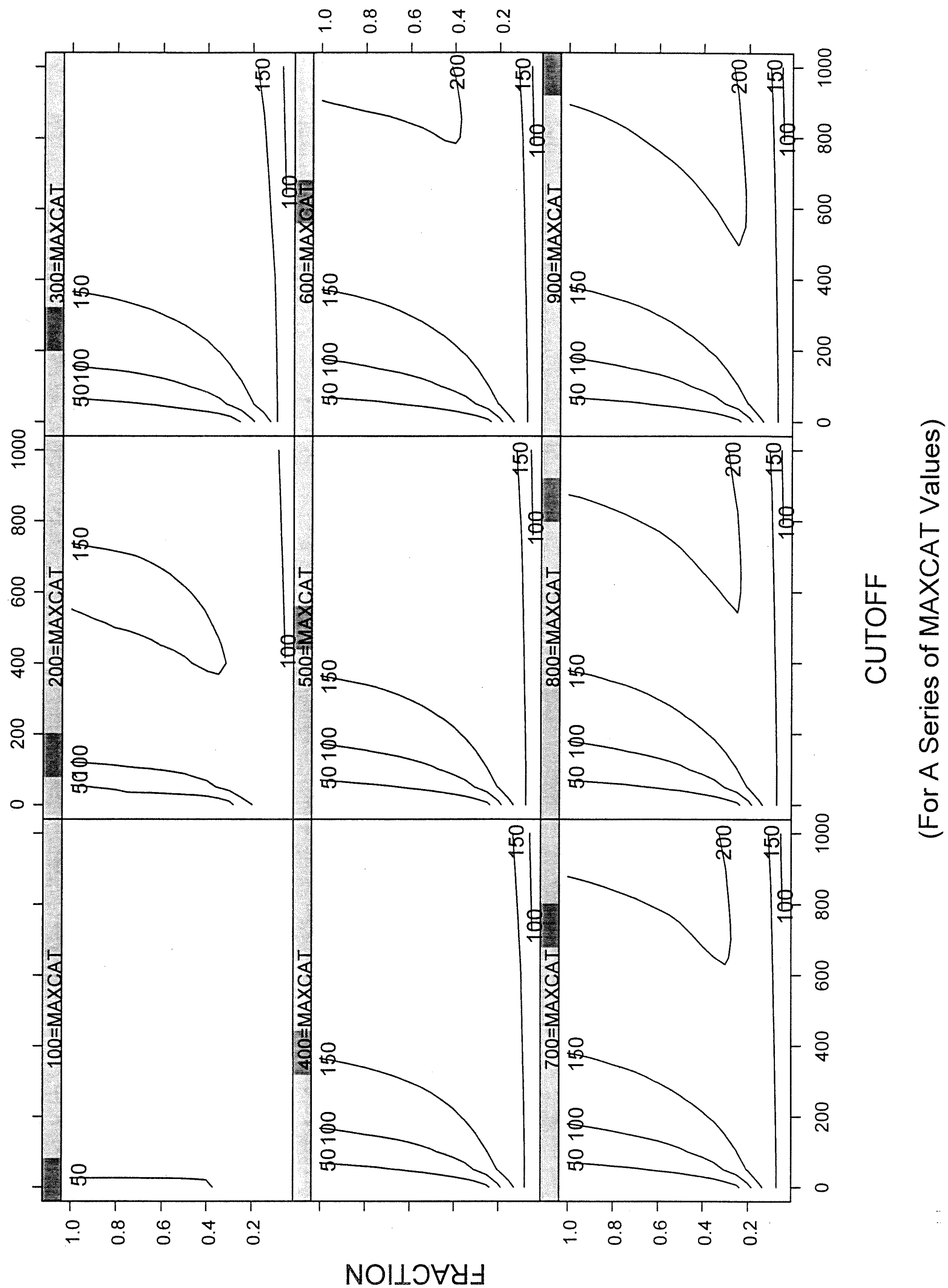


Fig. 4.2.3.3-2. Standard Deviation of Catch - Constant Fraction MSY Rule

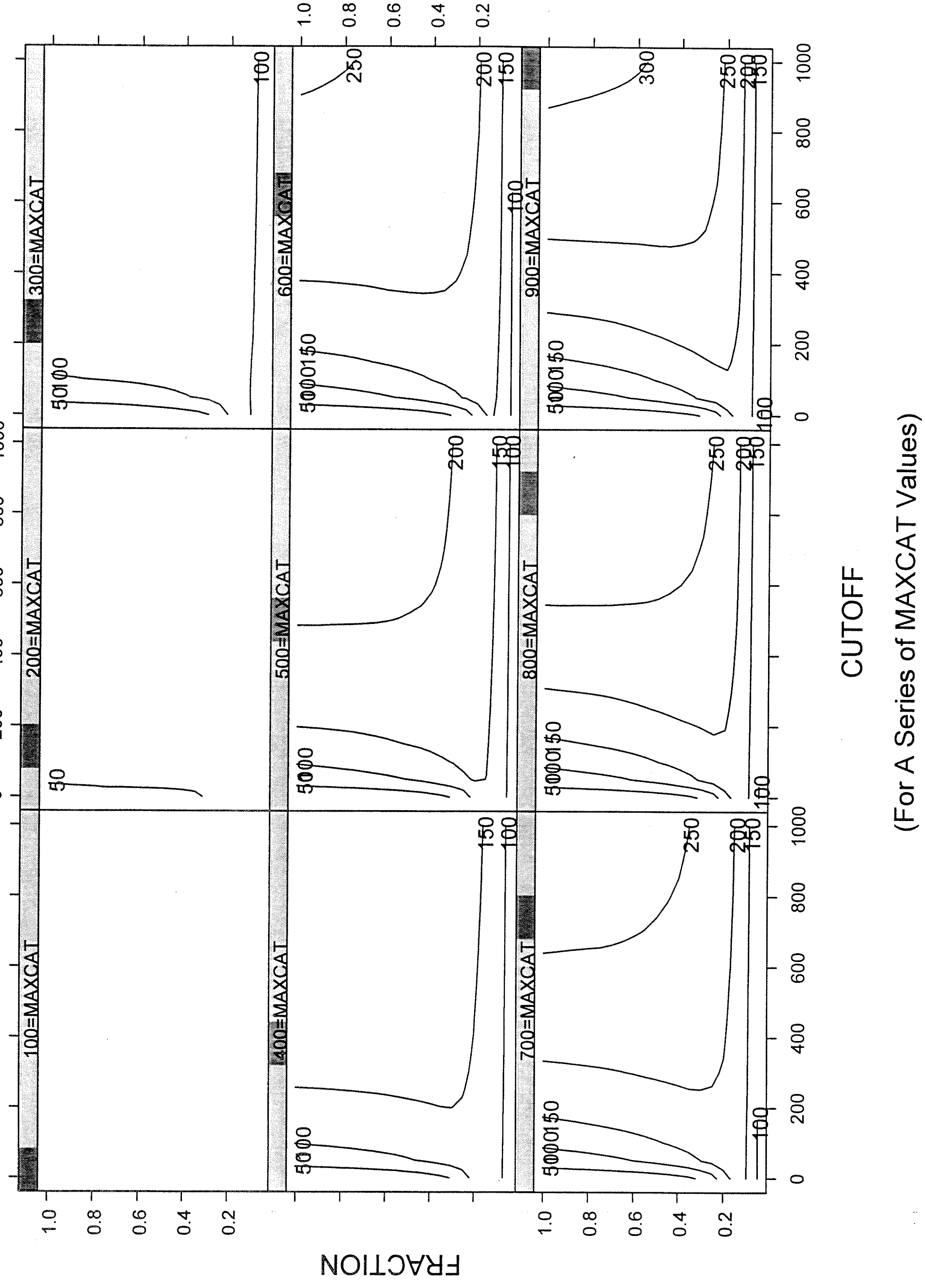


Fig. 4.2.3.3-3. Average Biomass - Constant Fraction MSY Rule

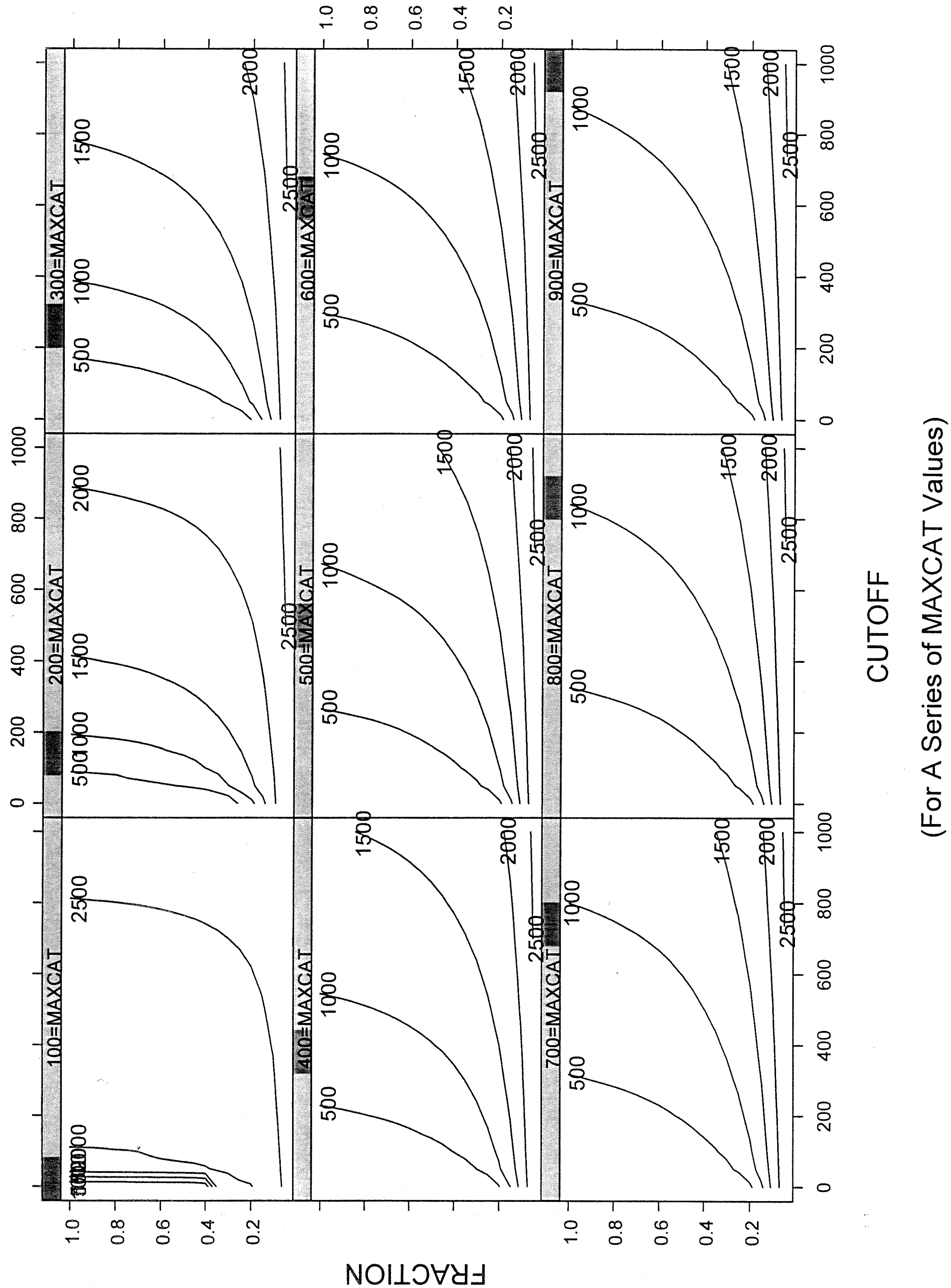


Fig. 4.2.3.3-4. Std. Deviation of Biomass - Constant Fraction MSY Rule

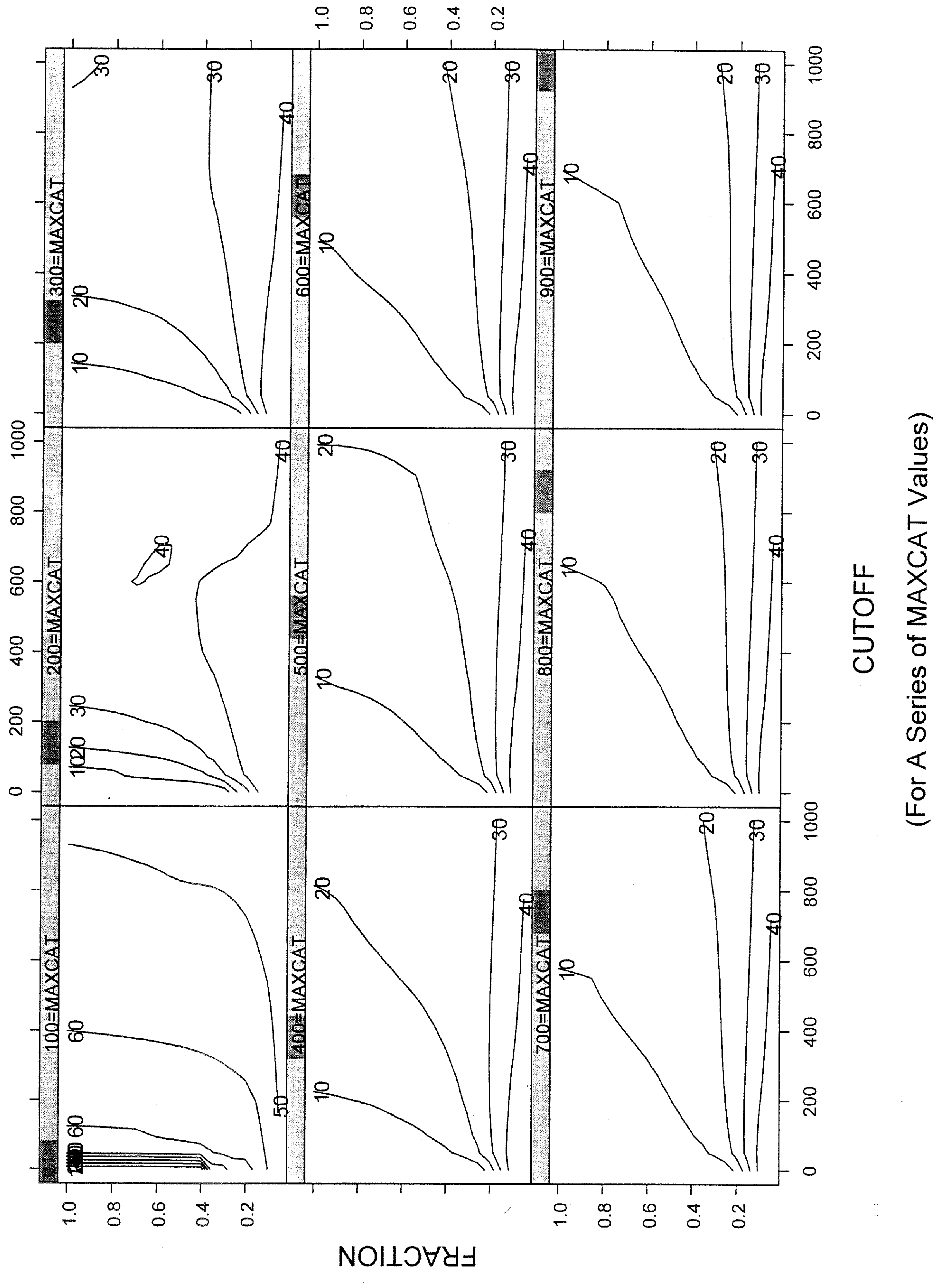
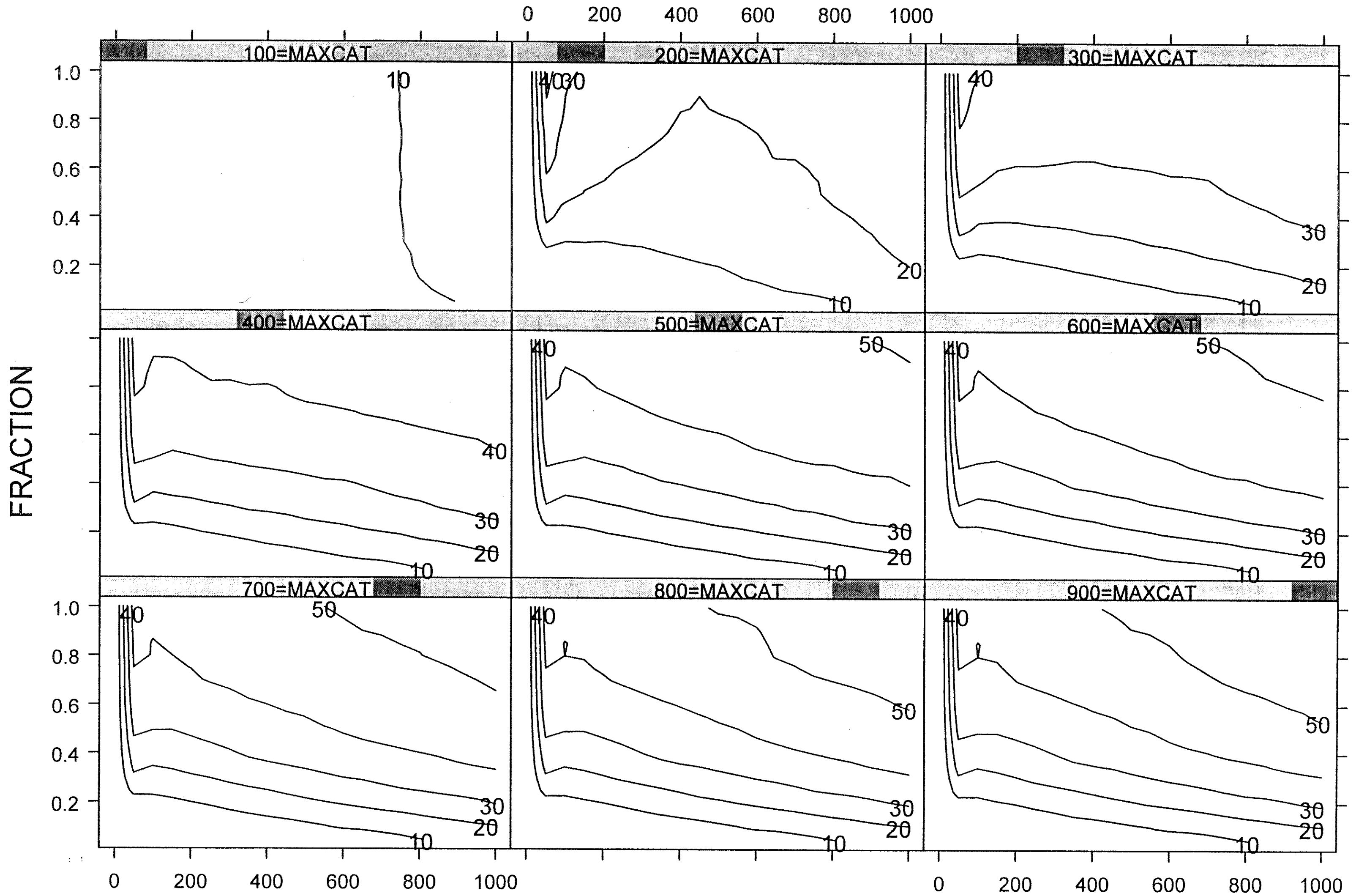


Fig. 4.2.3.3-5. % Years w/No Catch - Constant Fraction MSY Rule



CUTOFF

(For A Series of MAXCAT Values)

Fig. 4.2.3.3-6. % Years Biom>400K - Constant Fraction MSY Rule

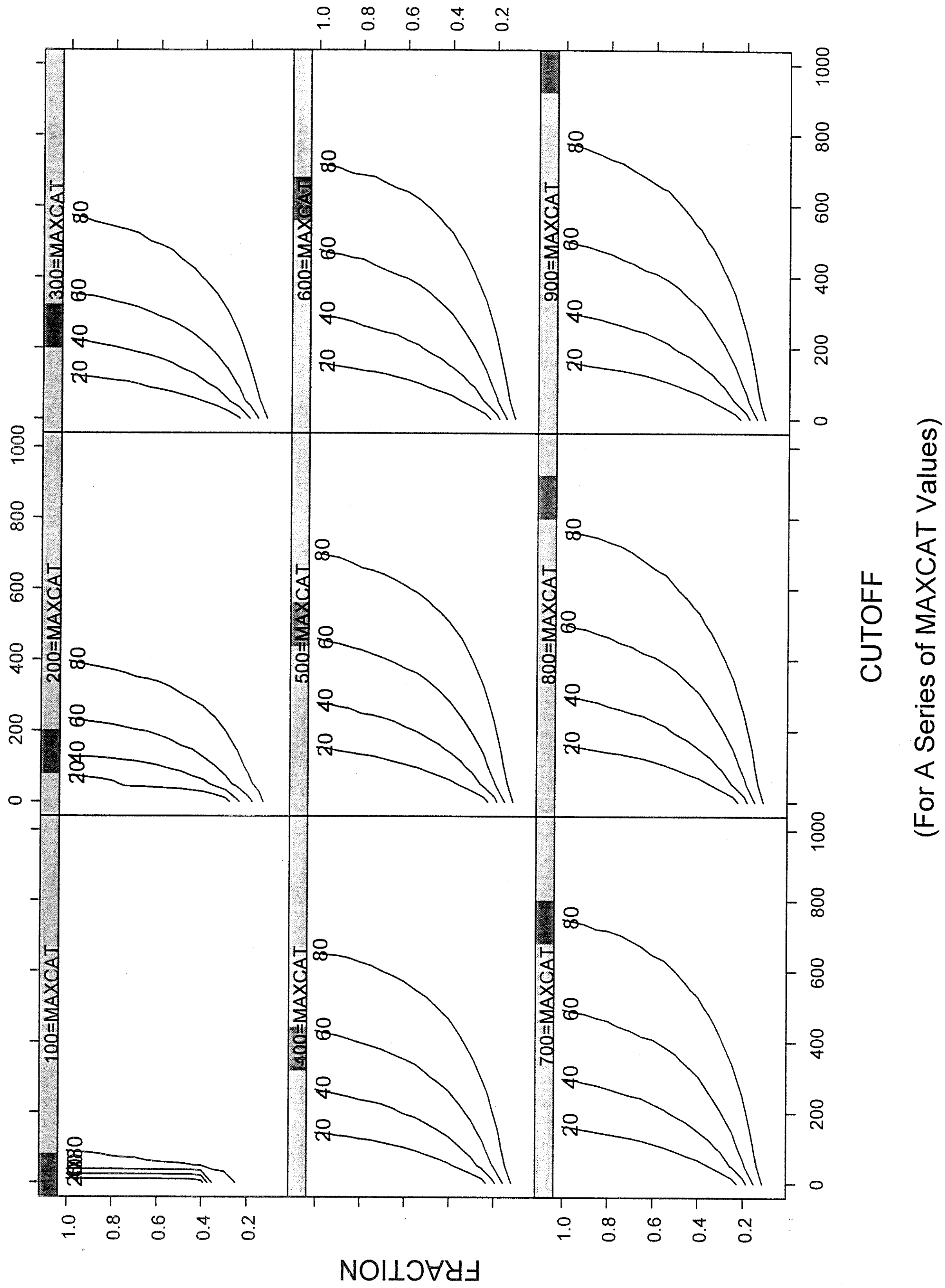
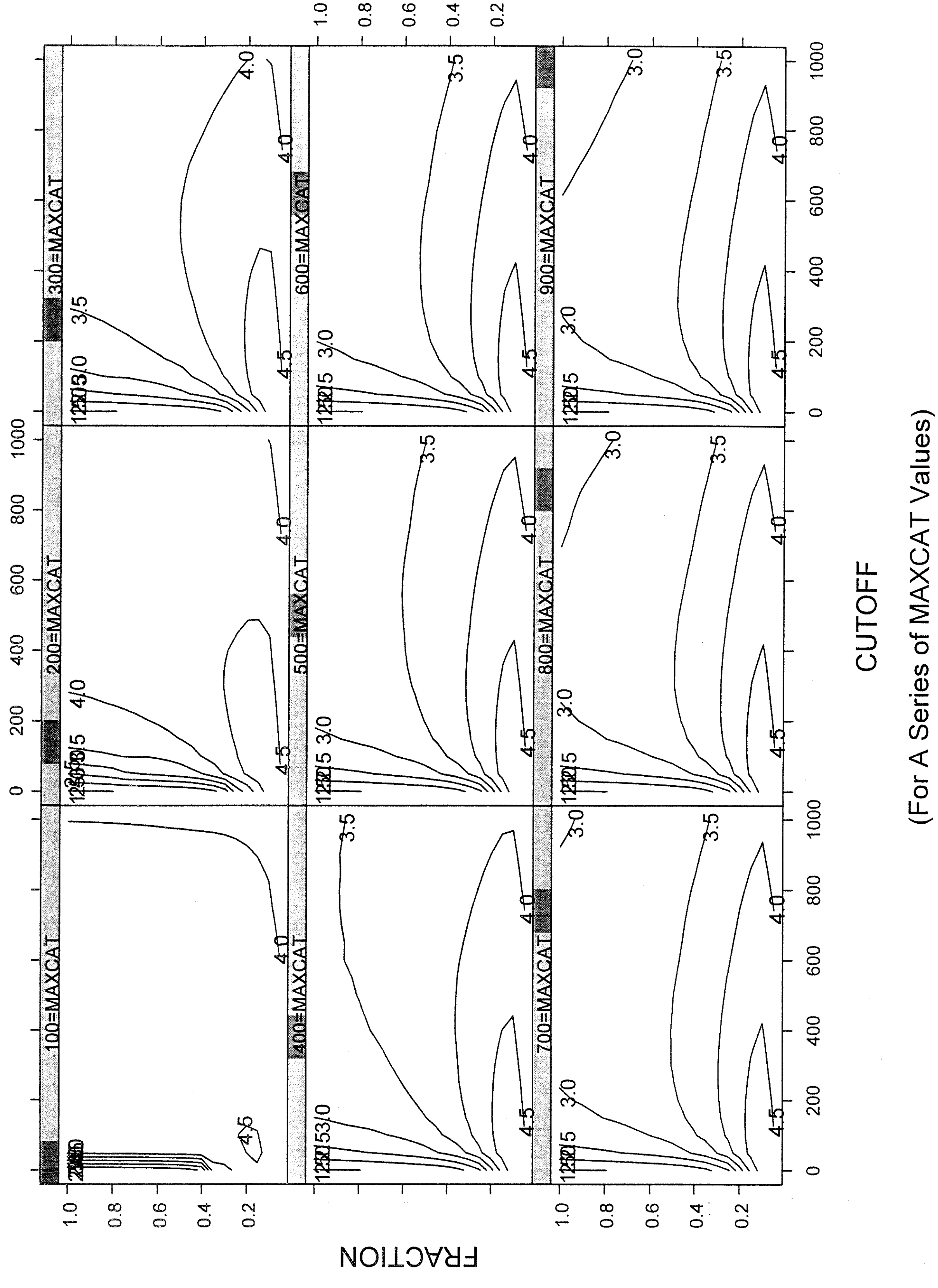


Fig. 4.2.3.3-7. Average Log Catch - Constant Fraction MSY Rule



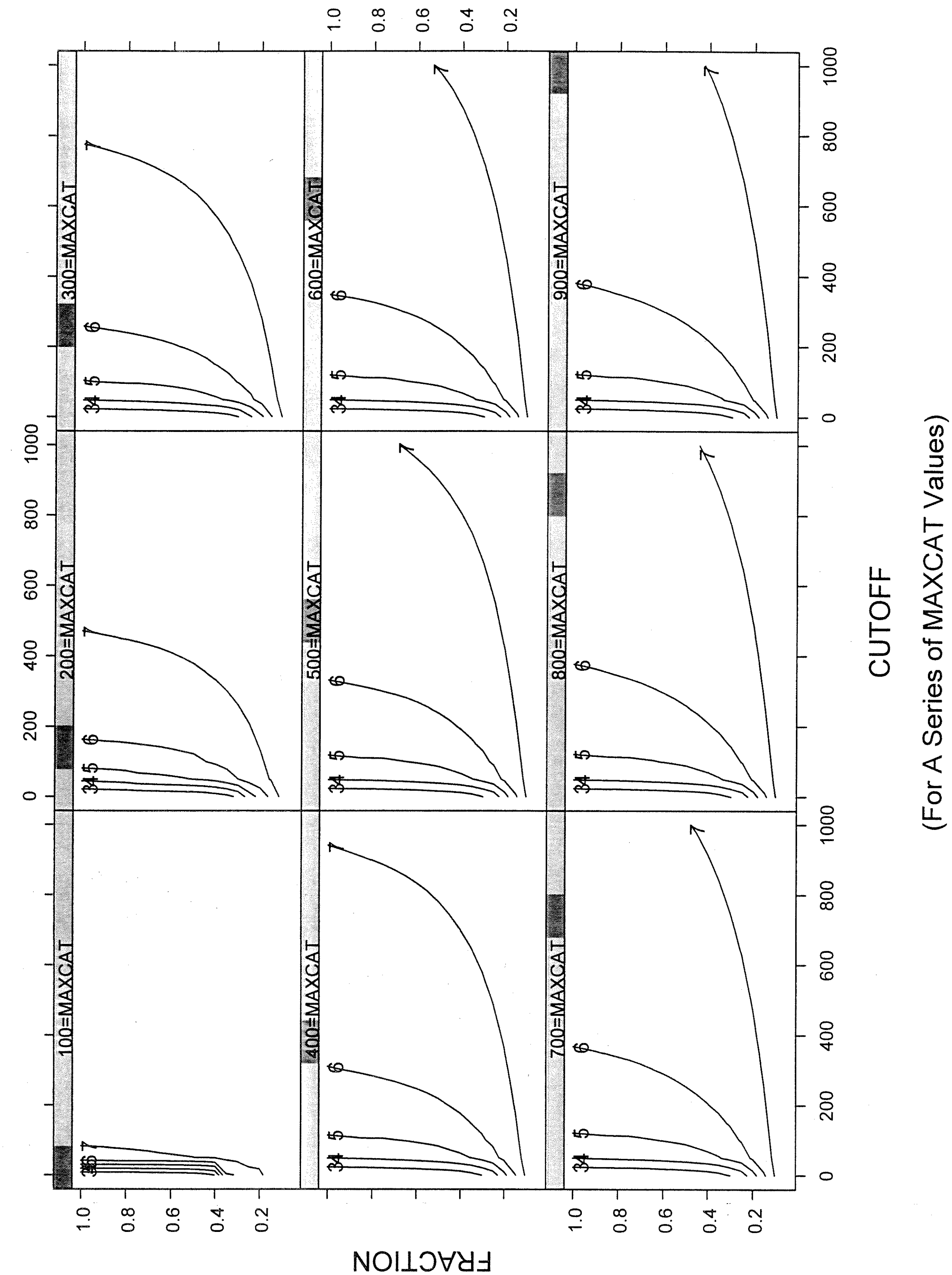


Fig. 4.2.3.3-8. Log Biomass - Constant Fraction MSY Rule

Fig. 4.2.3.3-9. Median Catch - Constant Fraction MSY Rule

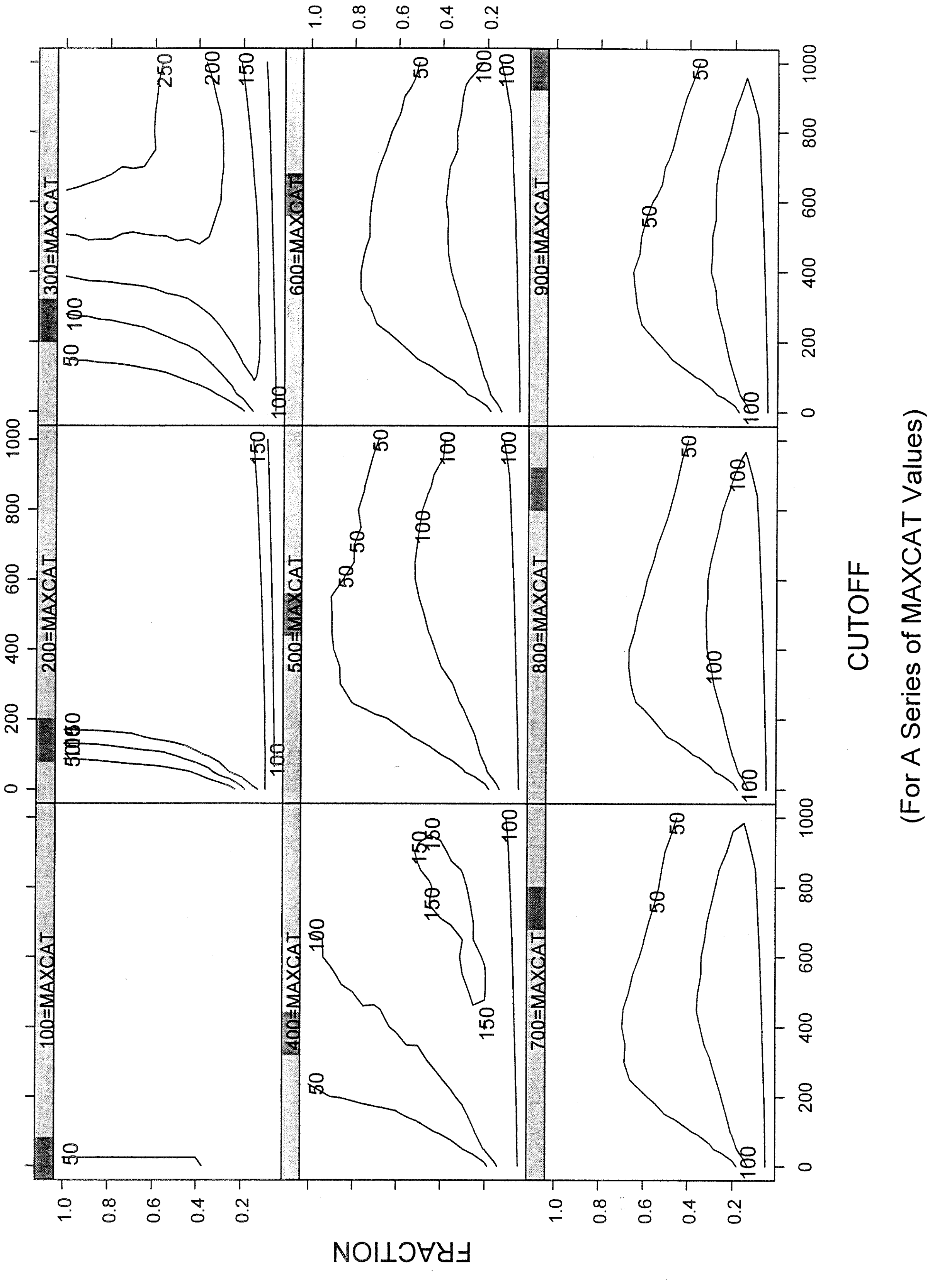


Fig. 4.2.3.3-10. Median Biomass - Constant Fraction MSY Rule

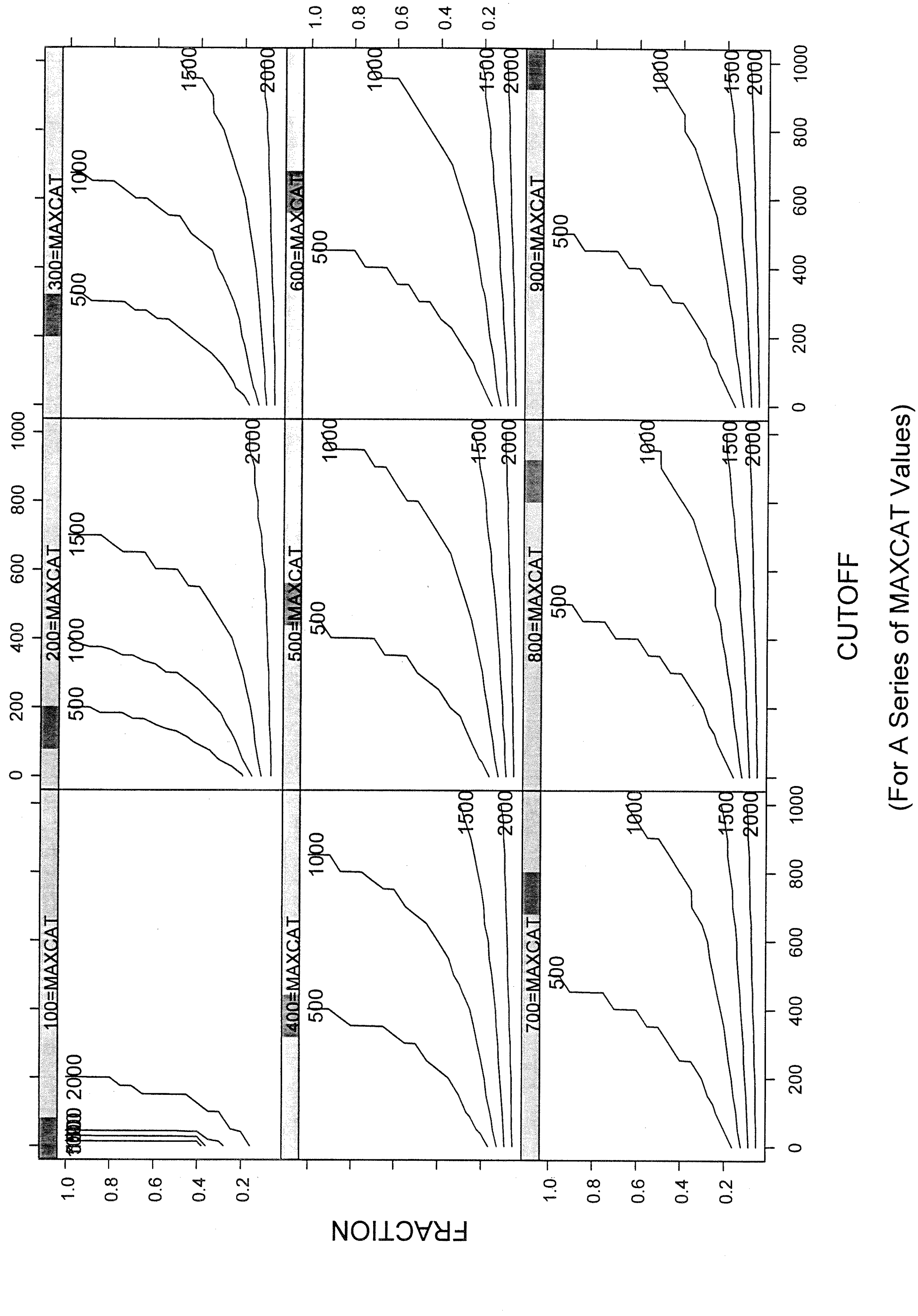


Figure 4.2.3.4-1. Deterministic Equilibrium MSY vs. Average Scripps Pier Sea Surface Temperature

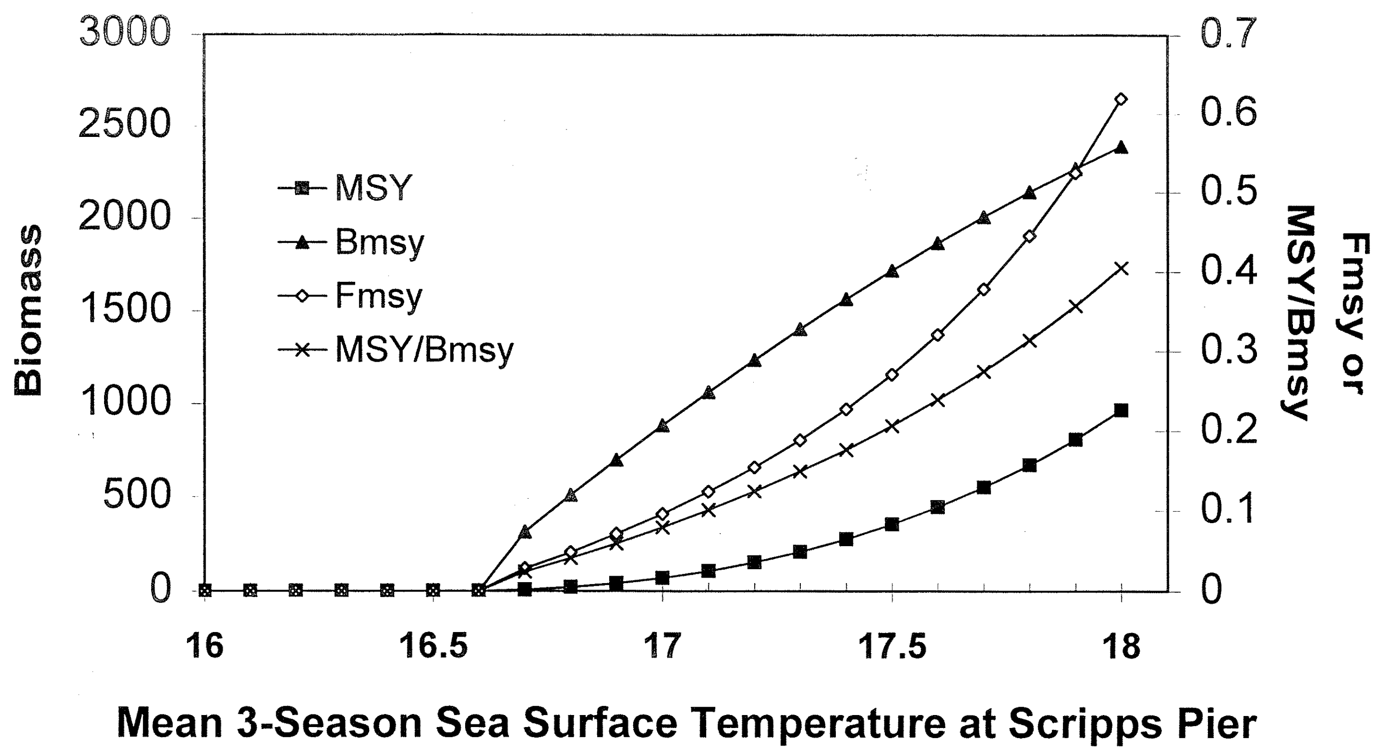


Figure 4.2.3.4-2. U=MSY/Bmsy vs. Average Scripps Pier Sea Surface Temperature

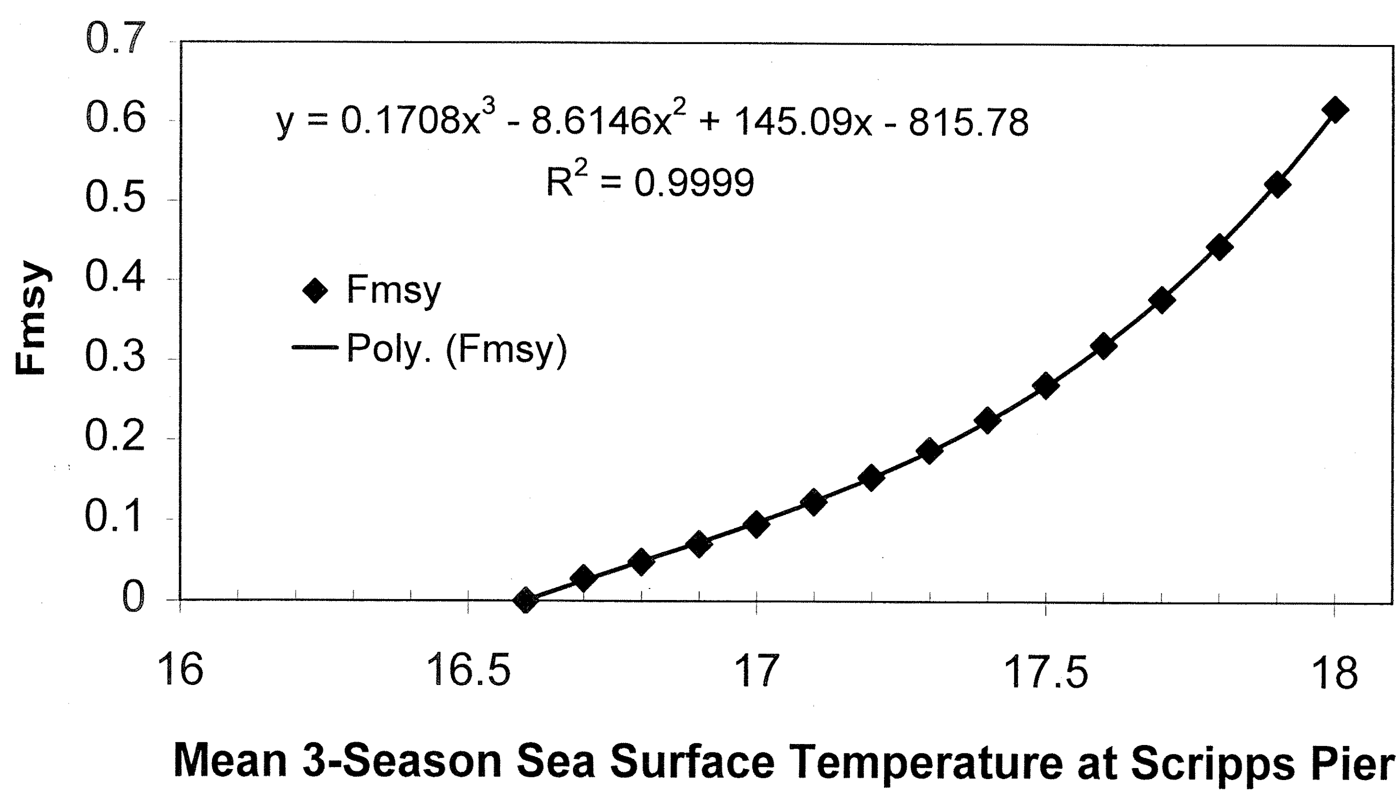


Figure 4.2.3.4-3. Average Three Season Temperature Data and Predicted Deterministic Equilibrium Fmsy for Sardine

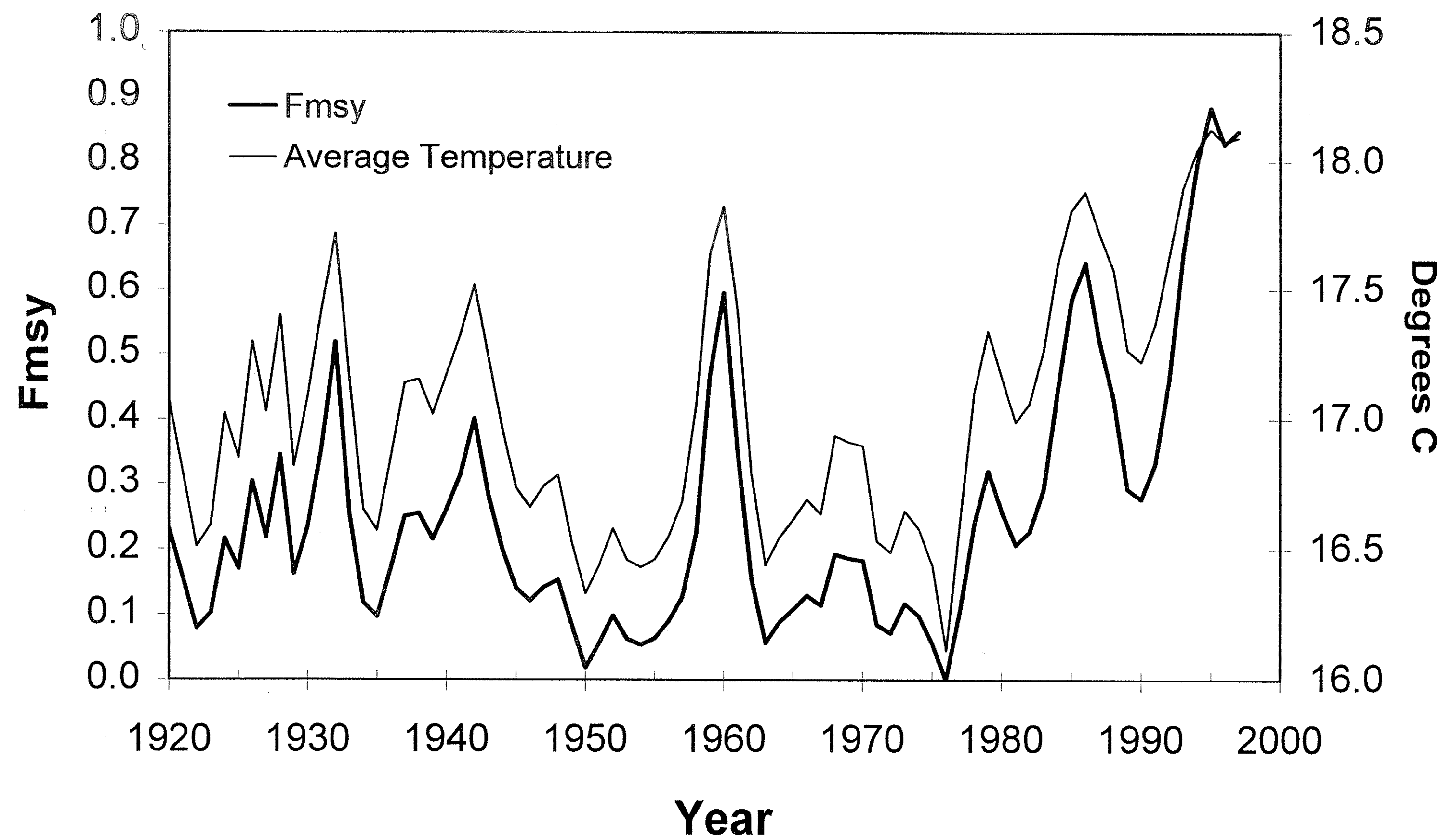
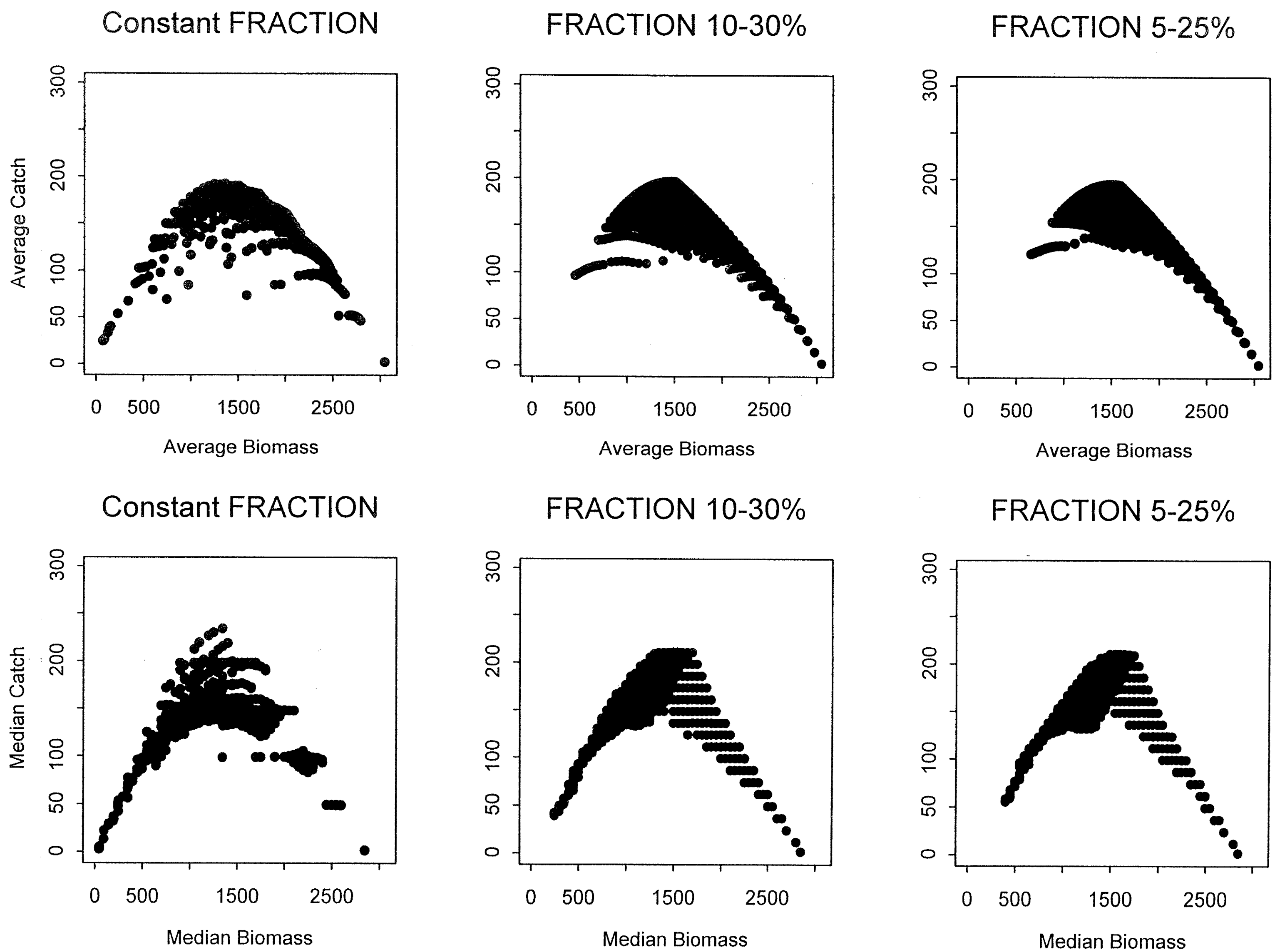


Figure 4.2.3.4-4. Mean catch vs biomass (top) and median catch vs biomass (bottom) for 3 types of sardine control rules.



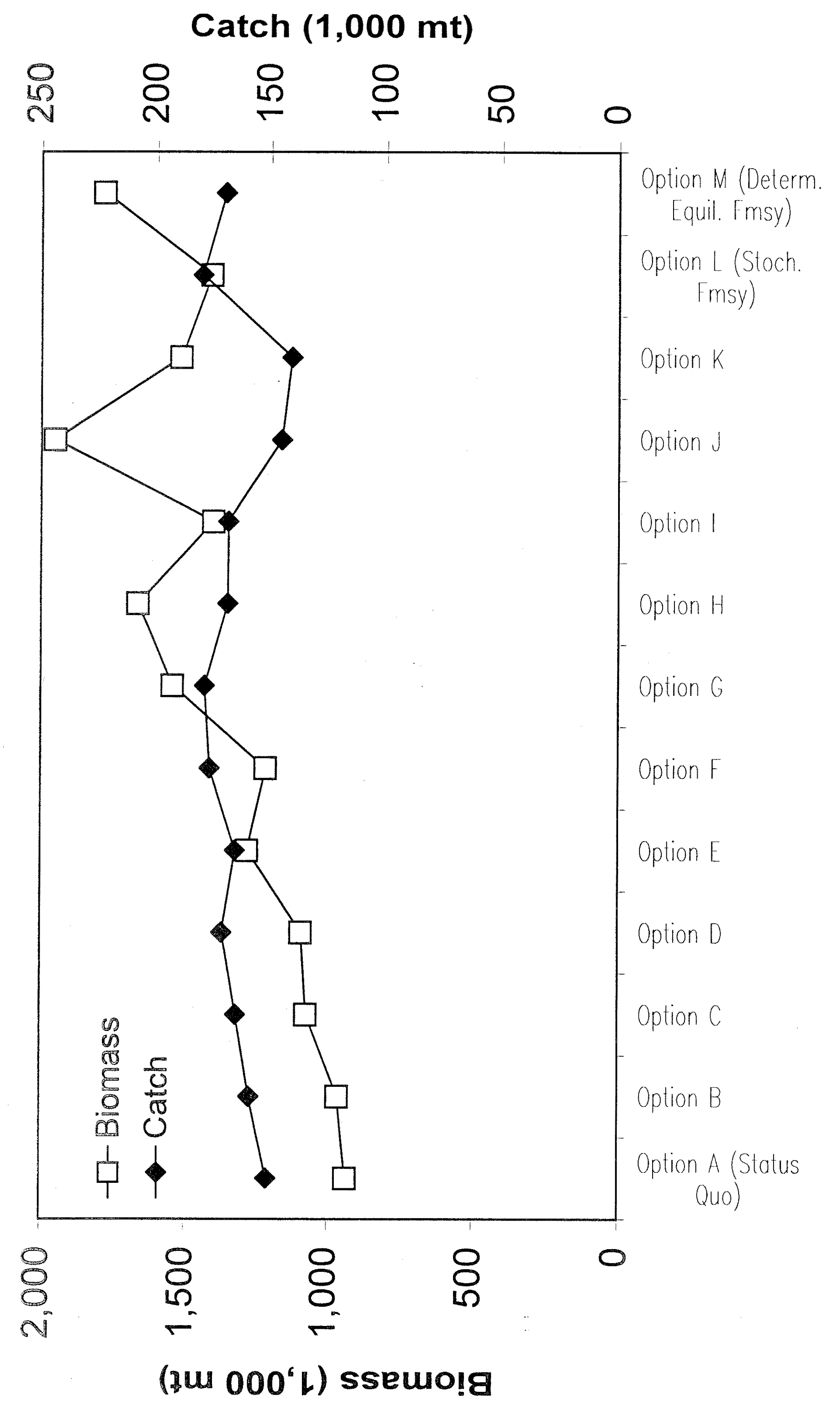
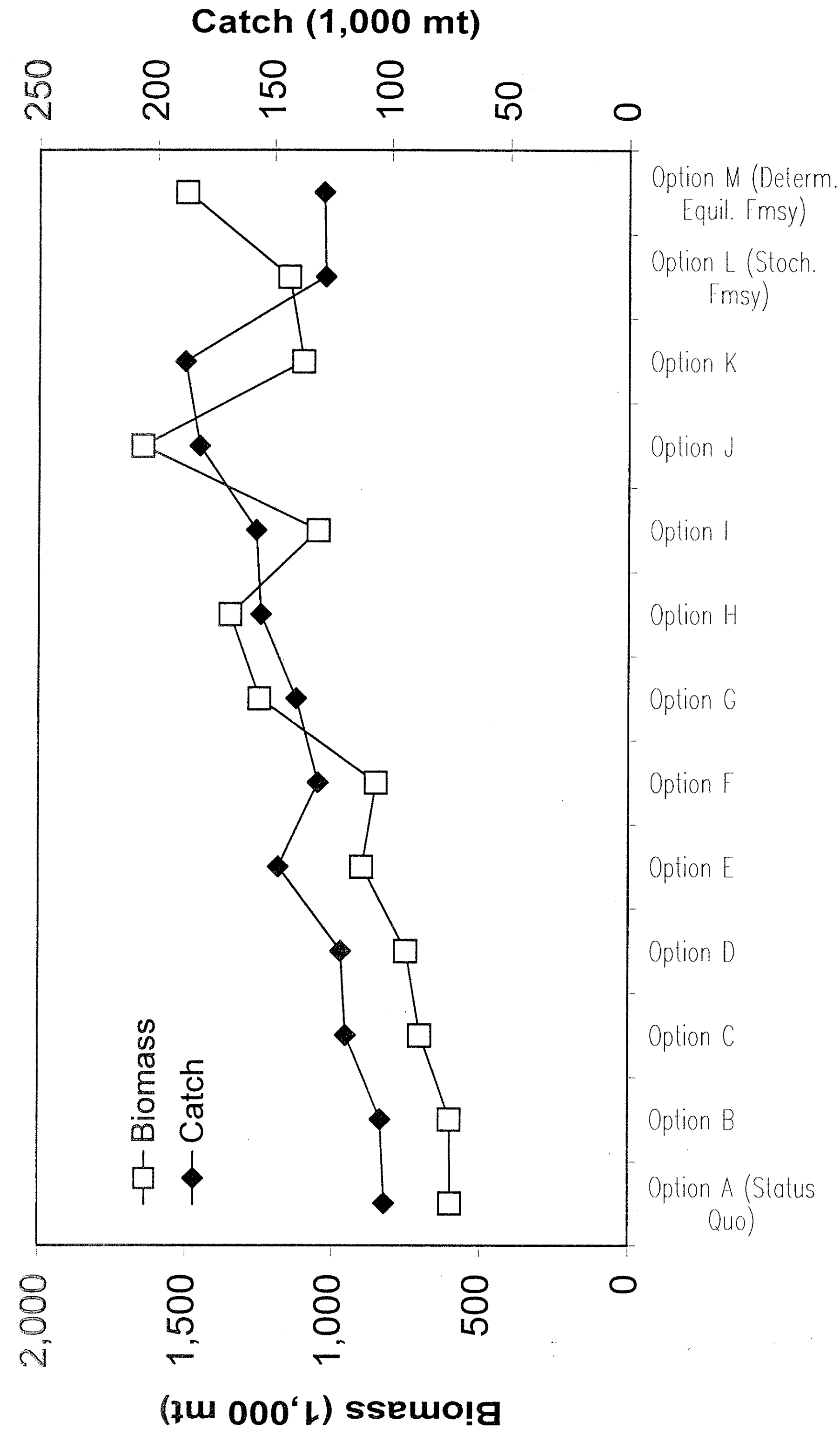


Figure 4.2.5-1. Average catch and average biomass for sardine MSY control rule options.

Figure 4.2.5-2. **Median catch and average biomass for sardine MSY control rule options.**



5.0 BYCATCH, INCIDENTAL CATCH, AND ALLOCATION FOR COASTAL PELAGIC SPECIES

This Fishery Management Plan (FMP) establishes incidental catch allowances for coastal pelagic species (CPS) and a geographic allocation for Pacific sardine.

5.1 Incidental Catch Allowances

"Bycatch" is defined in the Magnuson-Stevens Fishery Conservation and Management Act as "fish which are harvested in a fishery, but not sold or kept for personal use and includes economic discards and regulatory discards". In the CPS fisheries, fish are caught and sold incidental to catching other species, because they sometimes school together. Incidental catch allowances permit fishermen to land a certain percentage of fish that would otherwise be considered bycatch. Incidental catch allowances are percentages of catch, landings, or deliveries. For CPS, incidental allowances are normally measured in units of weight rather than numbers of fish or other units, but additional approaches may be used depending on circumstances.

Incidental catch allowances are applied when a stock is overfished or a harvest guideline is met, but may be employed under other conditions as well to avoid, for example, premature filling of a harvest guideline due to incidental catch. Loads of fish that exceed incidental catch allowances for overfished species or species with no harvest guideline cannot be delivered or sold. The Council will recommend incidental catch allowances according to guidelines described in this FMP.

Incidental catch allowances are normally applied to fish as they are landed (i.e., off loaded from a fishing vessel). However, incidental catch could be recorded or measured when fish are first caught, brought on deck, delivered, sold, or at any point that is appropriate and practical.

Incidental catch allowances will normally be recommended by the Council at the same time as harvest guidelines. Estimates of incidental catch and incidental catch rates will be considered in setting harvest guidelines and quotas (Section 4). Incidental catch allowances can be changed annually based on the socioeconomic framework, or more frequently, under the points-of-concern framework.

Incidental catch allowances are the primary method for managing bycatch in the CPS fishery. Other management approaches, such as fishing seasons or area restrictions, might also be required to reduce bycatch or incidental catch. These allowances do not exclude the possibility of trip limits or other regulations imposed to reduce incidental catch, prolong the directed fishery, or for other purposes.

5.1.1 Incidental Catch Allowances When Stocks are Overfished

When a stock is overfished according to the definition of overfishing in this FMP, incidental catch allowances for commercial fishing shall be set at zero percent to 20% of landed weight, as determined by the Council and/or the National Marine Fisheries Service (NMFS) Regional Administrator.

5.1.2 Incidental Catch Allowances When Stocks are Not Overfished

When a stock is not overfished according to the definition of overfishing in the FMP, incidental catch allowances for commercial fishing shall be set at zero percent to 45% of landed weight, as determined by theCouncil and/or the NMFS Regional Administrator.

5.1.3 Pacific (chub) Mackerel Landed Incidentally

When the Pacific (chub) mackerel resource is not overfished, and total landings established under a harvest guideline have been caught, the Council may set an allowable trip limit of one mt or lower according to guidelines described in Section 5.1.6.

5.1.4 Incidental Catch Allowances for Live Bait When Stocks are Overfished

When a stock is overfished according to the definition of overfishing in the FMP, incidental catch allowances for live bait fishing shall be set to no more than 15% of landed weight.

5.1.5 Incidental Catch Allowances for Live Bait When Stocks are Not Overfished

When a stock is not overfished according to the definition of overfishing in the FMP, no restrictions are placed on live bait harvest.

5.1.6 Guidelines and Criteria For Setting Incidental Catch Allowances

In setting incidental catch allowances, the Council will consider existing regulations, goals and objectives of this FMP, best available data, scientific and management advice available, guidelines given below, and other policies established by the Council. Decisions about incidental catch allowances will be made based on consultation between the Council Chair, the NMFS Regional Administrator, Director of the California Department of Fish and Game, Coastal Pelagic Species Management Team (CPSMT), Coastal Pelagic Species Advisory Panel, other representatives appointed by the Council, and interested parties as appropriate.

5.1.6.1 Overfished Stocks

In order of priority, the goals in setting incidental catch allowances for overfished stocks should be to (1) minimize fishing mortality on overfished stocks, and (2) minimize discards of overfished stocks. Incidental catch allowances for overfished stocks should approximate rates of incidental catch when fishing is conducted in a manner that minimizes catch of the overfished stock.

The Council must set incidental catch allowances for all overfished stocks. Once set, incidental catch allowances for overfished stocks remain in force until they are changed. Incidental catch allowances for overfished stocks can be revised during the fishing season if conditions warrant or new information becomes available.

5.1.6.2 Stocks Not Overfished

Incidental catch allowances for stocks that are not overfished are enforced once a harvest guideline has been reached, and the directed fishery has been closed. The goals in setting incidental catch allowances for stocks that are not overfished should be to (1) avoid unnecessary discard, (2) ensure that optimum yield is taken, but not exceeded, and (3) promote efficiency and profitability in the fishery. Estimates of total incidental catch (based on past or current incidental catch rates, incidental catch allowances, harvest guidelines and other conditions in the fishery) are normally considered when harvest guidelines are set. Thus, incidental catch allowances should be set at the same time and in concert with harvest guidelines.

Incidental catch allowances are meant to accommodate catches that are difficult to avoid during normal fishing directed at other species. Therefore, incidental catch allowances should be set at levels that approximate incidental catch rates during normal fishing activities.

5.2 North-South Allocation for Directed Fishery

This FMP authorizes allocations of Pacific sardine harvest guideline to participants by northern and southern areas (defined below). Nothing in this FMP precludes additional allocations based on other geographic areas or other factors developed under the authority of this FMP.

5.2.1 Definition of Northern and Southern Fishery Segments

The division between northern and southern areas for the U.S. Pacific sardine fishery is Point Piedreas Blancas (35°40' N latitude). Landings (or catches if their location is known) north of Point Piedreas Blancas apply to the northern area. U.S. landings (or catches if their location is known) south of Point Piedreas Blancas apply to the southern area.

5.2.2 Formulas for Allocating Pacific Sardine

The northern area allocation is 33% of the of Pacific sardine harvest guideline, and the southern area allocation is 66% of the of Pacific sardine harvest guideline. Nine months after the start of the fishing season, any uncaught portion of the harvest guideline will be totaled and reallocated with 50% of the total allocated to the northern area and 50% of the total allocated to the southern fishery area. Reallocation will be carried out by the NMFS Regional Administrator in consultation with the CPSPDT as an automatic management action.

APPENDIX C
COSTS INVOLVED IN MANAGING COASTAL PELAGIC SPECIES

1.0 INTRODUCTION

This section provides estimated costs for implementing the fishery management plan (FMP), grouping those costs into the categories of administrative, scientific, and enforcement, with a separate estimate for the administrative costs of issuing permits. The costs of employee benefits are added to all direct labor costs (23.8% for the Southwest Region; 21.0% for the Southwest Fisheries Science Center). Overhead costs incurred by the National Oceanic and Atmospheric Administration are also added to direct labor costs (64.1% for the Southwest Region; 51.6 % for the Southwest Fisheries Science Center). Employee benefits and overhead cost figures change periodically.

Scientific costs are the largest component under any option one might choose to manage coastal pelagic species. Administrative costs can be multiplied by any reasonable factor to account for underestimating those costs, and they would remain small compared to the costs of scientific research.

1.1 Administrative Support

Estimates of administrative costs are made by estimating the time to perform certain tasks, such as reviewing and editing documents. Generally, these kinds of processing costs are underestimated, because there is no way to determine how difficult some issues may be; the ability to account for reflection and debate is limited. Nevertheless, estimates are useful for determining what the actual costs may be and for comparing different options that may be proposed.

Estimates are based on staff processing time. Costs above the staff level are included in the overhead costs; therefore, the figures are an estimate of costs rather than time. This section does not address the question of whether there are enough personnel or enough personnel time available to complete tasks.

1.1.1 Annual Meeting of the Coastal Pelagics Species Plan Development Team

An annual meeting is held with the Coastal Pelagic Species Advisory Subpanel (CPSAS) in Long Beach to review the annual biomass estimates. Pacific (chub) mackerel and jack mackerel would be managed using a February to January fishing season with review by industry and technical experts during January. Northern anchovy and Pacific sardine would be managed using an August to July annual cycle, which is currently used for northern anchovy. Biomass estimates would be reviewed during June. Therefore, the plan requires two meetings, which would be held in Long Beach, California. This estimate allows for attendance by the three NMFS members of the Coastal Pelagic Species Plan Development Team (CPSPDT), two from LaJolla, California, and one from Monterey, California, and two regional personnel. All CPSPDT members may not attend the meeting; therefore, over the long term the annual costs are likely to average less than those described here.

Travel of two people from La Jolla:

$.31/mile X 226 miles (round trip) X 2 trips = $140.12

Travel of one person from Monterey:

$108.00(Air fare) + $30.00(rental car) + 38.00 (per diem) X 2 = $352.00

CPSPDT labor costs:

$23.91/hr X 8 hrs X 2 meetings X 3 people = $1,147.68

Regional labor costs:

$23.91/hr X 4 hrs/meeting X 2 people/meeting X 2 meetings = $382.56

1.1.2 Coastal Pelagic Species Advisory Subpanel Travel

Estimate of the annual cost of sending CPSAS members to meetings is approximately $1,500. Most members are in southern California, and not all members are likely to attend.

1.1.3 Publication of Annual Biomass Estimates and Harvest Guidelines

Labor costs are for drafting and reviewing required documents such as decision memoranda and *Federal Register* announcements. Calculations are assumed to include all individuals that might be involved. Quotas are determined by a formula in the FMP and are based on the annual biomass. There is no flexibility in setting a quota once the biomass estimate is known unless errors are detected in the determination of calculating the biomass. The determination of the biomass and the resulting quotas are reviewed by the Pacific Fishery Management Council (Council) at a public meeting before publication in the *Federal Register*. As a result, the quotas are published once as an interim final action with a thirty-day comment period.

Labor cost of preparing announcement and supporting documentation:

2 hrs X $23.91/hr X 2 rules = $95.64

Labor cost of reviewing package (supervisor level):

1 hr X $30.93/hr X 2 rules = $61.86

Secretarial costs (final documents plus copies):

1/3 hrs X $11.77/hr X 2 rules = $7.85

Publication costs:

1 page X $405.00/page X 2 rules = $810.00

Labor cost of review by the Central Office:

3 hrs X $23.91/hr X 2 rules = $142.46

1.1.4 Closing Fisheries

This estimate is based on the assumption that a notice of closure will have to be issued each year for three species: anchovy, sardine, and Pacific (chub) mackerel. This has not been true for anchovy in recent years; however, this exercise assumes that there is a significant fishery for these three species. When Pacific (chub) mackerel abundance is high, closing the fishery has not been necessary, because the market has been limited. A large biomass of Pacific sardine may also eliminate the need for a closure if expansion of the resource out paces market opportunities. Nevertheless, the assumption here is that the harvest of each species will be terminated at some point each year.

Labor cost of preparing closure notice:

2 hrs X $23.91/hr X 3 rules = $143.46

Labor cost of reviewing closure notice (supervisor level):

1/3 hrs X $30.93/hr X 3 rules = $30.93

Secretarial costs:

1/3 hrs X $11.77/hr X 3 rules = $11.77

Labor cost of Central Office review of closure notice:

2 hrs X $23.91/hr X 3 rules = $143.46

Publication costs:

2 columns X $135.00/column X 3 rules = $810.00

1.1.5 Changing Incidental Harvest Amounts

In each announced harvest guideline, a quantity is reserved to allow for an incidental harvest. If a quota for one species is reached, an incidental harvest will be allowed so that the harvest of other species can continue. A specific incidental harvest goes into effect after a quota is reached, but adjustments of the incidental harvest may be necessary. The assumption here is that three adjustments will be needed, although no adjustments may be required. Changes in incidental catch rates are announced as notices.

Labor costs include the drafting and reviewing time of required documents such as decision memoranda and *Federal Register* announcements. Calculations are assumed to include all individuals that might be involved.

Labor cost of preparing change in incidental catch rates:

1 hr/notice X $23.91/hr X 3 notices = $71.73

Labor cost of reviewing changes in catch rate (supervisor level):

1/3 hr/notice X $30.93/hr X 3 notices = $30.93

Secretarial costs (final documents plus copies):

1/3 hrs X 11.77/hr X 3 notices = $11.77

Publication costs:

2 columns X $135.00/column X 3 notices = $810.00

Labor cost of Central Office review of changes in incidental catch rates:

1 hr/notice X $23.91/hr X 3 notices = $71.73

1.1.6 Travel of Two National Marine Fisheries Service Coastal Pelagic Species Plan Development Team Members and One National Marine Fisheries Service Employee to Two Council Meetings

$238.00 (air fare) + $127.00 (per diem, Portland) X 2 = $730.00 + $30.00 (car rental) = $760.00

Labor cost of meetings:

16 hr (2 days) X $23.91/hr X 2 = $765.12

1.1.7 Coordination

There is a need to include a figure for day-to-day operations of supporting a CPS FMP.

2 hr/week X 52 weeks X $23.91/hr = $2,486.64

Telephone = $500.00

Supplies = $500.00

1.1.8 Council Review

An estimate is needed for the time spent by Council members, Council staff, and Council technical committees to review matters concerning the management of CPS.

Scientific review of biomass estimates (anchovy, Pacific [chub] mackerel, and sardine; Jack mackerel is a fixed quota.):

1 hr/review X 3 reviews X 14 individuals x $23.91/hr = $1,004.22

Review time of the Council members, Council staff, and others, which is assumed to be 1/10 of a Council meeting per year.

1/10 X $111,468.00 (includes costs of meeting + pre and post meeting costs) = $11,146.80

1.1.9 Summary of Administrative Support

Direct Labor Costs	$9,810
Travel Costs	$2,752
Publication Costs	$2,430
Supplies	$500
Telephone	$500
Employer's Surcharge (23.8%)	$2,266
NOAA Support (64.1%)	$6,104
Total	$24,362

1.2 Scientific Support

1.2.1 Coastal Fisheries Resources Division

The La Jolla Laboratory's Coastal Fisheries Resources Division (Division) studies economically and ecologically important small, schooling fish of the California current. Biologists evaluate factors that affect their distribution, abundance, and survival; and the Division studies factors that affect the economics of the fisheries harvesting these coastal resources as well. The staff works with Mexico, the California Department of Fish and Game (CDFG), and Scripps Institution of Oceanography (SIO) on cooperative assessments of these CPS stocks. The information is obtained from trawl and ichthyoplankton surveys carried out on research cruises, environmental data monitoring, and laboratory and field studies of early life history, physiology, and reproduction.

An important activity of the Division is participation in the state-federal California Cooperative Fisheries Investigations (CalCOFI) program, a consortium of state and federal research agencies whose scientists conduct integrated research on the ecology of the California Current. The CalCOFI program was originally established in 1949 to investigate factors related to the collapse of the sardine fishery off California, but over the years its research has broadened to include other species as well. As a result of the CalCOFI effort, the biology and oceanography of a 250,000 square mile area of the Pacific Ocean off California and Baja California is perhaps the best ecologically understood of any comparable body of water in the world. The SIO chiefly processes and analyzes oceanographic observations and studies the taxonomy and zoogeography of planktonic organisms other than fish, while NMFS scientists are responsible for ichthyoplankton collections, studying species abundance and distribution, systematics, and application of fish early life history information to stock assessments.

The Division devotes 50% of its resources to West Coast groundfish and 50% to coastal pelagic fish. To assess coastal pelagic resources, relative abundance is monitored through CalCOFI and aerial spotter surveys with a fishery independent survey to measure absolute abundance every three to five years. Fishery data, and size at age information is provided by CDFG (see below).

Personnel Costs	$981,050
Travel, Supplies, Etc.	$133,000
Fish Spotter Surveys	$27,000
Ship Time (23 days)*	$253,000
Special Surveys (22.5 days)**	$247,000

*The same CalCOFI surveys collect data on groundfish and CPS. For the purpose of determining costs, 23 of the 46 survey days now carried out have been allocated to CPS.

**Twenty-two and one-half days of the 45 survey days now carried out have been allocated to CPS. This is an average over the last ten years.

1.2.2 Coastal Pelagics Sampling

Currently, CDFG conducts a sampling program for CPS under a grant from the Interjurisdictional Fisheries Act. The total cost of the project is given below. This project provides basic biological data such as length, weight, age, sex, and maturity of CPS, as well as providing landings data and species composition. These Federal costs are included in the totals, but they are not subject to the overhead that is attributed to other costs.

Personnel Costs	$76,576
Fringe Benefits	$17,381
Travel	$2,175
Supplies	$3,975
Telephone	$825
Data Processing	$900
Rent	$6,081
Training	$525
Indirect Costs	$20,647
Total	$129,085

All of the above costs summarize the effort now directed to CPS; they are existing costs and therefore unrelated to implementation of the FMP. These costs will not change with or without the plan. This total is $1,770,135.

1.2.3 Additional Scientific Costs

The following figures can be viewed in two ways, as new costs required by the FMP, or as reallocating more of the budget of the Division from groundfish species to CPS. The shift in resources would be from a 50% allocation of the Division's efforts to 75%, reducing the effort spent on groundfish to 25% rather than 50%. The following summarizes the additional costs required.

Personnel Costs	$490,525
Travel, Supplies, Etc.	$66,500
Special Surveys	$123,750

The FMP can be implemented without new funding if (1) the Division has the same number of vessel days allocated to it, (2) CDFG continues to support CPS research at its present level, and (3) a reallocation of resources within the Division can be achieved.

1.2.4 Summary of Science Costs

Existing Costs that will not change	$1,770,135
Additional Science Costs	
Direct Labor Costs	$490,525
Travel, Supplies, Etc.	$66,500
Special Surveys	$123,750
Employee's Surcharge (21.0%)	$103,010
NOAA Support (51.6%)	$253,111
Total Additional Costs	$1,036,896
Total	$2,807,031

1.3 Enforcement Support

Enforcement costs are projected costs based on existing landings of CPS. If landings increase, the costs of enforcement will increase. The Southwest Regional Enforcement Office has a contract with CDFG to monitor federal fisheries in California, (e.g., groundfish).

Contractual costs = 260 landings X 6 hrs X $38.00/hr = $59,200
Special agent support = $ 80,775

Summary of Enforcement Costs

Contractual Costs	$59,200
Special Agent Support	$80,775
Employee's Surcharge (23.8%)	$19,225
NOAA Support (51.6%)	$51,777
Total	$210,997

1.4 Permit Costs

The Council's preferred option is to implement a limited entry program that requires the owner of each qualifying vessel to obtain a permit. Such a limited entry scheme would effect and estimated 70 vessels. The administrative costs of issuing permits would be recovered from the applicants, in which case the costs would be passed on to the fishermen. Based on the following information, the cost of a permit would be $35.00. This is based on taking the total permit costs and spreading the cost over 70 vessels. A permit would have to be renewed every two years; therefore, the cost would be $35.00. ($4,868/ 70 vessels = $70/2 = $35.00.

The cost of setting up the permit files on a data base is estimated at $956.40 (40hrs X $23.91/hr = $956.40.

This cost is annualized by dividing it be ten. The number of vessels included in the permit system is small and the information collected is minimal. A revision of the recordkeeping system is not expected to occur in less than ten years, even considering the rapid change in software development. As a result, the annualized cost is: $95.64

Maintain data base system: 1hr/month X $23.91/hr X 12 months = $286.92

Review applications for completeness: 0.17hr/permit X 70 permits X $23.91/hr = $284.53

Return incomplete applications (6% return rate): .17hr/permit X 4 permits X $23.91/hr = $16.26

Phone calls to verify information: .5 hr/permit X 7 permits (70 X 10%) X $23.91/hr = $83.69

Check landings data to determine qualification: .25hr/permit X 70 permits X $23.91/hr = $418.43

Enter permit information in data base: .17hr/permit X 70 permits X $23.91/hr = $284.53

Print and mail permit: .17hr/permit X 70 permits X $23.91/hr = $284.53

Appeals: 11 vessels (15% X 70) X 6hr X 23.91/hr = $1,578.06

11 vessels X .5hr X $30.93/hr (supervisory time) = $170.12

Vessel transfers: 7 vessels (10% X 70) X .5hr/permit X $23.91/hr = $83.69

PERMIT COSTS	
Set up and maintain database	$383
Reviewing applications	$384
Determining qualification	$418
Entering permit information	$285
Print and mailing permits	$285
Appeals	$1,748
Transfers	$84
Telephone	$360
Supplies	$500
Employer's Surcharge (23.8%)	$854
NOAA Support (64.1%)	$2,299
TOTAL	$7,600

APPENDIX D
DESCRIPTION AND IDENTIFICATION OF ESSENTIAL FISH HABITAT FOR THE COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

Page

This document contains the identification and description of essential fish habitat (EFH) for the coastal pelagic species (CPS) fishery management plan (FMP) of the Pacific Fishery Management Council (Council). This document also contains fishing and nonfishing threats and potential conservation and enhancement measures to preserve EFH of CPS as specified in the interim final rule to implement the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), 50 CFR 600 (added by the interim final rule published at 62 Fed. Reg. 66531; December 19, 1997).

1.0 INTRODUCTION

The 1996 amendments to the Magnuson-Stevens Act established new requirements for describing and identifying EFH in federal FMPs. The amendments (16 U. S. C. 1801 *et. seq.*) also require consultation between the National Marine Fisheries Service (NMFS) and federal agencies on activities that may adversely impact EFH for those species managed under FMPs. The amended Magnuson-Stevens Act requires Fishery Management Councils to amend all of their FMPs to describe and identify EFH for the fishery based on guidelines established by NMFS, to minimize to the extent practicable adverse effects on such habitat caused by fishing, and to identify other actions to encourage the conservation and enhancement of EFH. NMFS guidelines on EFH requirements for FMPs were published as an interim final rule in the *Federal Register* on December 19, 1997 (62 FR 66531). These guidelines were used in the description and identification of EFH for the CPS Fishery.

The Magnuson-Stevens Act defines "essential fish habitat" as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." To clarify this definition, the following interpretations are made: "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers the full life cycle of a species. The definition of EFH may include habitat for an individual species or an assemblage of species, whichever is appropriate to the FMP.

The CPS fishery includes four finfish (Pacific sardine, Pacific (chub) mackerel, northern anchovy, and jack mackerel) and the invertebrate, market squid. CPS finfish are pelagic (in the water column near the surface and not associated with substrate), because they generally occur above the thermocline in the upper mixed layer. For the purposes of EFH, the four CPS finfish are treated as a single species complex, because of similarities in their life histories and similarities in their habitat requirements. Market squid are also treated in this same complex because they are similarly fished above spawning aggregations.

2.0 DESCRIPTION AND IDENTIFICATION OF ESSENTIAL FISH HABITAT FOR THE COASTAL PELAGIC SPECIES FISHERY

In determining EFH for the CPS, including CPS finfish (northern anchovy, Pacific sardine, Pacific (chub) mackerel, and jack mackerel) and market squid, the estuarine and marine habitat necessary to provide sufficient CPS production to support a maximum sustained yield (MSY) CPS fishery and a healthy ecosystem was considered. Using Level 1 information, (i.e., presence/absence distribution data) EFH for CPS is based upon a thermal range bordered within the geographic area where a CPS species occurs at any life stage, where the CPS species has occurred historically during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by the CPS species. EFH for CPS species is derived from distributional (presence/absence) data, oceanographic data (e.g., sea surface temperatures), relationships between oceanographic variables (e.g., temperature), and other published information. Specific EFH boundaries (i.e., the habitat necessary to provide sufficient CPS production) are based on best available scientific information. Sufficient Level 1 information exists to describe and identify EFH in a more precise manner for CPS finfish than for market squid.

The specific description and identification of EFH for CPS finfish accommodates the fact that the geographic range of all CPS finfish varies widely over time in response to the temperature of the upper mixed layer of the ocean, particularly in the area north of Point Arena, California (39° N latitude). This generalization is probably also true for market squid but few data are available. Adult CPS finfish are generally not found at temperatures colder than 10°C or warmer than 26°C and preferred temperatures and minimum spawning temperatures are generally above 13°C (see Figures 2-1 through 2-4). Spawning is most common at 14°C to 16°C.

The east-west geographic boundary of EFH for each individual CPS finfish and market squid is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the exclusive economic zone (EEZ) and above the thermocline where sea surface temperatures range between 10°C to 26°C. The southern boundary of the geographic range of all CPS finfish is consistently south of the US-Mexico border, indicating a consistency in sea surface temperatures at below 26°C, the upper thermal tolerance of CPS finfish. Therefore, the southern extent of EFH for CPS finfish is the United States-Mexico maritime boundary. The northern boundary of the range of CPS finfish is more dynamic and variable due to the seasonal cooling of the sea surface temperature. The northern EFH boundary is, therefore, the position of the 10°C isotherm which varies both seasonally and annually. EFH for CPS species is summarized in Table 2-1.

Sea surface temperatures and habitat boundaries for CPS finfish vary seasonally and from year to year (Figures 2-1 through 2-4). Year to year variation in temperature and habitat boundaries is most pronounced during the summer. Additionally, variation in the boundaries of preferred habitat are more pronounced than variation in the boundaries of thermal tolerance. These relationships mean that highly mobile mackerels and sardine are seasonally much more abundant in the Oregon to Alaska region during the summer and warm water years (e.g., El Niño) than during the winter and cold water years due to increased habitat availability (Pearcy et al. 1985).

In years with cold winter sea surface temperatures, the position of the 10°C isotherm (a rough estimate of the lower thermal and northern geographic bound for CPS finfish) during February is near Cape Mendocino along the coast (about 40° N latitude) and at about 43° N latitude further offshore (Figures 2-1 through 2-4). In warm years, the 10°C isotherm during February is further north along the coast but still at about 43° N latitude offshore. The 14°C isotherm (a rough measure of the location of preferred temperatures) during February is near the U.S.-Mexico border (about 31° N latitude) in cold years and near Point Arena (about 39° N latitude) in warm years.

Sea surface temperatures and habitat boundaries for CPS finfish extend farther to the north during the summer than during the winter (Figures 2-1 through 2-4). The position of the 10°C isotherm during August is off Canada and Alaska in years with both cold and warm summer sea surface temperatures. The 14°C isotherm during August is off Cape Flattery (about 43° N latitude) in cold years and off Canada above 53° N latitude in warm years. As described above, sea surface temperatures of 14°C to 16°C are generally preferred for spawning. The 16°C isotherm, and preferred spawning habitat for CPS finfish, is south of the 14°C isotherm, but shows the same patterns of variability.

Differences between spawning habitat (14°C to 16°C) and geographic range (>10°C) mean that sardine and Pacific (chub) mackerel tend to move north to feed during summer and south to spawn during winter. Abundance and biomass are probably both related to the geographic extent of spawning. Pacific (chub) mackerel and sardine in particular may have increased reproductive success during warm decades (i.e., the 1930s, 1980s, and 1990s) and it is likely the carrying capacity for CPS is larger during warm water years, because the maximum preferred habitat is larger.

Information regarding the distribution, habitat, life history, abundance, and fishery utilization are available in Section 6.0 of this Appendix. Average February (winter) and August (summer) sea surface temperatures (°C) in the California Current within the EEZ during warm winters, cold winters, warm summers and cold summers from the Comprehensive Ocean Atmosphere Data Set database. Warm winter data are averages for 1958, 1981, and 1983 (years with the warmest temperatures during January through March within a band two degrees Celsius wide along the coast from central Baja California to the Queen Charlotte Islands during 1950 to 1995). Cold winter data are averages for 1950, 1971, and 1972 (years with the coldest January through March sea surface temperatures). Warm summer data are averages for 1983, 1990, and 1992 (years with the warmest July through September sea surface temperatures). Cold summer data are averages for 1952, 1950, and 1955 (years with the coldest July through September sea surface temperatures).

TABLE 2.0. Summary of distribution and essential fish habitat for Pacific CPS including finfish (northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel) and market squid. CPS are most common in the upper mixed layer of the ocean (above the thermocline) in a broad band (up to hundreds of miles wide) along the coast. CPS may occur in shallow embayments and brackish water, but do not depend on these habitats to any significant degree. In general, older and larger individuals occur further north and offshore. The northern extent of the distribution and essential fish habitat for CPS depends on temperature and biomass. Northern areas tend to be used most extensively when water temperatures are warm and abundance is high. Adult CPS prefer water temperatures in the range 10°C to 26°C. Spawning and successful reproduction occurs at about 14°C to 16°C. "??" indicates unavailable information.

Common Name (Scientific Name)	Lifestage	Punta Baja - Pt. Conception	Pt. Conception - Cape Blanco	Cape Blanco - Queen Charlotte Islands	Queen Charlotte Is. - Western Aleutian Islands	Benthic Association
Northern anchovy (*Engraulis mordax*)	Eggs/Larvae/ Juveniles	yes	yes	yes	no	no
	Adults	yes	yes	yes	no	no
Pacific sardine (*Sardinops sagax*)	Eggs/Larvae/ Juveniles	yes	yes (warm environ. / high abund.)	yes (warm environ. / high abund.)	yes (warm environ. / high abund.)	no
	Adults	yes	yes (warm environ. / high abund.)	yes (warm environ. / high abund.)	yes (warm environ. / high abund.)	no
Pacific (chub) mackerel (*Scomber japonicus*)	Eggs/Larvae/ Juveniles	yes	yes	yes (warm environ. / high abund.)	yes (warm environ. / high abund.)	no
	Adults	yes	yes	yes (warm environ. / high abund.)	yes (warm environ. / high abund.)	no
Jack mackerel (*Trachurus symmetricus*)	Eggs/Larvae/ Juveniles	yes	yes	no	no	no
	Adults	yes	yes	yes	yes	no
Market squid (*Loligo opalescens*)	Eggs/Larvae/ Juveniles	yes	yes	??	??	yes
	Adults	yes	yes	yes	yes	yes

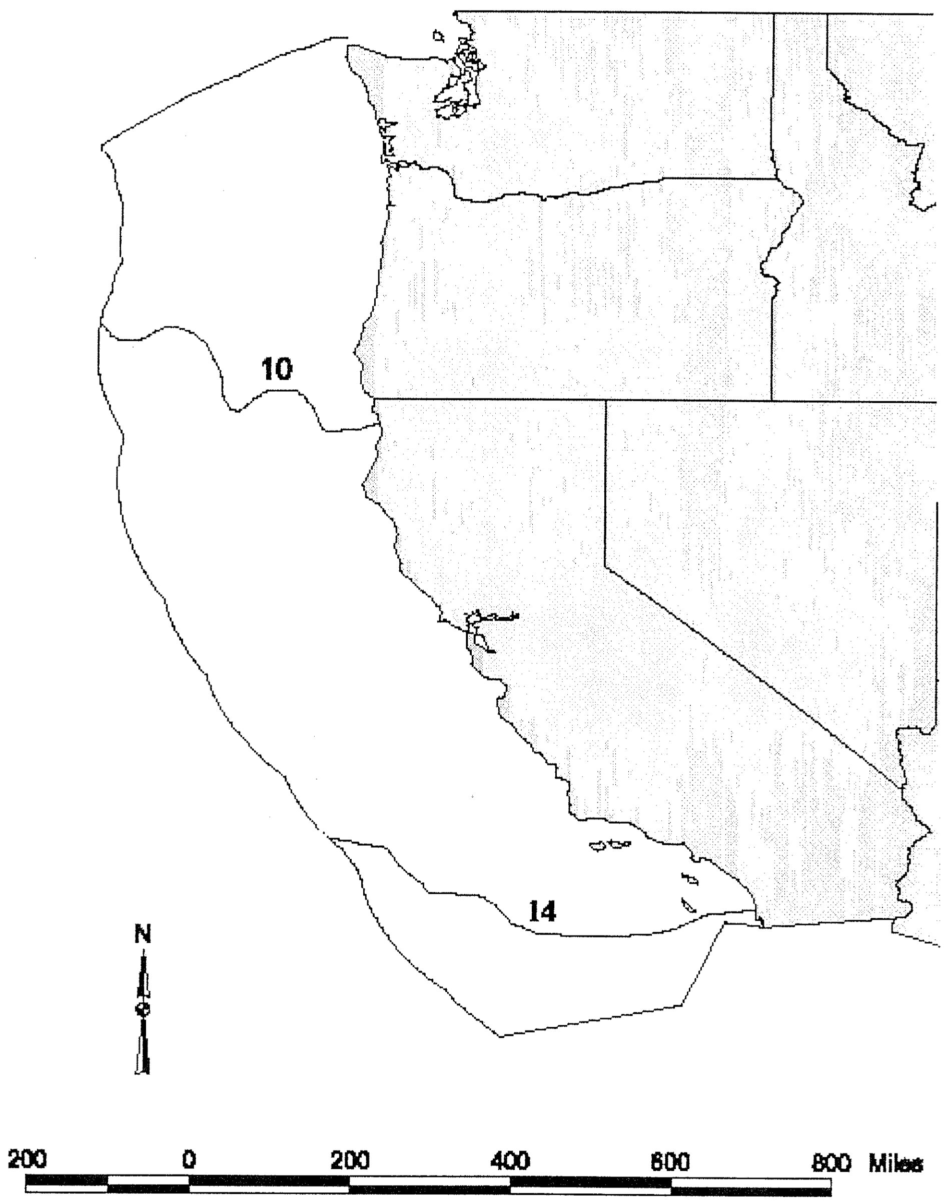


Figure 2-1. February sea surface temperatures (coldest three winters).

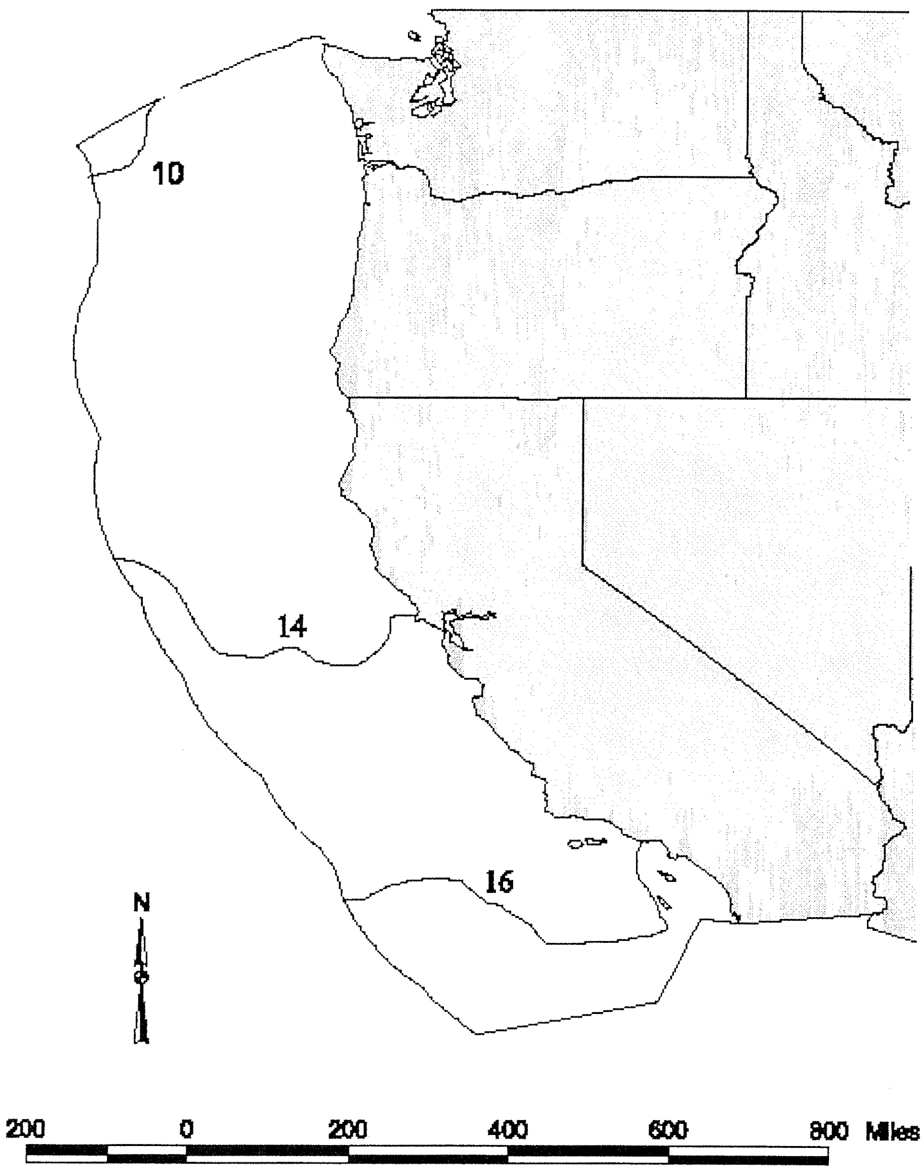


Figure 2-2. February sea surface temperatures (warmest three winters).

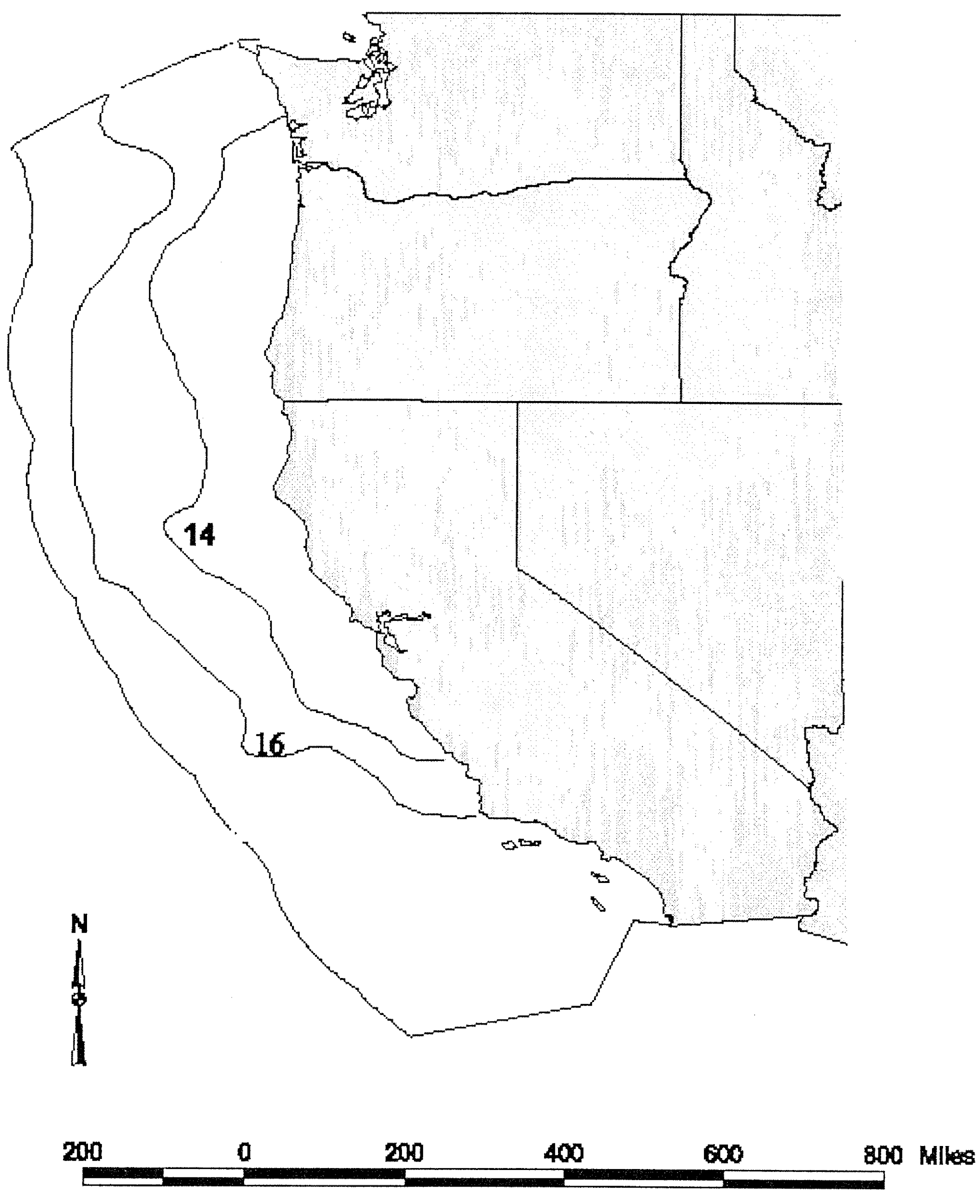


Figure 2-3. August sea surface temperatures (coldest three summers).

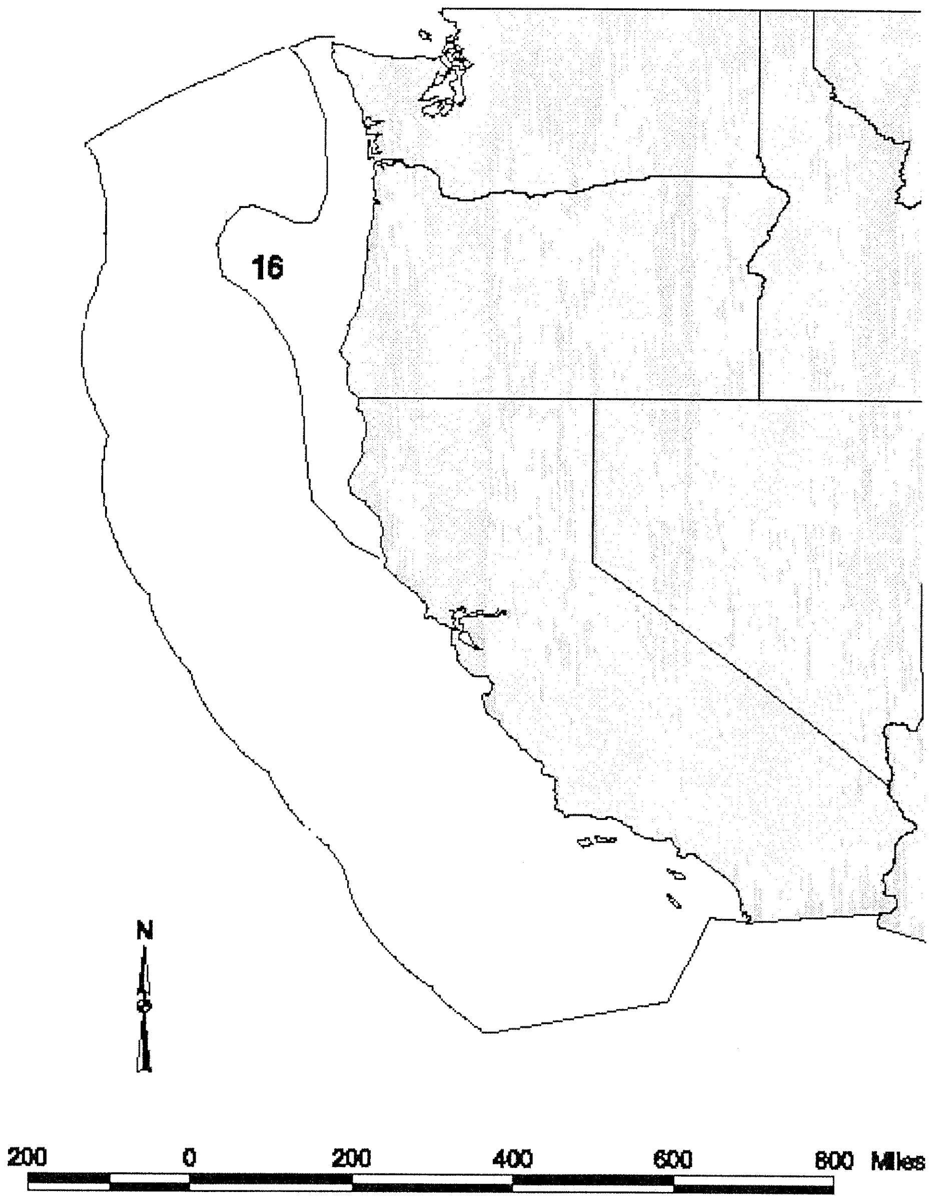


Figure 2-4. August sea surface temperatures (warmest three summers).

3.0 FISHING EFFECTS AND CONSERVATION MEASURES ON COASTAL PELAGIC SPECIES ESSENTIAL FISH HABITAT

3.1 Background

Section 600.815 (a) (3) of the interim final rule lists the mandatory contents of FMPs regarding fishing activities that may adversely affect EFH. The adverse effects from fishing activities may include physical, chemical, or biological alterations of the substrate, and loss of, or injury to, benthic organisms, prey species and their habitat, and other components of the ecosystem. FMPs must include management measures that minimize adverse effects on EFH from fishing, to the extent practicable, and identify conservation and enhancement measures. They must also contain an assessment of the potential adverse effects of all fishing activities in waters described as EFH. This assessment should consider the relative impacts of all fishing equipment types used in EFH on different types of habitat found within EFH. In completing this assessment, Councils should use the best scientific information available, as well as other appropriate information sources, as available. The assessment should also consider the establishment of research closure areas and other measures to evaluate the impact of any fishing activity that alters EFH.

Councils must act to prevent, mitigate, or minimize any adverse effects from fishing activities, to the extent practicable, if there is evidence that a fishing activity is having an identifiable adverse effect on EFH. In determining whether it is practicable to minimize an adverse effect from fishing, Councils should consider whether, and to what extent, the fishing activity is adversely impacting EFH, including the fishery; the nature and extent of the adverse effect on EFH; and whether the management measures are practicable, taking into consideration the long and short-term costs and benefits to the fishery and EFH, along with other appropriate factors, consistent with national standard 7 (conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication).

Fishery management options to prevent, mitigate, or minimize adverse effects from fishing activities may include, but are not limited to:

Fishing gear restrictions: Seasonal and areal restrictions on the use of specified gear; gear modifications to allow escapement of particular species or particular life stages (e.g., juveniles); prohibitions on the use of explosives and chemicals; prohibitions on anchoring or setting gear in sensitive areas; and prohibitions on fishing activities that cause significant physical damage in EFH.

Time/area closures: Closing areas to all fishing or specific gear 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, such as those areas designated as habitat areas of particular concern.

Harvest limits: Limits on the take of species that provide structural habitat for other species assemblages or communities, and limits on the take of prey species.

3.2 Impacts

With the exception of harvesting prey species, fishing for CPS finfish has little effect on CPS EFH because CPS finfish are pelagic at all life stages. Contact between roundhaul gear and substrate is rare in fishing for CPS finfish, because fishing usually occurs in water deeper than the height of the net. Thus, the only opportunity for damage to benthos or EFH for any species in fishing for CPS finfish is from lost gear. There is potential for fishing to impact squid spawning grounds because market squid attach their egg cases to the bottom substrate at spawning sites that include shallow, nearshore areas. Such damage is not believed to be extensive and is transitory with regard to the habitat.

CPS are planktivores at all or most life stages and utilize forage that is not affected by fishing. Pacific (chub) mackerel, jack mackerel, and market squid are piscivorous as adults, however, with diets that include northern anchovy, Pacific (chub) mackerel, young salmon (possibly when water temperatures are warm and pelagic fish are common off the Pacific northwest) and other species of commercial interest. Thus, overfishing of northern anchovy, Pacific sardine, market squid, or other species could adversely affect EFH for Pacific (chub) mackerel, jack mackerel, and market squid. Harvest policies used to manage northern anchovy and Pacific sardine should be taken into consideration while recognizing the importance of these species as forage in the ecosystem as a whole.

Although there are presumably few, if any, direct effects from mid-water trawling on EFH for CPS finfish, other fishery operations may alter species complexity in the water column. Off the Pacific coast, there is a large mid-water trawl fishery for Pacific whiting, primarily occurring north of 39° N latitude. Discharge of offal and processing slurry may affect EFH for CPS. Prolonged offal discards from some large-scale fisheries have redistributed prey food away from mid-water and bottom feeding organisms to surface-feeding organisms like CPS finfish, usually resulting in scavenger and seabird population increases (Hill and Wassenberg 1990, Evans et al. 1994). Offal discards in low-current environments can collect and decompose on the ocean floor, creating anoxic bottom conditions that may affect CPS. Pacific coast marine habitat is generally characterized by strong current and tide conditions, but there may be either undersea canyons affected by at-sea discard, or bays and estuaries affected by discard from shoreside processing plants. As with bottom trawling off the Pacific coast, little is known about the environmental effects of mid-water trawling and processing discards on habitat conditions.

3.3 Conservation Measures to Mitigate Fishing Effects on Coastal Pelagic Species Essential Fish Habitat

There is a growing body of research on the effects of fishing activities on marine habitat and general conclusions about the effects of some gear types on marine habitat may be drawn from this body of research (Auster and Langton, 1998). However, it has been noted above that there has been little research on Pacific coast fisheries EFH and into the fishing effects on such habitat, especially market squid EFH. Implementing measures to mitigate gear impacts on habitat may require research that specifically describes the effects of the fishing gear used in Pacific coast fisheries on marine habitat utilized by market squid. The Council may weigh the magnitude of this potential impact and develop appropriate recommendations for addressing them.

In addition to suggesting measures to restrict fishing gears and methods, NMFS' regulatory guidance on EFH also 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. Some of these closures may already exist, such as the exclusion of trawling within three miles of the California coastline and areas closed to commercial fishing (e.g., Santa Monica Bay). The Council may examine whether such opportunities exist for CPS and make appropriate recommendations for addressing them.

Beyond protecting natural reserves and areal closures for particular species, the Council may consider creating habitat reserves closed to all fishing. Several no-fishing zones have been created by the North Pacific Fishery Management Council for the waters off Alaska, generally for the purposes of protecting either crabs or marine mammal rookeries.

3.4 References

Auster, P. J. and R. W. Langton. The indirect effects of fishing. Draft document prepared for National Marine Fisheries Service, Office of Habitat Conservation, Silver Spring, MD.

4.0 NONFISHING EFFECTS ON COASTAL PELAGIC SPECIES ESSENTIAL FISH HABITAT

4.1 Background

Section 600.815 (a) (5) of the draft interim EFH regulations pertains to identifying nonfishing related activities that may adversely affect EFH. The section states that FMPs must identify activities that have the potential to adversely affect, directly or cumulatively, EFH quantity or quality, or both. Broad categories of activities which can adversely affect EFH include, but are not limited to: dredging, fill, excavation, mining, impoundment, discharge, water diversions, thermal additions, actions that contribute to nonpoint source pollution and sedimentation, introduction of potentially hazardous materials, introduction of exotic species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH. FMPs should describe the EFH most likely to be adversely affected by these or other activities. For each activity, FMPs should describe known and potential adverse impacts to EFH. The descriptions should explain the mechanisms or processes that may cause adverse effects and how these may affect habitat function. A geographical information system (GIS) or other mapping system should be used to support analyses of data and to present these data in an FMP in order to geographically depict impacts identified in this paragraph.

The Magnuson-Stevens Act requires federal agencies undertaking, permitting or funding activities that may adversely affect EFH to consult with NMFS. Under section 305 (b)(4) of the Magnuson-Stevens Act, NMFS is required to provide EFH conservation and enhancement recommendations to federal and state agencies for actions that adversely affect EFH. However, state agencies and private parties are not required to consult with NMFS. EFH consultations will be combined with existing interagency consultations and environmental review procedures that may be required under other statutes such as the Endangered Species Act, Clean Water Act, the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the Federal Power Act, or the Rivers and Harbors Act.

EFH consultation may be at either a broad programmatic level or project-specific level. Programmatic is defined as "broad" in terms of process, geography, or policy (e.g., "national level" policy, a "batch" of similar activities at a "landscape level", etc.) Where appropriate, NMFS will use a programmatic approach designed to reduce redundant paperwork and to focus on the appropriate level of analysis whenever possible. The approach would permit project activities to proceed at broad levels of resolution so long as they conform to the programmatic consultation. The wide variety of development activities over the extensive range of EFH, and the Magnuson-Stevens Act requirement for a cumulative effects analysis warrants this programmatic approach.

4.2 Nonfishing Effects

The following is a general description of nonfishing related activities that may directly or cumulatively, temporarily or permanently, threaten the physical, chemical and biological properties of the habitat utilized by CPS and/or their prey. The direct result of these threats is that EFH may be eliminated, diminished or disrupted. The list includes common activities with known or potential impacts to EFH. The list is not prioritized nor is it to be considered all-inclusive. The potential adverse effects described below, however, do not necessarily apply to the described activities in all cases, as the specific circumstances of the proposed activity or project must be carefully considered on a case-by-case basis. Furthermore, some of the activities described below may also have beneficial effects on habitat, which need to be considered in any analysis of an action's net effect by agencies conducting adverse effects analysis.

Nonfishing related effects on EFH for CPS finfish (northern anchovy, Pacific sardine, Pacific (chub) mackerel, or jack mackerel) may not be as adverse relative to other EFH types, because adults and juveniles are mobile, and all life stages are pelagic (in the water column near the surface and not associated with substrate) and dispersed in a wide band along the west coast of north America. However, impacts to CPS finfish prey are conceivable. Nonfishing adverse impacts on EFH may be more important for market squid that attach their egg cases to the substrate at spawning sites that include shallow, near shore areas. Table 4.0-1 summarizes the potential adverse impacts of these nonfishing activities and conservation/enhancement measures to minimize those effects.

4.2.1 Dredging

Dredging navigable waters has a periodic impact on benthic and adjacent habitats during construction and operation of marinas, harbors and ports. Periodic dredging is required to maintain or create ship (e.g., ports) and boat (e.g., marinas) access to docking facilities. Dredging is also used to create deepwater navigable channels or to maintain existing channels that periodically fill with sediments from rivers or transported by wind, wave, and tidal processes. In the process of dredging, large quantities and qualities of the seafloor are removed, disturbed, and resuspended and the biological characteristics of the seafloor are changed. Turbidity plumes may arise.

4.2.1.1 Adverse Impacts

Dredging events using certain types of dredging equipment can result in greatly elevated levels of fine-grained mineral particles, usually smaller than silt, and organic particles in the water column habitat utilized by CPS finfish. These turbidity plumes of suspended particulates may reduce light penetration and lower the rate of photosynthesis (e.g., adjacent eelgrass beds) and the primary productivity of an aquatic area if suspended for variable periods of time. CPS finfish may suffer reduced feeding ability if suspended particulates persist. The contents of the suspended material may react with the dissolved oxygen in the water and result in short-term oxygen depletion to aquatic resources. Toxic metals and organics, pathogens, and viruses absorbed or adsorbed to fine-grained particulates in the material may become biologically available to organisms either in the water column or through food chain processes.

Dredging as well as the equipment used in the process such as pipelines may damage or destroy spawning, nursery habitat and other sensitive habitats important to market squid. Within bays and harbors, dredging may also modify current patterns and water circulation of the habitat by changing the direction or velocity of water flow, water circulation, or otherwise changing the dimensions of the water body potentially utilized by CPS finfish.

4.2.1.2 References

Collins, M. A. 1995. Dredging-induced near-field resuspended sediment concentration and source strengths. Miscellaneous Paper D-95-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A299 151.

Farnworth, E.G., M. C. Nichols, C.N. Vann, L. G. Wolfson, R. W. Bosserman, P. R. Hendrix, F. B. Golley, and J. L. Cooley. 1979. Impacts of sediment and nutrients on biota in surface waters of the United States. EPA; Athens, GA (USA)., Oct 1979., 331 p., Ecol. Res. Series U. S. Environ. Protect. Agency.

LaSalle, M. W., Clarke, D. G., Homziak, J., Lunz, J. D., and Fredette, T. J. (1991). A framework for assessing the need for seasonal restrictions on dredging and disposal operations. Technical Report D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A240 567.

Port of Long Beach, California, Port of Los Angeles, California, Department of the Army, Corps of Engineers, Department of the Interior, Fish and Wildlife Service; Department of Commerce, National Oceanic and Atmospheric Administration. 1990. Phase I 2020 Plan and Feasibility Study, Los Angeles and Long Beach Harbors, San Pedro Bay, California. EPA No.: 900342D, 987 pages and maps, September 10, 1990.

4.2.2 Dredge Material Disposal/Fills

The discharge of dredged materials subsequent to dredging operations or the use of fill material in the construction/development of harbors results in sediments (e.g., dirt, sand, mud) covering or smothering existing submerged substrates. Usually these covered sediments are of a soft-bottom nature as opposed to rock or hard-bottom substrates.

4.2.2.1 Adverse Impacts

The disposal of dredged or fill material can result in varying degrees of change in the physical, chemical, and biological characteristics of the substrate. Direct discharges may adversely alter the habitat of benthic organisms such as market squid. Subsequent erosion, slumping, or lateral displacement of surrounding bottom of such deposits can also adversely affect substrate outside the perimeter of the disposal site by changing or destroying benthic habitat. The bulk and composition of the discharged material and the location, method, and timing of discharges may all influence the degree of impact on potential market squid EFH. The discharged material can also change the chemistry of the receiving water at the disposal site by introducing chemical constituents in suspended or dissolved form.

The discharge of dredged or fill material can result in greatly elevated levels of fine-grained mineral particles, usually smaller than silt, and organic particles in the water column thereby affecting CPS finfish. These suspended particulates may reduce light penetration and lower the rate of photosynthesis and the primary productivity of an aquatic area if suspended for lengthy intervals. CPS finfish may suffer reduced feeding ability leading to limited growth and lowered resistance to disease if high levels of suspended particulates persist. The contents of the suspended material may react with the dissolved oxygen in the water and result in oxygen depletion. Toxic metals and organics, pathogens, and viruses absorbed or adsorbed to fine-grained particulates in the material may become biologically available to organisms either in the water column or through food chain processes.

4.2.2.2 References

Peddicord, R.K. and J. B. Herbich (ed.). 1979. Impacts of open-water dredged material discharge. Proceedings of the eleventh dredging seminar., Publ. by: TAMU; College Station, TX (USA)., Oct 1979., p. 24-40., Rep. Tex. A and M Univ. Sea Grant Program

National Oceanic and Atmospheric Administration. 1991. National Status and Trends Program for marine environmental quality. Progress report on secondary summary of data on chemical contaminants in sediments from the National Status and Trends Program. Tech. Mem. NOS OMA 59. NOAA, NOS, Silver Spring, MD. 29pp.

4.2.3 Oil/Gas Exploration/Production

Oil exploration/production occurs in a wide range of water depths and usually over soft-bottom substrates although hard-bottom habitats may be present in the general vicinity. Oil exploration/production areas are vulnerable to an assortment of physical, chemical, and biological disturbances as oil and gas deposits are located using high energy seismic surveys. EFH may be disrupted by the use and/or installation of anchors, chains, drilling templates, dredging, pipes, and platform legs. During actual operations, chemical contaminants may also be released into the aquatic environment.

4.2.3.1 Adverse Impacts

The impacts of oil exploration-related seismic energy release may interrupt and cause CPS finfish to disperse. Available data indicates that sensitive egg and larval stages within a few meters of the sources of seismic energy releases are not affected, however, disruption to CPS finfish feeding is possible.

Exploratory activities may also result in resuspension of fine-grained mineral particles, usually smaller than silt in the water column. These suspended particulates may reduce light penetration and lower the rate of photosynthesis and the primary productivity of the aquatic area especially if suspended for lengthy intervals. The contents of the suspended material may react with the dissolved oxygen in the water and result in oxygen depletion.

The discharge of oil drilling muds can change the chemistry and physical characteristics of the receiving water at the disposal site by introducing toxic chemical constituents thereby potentially impacting market squid EFH. Changes in the clarity and the addition of contaminants can reduce or eliminate the suitability of water bodies for habituation of fish species and their prey.

4.2.3.2 References

Battelle Ocean Sciences. 1988. The Effects of Seismic Energy Releases on the Zoeal Larvae Of the Dungeness Crab *(Cancer magister)*. Submitted by: Battelle Memorial Institute, Marine Research Laboratory, 439 W. Sequim Bay Road, Sequim, Washington to State of California Department of Fish and Game 1416 Ninth Street, Sacramento, California 95814. Contract Number 6c-194398-382

Coats, D. A. 1994. Deposition of drilling particulates off Point Conception, California. Mar. Environ. Res. 37:95-127.

Hyland, J., D. Hardin, M. Steinhauer, D. Coats, R. Green, and J. Neff. 1994. Environmental impact of offshore oil development on the outer continental shelf and slope off Point Arguello, California. Mar. Environ. Res. 37:195-229.

MEC Analytical Systems. 1995. Disturbance of deep-water reef communities by exploratory oil and gas operations in the Santa Maria Basin and Santa Barbara Channel. U.S. DOI, Minerals Management Service, Camarillo, CA. OCS Study MMS 95-0030

4.2.4 Water Intake Structures

The withdraw of ocean water by offshore water intakes structures is a common coastwide occurrence. Water may be withdrawn for providing sources of cooling water for coastal power generating stations or as a source of potential drinking water as in the case of desalinization plants. If not properly designed, these structures may create unnatural and vulnerable conditions to various fish life stages and their prey.

4.2.4.1 Adverse Impacts

The withdrawal of seawater can create unnatural habitat conditions to the EFH for all life stages of CPS finfish as well as their prey. Various life stages of CPS can be affected by water intake operations such as entrapment through water withdrawal, impingement on intake screens, and entrainment through the heat-exchange systems or discharge plumes of both heated and cooled effluent.

4.2.4.2 References

Helvey, M. 1985. Behavioral factors influencing fish entrapment at offshore cooling-water intake structures in southern California. Marine Fisheries Review 47(1) 18-26.

4.2.5 Aquaculture

The culture of estuarine, marine, and freshwater species in coastal areas can reduce or degrade habitats used by native stocks. The location and operation of these facilities will determine the level of impact on the marine environment.

4.2.5.1 Adverse Impacts

A major concern of aquaculture operations is the discharge of organic waste from the farms. Wastes are composed primarily of feces and excess feed and the buildup of waste products into the receiving waters will depend on water depths and circulation patterns. The release of these wastes may introduce nutrients or organic materials into the surrounding water body and lead to a high biochemical oxygen demand (BOD) which may reduce dissolved oxygen, thereby potentially affecting the survival of many aquatic organisms in the area. Net effects to CPS may be either positive or negative.

Aquaculture operations also have the potential to release high levels of antibiotics, disease, as well as allowing cultured organisms to escape into the environment. These events have unknown but potential adverse impacts on fish habitat.

4.2.5.2 References

British Columbia Minist. of Environment, Victoria, (Canada). Water Management Branch. 1990. Environmental management of marine fish farms. 28 pp NTIS Order No.: MIC-91-00496/GAR.

4.2.6 Wastewater Discharge

The discharge of point and nonpoint source wastewater from activities including municipal wastewater treatment plants, power generating stations, industrial plants (e.g., pulp mills, desalination plants) and storm drains into open ocean waters, bay or estuarine waters can introduce pollutants detrimental to estuarine and marine habitats. These pollutants include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, hydrocarbons and other toxics. Historically, wastewater discharges have been one of the largest sources of contaminants into coastal waters. However, whereas wastewater discharges have been regulated under increasingly more stringent requirements over the last 25 years, non-point source/ stormwater runoff has not, and continues to be a significant remaining source of pollution to the coastal areas and ocean. Outfall-related changes in community structure and function, health and abundance may result. Many of these changes can be long-lasting.

4.2.6.1 Adverse Impacts

Wastewater effluent and non-point source/ stormwater discharges may affect the growth and condition of fish associated with wastewater outfalls should high contaminant levels (e.g., chlorinated hydrocarbons; pesticides; herbicides) be discharged. In addition, the high nutrient levels downcurrent of these outfalls may also be a concern. If contaminants are present, they may become bioavailable by absorption across the gills or bioaccumulate as a result of consuming contaminated prey. This is especially true for benthic-feeding fish frequenting wastewater discharge outfalls. Due to bioturbation, diffusion, and other upward transport mechanisms, buried contaminants may migrate to surface layers and become bioavailable.

Prager and MacCall (1993) detected possible effects of contaminant loadings in the ocean off southern California on reproductive success of Pacific sardine but not for northern anchovy or Pacific (chub) mackerel. Contaminant loadings were measured using a synthetic variable that included data from a wide variety of sources along the coast of southern California. The study was meant to generate rather than test hypotheses, however, and results were not definite.

Localized sources of pollution may effect CPS in bays and harbors along the coast but likely may not affect CPS stocks as a whole because CPS are distributed over large areas of the open coast and respond quickly to adverse changes in their environment by moving away. It is known however, that growth and survival of Pacific sardine adults can be affected by low level exposure to paper and cardboard pulp suspended in the water and ingested while feeding. Data are limited for most CPS, but information available for northern anchovy (see below) is probably applicable to other CPS species.

There is relatively little information regarding the water quality requirements and preferences of northern anchovy except for studies in the Los Angeles area concerning environmental problems corrected decades ago. Oxygen depletion due to die-off of massive dinoflagellate blooms caused occasional fish kills in both Santa Cruz Harbor and Fish Harbor (1973 to 1974) at Terminal Island, Los Angeles. Prior to regulatory control, oxygen depletion due to excessive dumping of high oxygen demand wastes into waters with reduced circulation caused episodes of fish kills as well, but such areas provided attractive food supplies preliminary to the oxygen depletion events. Anchovy tended to congregate around areas of sewage outfall, such as White's Point off Palos Verdes Peninsula, and prior to regulatory control, around the outfalls of the Terminal Island fish processors and sewage treatment plant.

Impacts of cannery and sewage waste on anchovy have been studied extensively only in the Los Angeles Harbor area during the 1980s and earlier. At the time of the studies, anchovy reduction processing was only one of the various fishery products that contributed to cannery effluent. Cannery wastes for many years were dumped into Inner Fish Harbor along with pumpings from boat holds and human wastes. The waters were frequently anoxic and the debris laden bottom was devoid of benthic macro organisms. In 1964, two cannery discharges were relocated intertidally outside Fish Harbor in Los Angeles Harbor not far from the sewage treatment outfall (Soule and Oguri, 1973). The Way Street Station outfall received wastes from various canneries and the other discharges effluent from only Starkist canneries. The discharge of cannery wastes was most critical during the fall of the year when seasonal die-off of biota from late summer and early fall plankton blooms and water column turnover placed a heavy natural oxygen demand on the receiving waters (Chamberlain 1975). Soule and Oguri (1976) report that "under (then) present conditions, a small zone within approximately 200 feet of the outfalls exists where numbers of species are low. Adjacent to this zone is a zone of enrichment which extends through most of the outer harbor. Beyond that, conditions return to average coastal populations. The regulations of waste loadings and control of pollutants in the past six-year period has brought the harbor ecosystem from a depauperate biota to a moderately rich one in the immediate outfalls zone, with a very rich biota in the adjacent outer harbor area."

Soule and Oguri (1973) reported that "Nothing is known about the distance traveled by individual anchovies within the harbor, nor about the degree to which they move in and out of the harbor. Catches by the bait boats, presently being surveyed, indicate that there may be an area of inhibition in the immediate vicinity of the cannery outfalls. There are indications that the anchovies move away from the area when the oxygen is low and also when it is excessively high, during plankton blooms. Weather conditions may exert influence as well, for anchovies apparently disappeared from harbor catches prior to heavy winter storms and subsequent rainwater runoff. They also were not caught in the harbor near the end of the season when the Davidson Current brought warmer southerly waters into the area, but reappeared just after water temperatures dropped."

Turbid waters with high densities of edible fine particulate matter apparently made harbor waters an excellent habitat for larval and juvenile fishes. Fish productivity began to decrease when dissolved air flotation treatment (DAF) was installed on the cannery waste streams in 1975, even though esthetically the harbors were improved. The installation of secondary waste treatment at the Terminal Island Treatment Plant and the subsequent connecting of cannery waste streams to the treatment plant in 1977 to 1978 resulted in a dramatic decrease in harbor biota and, in particular, in anchovies (Soule and Oguri 1979; 1980). Benthic populations decreased three-to four-fold in the outer harbor between 1973 and 1978, and the fish populations, sampled by otter trawl, also dropped four-fold. Trawl catches of anchovy in the outer harbor decreased about ten-fold between 1973 and 1974 continued to decrease at a slower rate through 1978 (Soule and Oguri 1980). The offshore anchovy population increased from 1973 to 1974 then decreased about five-fold through 1978 and recovered in 1979. Anchovy and other fish have been attracted to the harbor during episodes when the treatment plant malfunctioned and released high biological oxygen demand floc and wastes, and when dredging created high levels of turbidity and resuspended edible particulates and microbiota. Fish catches by commercial party boats decreased dramatically off the Orange County Sanitation District outfall after conversion to a deep water outlet (Soule and Oguri 1982).

The use of biocides (e.g., chlorine; heat treatments) to prevent biofouling or the discharge of brine as a byproduct of desalinization may reduce the suitability of water bodies for populations of fish species and their prey in the general vicinity of the discharge pipe. The impacts of chlorination and heat treatments, if any, are minimized due to their intermittent use and regulation pursuant to state and/or federal national pollutant discharge elimination system (NPDES) permit requirements. These compounds may change the chemistry and the physical characteristics of the receiving water at the disposal site by introducing chemical constituents in suspended or dissolved form. In addition to chemical and thermal effects, discharge sites may adversely impact sensitive areas such as emergent marshes, seagrasses, and kelp beds if located improperly.

High discharge velocities may cause scouring at the discharge point as well as entrainment of particulates with resulting turbidity plumes. Turbidity plumes may reduce light penetration and lower the rate of photosynthesis and the primary production in an area if suspension persists. Fish may suffer reduced feeding ability especially if suspended particulates persist. The contents of the suspended material may react with the dissolved oxygen in the water and result in oxygen depletion.

A significant portion of impacts to coastal waters may also be caused by nonpoint source pollution. Major sources in coastal waters include agriculture and urban runoff. Other significant sources include faulty septic systems, forestry, marinas and recreational boating, physical changes to stream channels, and habitat degradation, especially the destruction of wetlands and vegetated areas near streams. Runoff can include heavy metals, pesticides, fertilizers, synthetic and petroleum hydrocarbons, and pet droppings. Unless proper management measures are incorporated, these contaminants can find their way into the food web through benthic infaunal communities and subsequently bioaccumulate in numerous fish species.

4.2.6.2 References

Bay, S. and D. Greenstein. 1994. Toxic effects of elevated salinity and desalination waste brine. *In:* J. Cross (ed.) Southern California Coastal Water Research Project, Annual Report 1992-93, pp. 149-153. SCCWRP, Westminster, CA.

Environmental Protection Agency; Department of Commerce, National Oceanic and Atmospheric Administration. 1995. Coastal Nonpoint Pollution Control Program. EPA number: 950298D, 100 pages, July 7, 1995.

Ferraro, S. P., R.C. Swartz, F. A. Cole, and D.W. Schults. 1991. Temporal changes in the benthos along a pollution gradient: discriminating the effects of natural phenomena from sewage-industrial wastewater effects. Estuarine Coastal Shelf sei. 33:383-407.

Leonard, J.N. 1994. Ocean outfalls for wastewater discharges -- meeting Clean Water Act 403C requirements. Marine Technology Soc. '94, Conference Proceedings. Challenges and Opportunities in the Marine Environment, Washington, DC, 7-9 Sept. pp. 115-120.

Stull, J. K. and C. I. Haydock. 1989. Discharges and environmental responses: the Palos Verdes case. *In* Managing inflows in California's bays and estuaries. The Bay Institute, Sausalito, Calif. Pp. 44-49.

USEPA. 1993. Guidance for specifying management measures for sources of nonpoint pollution in coastal waters. Office of Water. 840-B-92-002. 500+p.

Raco-Rands, V. E. 1996. Characteristics of effluents from power generating stations in 1994. *In:* M. J. Allen (ed.) Southern California Coastal Water Research Project, Annual Report 1994-95. SCCWRP, Westminster, CA, pp29-36.

Soule, D.F., and M. Oguri. 1973. Introduction. In: D. Soule and M. Oguri (eds.). Biological investigations, p. 1-20. Marine Studies of San Pedro Bay, California. Part XVI. Allan Hancock Foundation and California Sea Grant Program, Institute of Marine and Coastal Studies, University of Southern California.

Soule, D.F., and M. Oguri. 1976. Executive summary, p. iv. *In*: D. Soule and M. Oguri (eds.). Bioenhancement studies of the receiving waters in outer Los Angeles Harbor. Marine Studies of San Pedro Bay, California. Part 12. Allan Hancock Foundation and California Sea Grant Program, Institute of Marine and Coastal Studies, University of Southern California.

Soule, D.F., and M. Oguri. 1979. Ecological changes in the outer Los Angeles-Long Beach harbors following initiation of secondary treatment and cessation of fish cannery waste effluent. *In*: Marine studies of San Pedro Bay, California. Part 16. Allan Hancock Foundation and California Sea Grant Programs, Institute of Marine and Coastal Studies. University of Southern California: 597 p.

Soule, D.F., and M. Oguri. 1980. The marine environment in Los Angeles and Long Beach harbors during 1978. Marine studies of San Pedro Bay, California. Part 17. Allan Hancock Foundation, California Sea Grant Program, Institute of Marine and Coastal Studies, University of Southern California, and U.S. Army Corps of Engineers: 688 p. + appendix.

Soule, D.F., and M. Oguri. 1982. Evaluation of the outer Los Angeles Harbor benthos in 1981- 82, compared with conditions from 1971-78 investigations. Special report part B. Harbors Environmental Projects, University of Southern.

Vetter, R., L. Robertson, and C.A. Kimbrell (In prep.). Effects of dispersed paper waste on the filter-feeding capacity, ingestion of paper and growth of Pacific sardine, *Sardinops sagax*. Southwest Fisheries Science Center, La Jolla, CA.

4.2.7 Discharge of Oil or Release of Hazardous Substances

The discharge of oil or release of a hazardous substance into estuarine and marine habitats, or exposure to a product of reactions resulting from the discharge of oil or release of a hazardous substance can have both acute and chronic effects on fish resources and their prey.

4.2.7.1 Adverse Impacts

Exposure to petroleum products and hazardous substances from spills or other unauthorized releases can have both acute and chronic effects on fish resources and their prey, and also potentially reduce the marketability of target species. Direct physical contact with discharged oil or released hazardous substances (e.g., toxics; oil dispersants, mercury) or indirect exposure resulting from food chain processes can produce a number of biological responses in fish resources and their prey. These responses can occur in a variety of habitats including the water column, seafloor, bays, and estuaries. Chronic and large oil spills have a significant impact on fishery populations.

Other issues related to the category include efforts to cleanup spills or releases that in themselves can create serious harm to the habitat. For example, the use of potentially toxic dispersants to break up an oil spill may adversely effect the egg, larval, and adult stages of CPS finfish.

4.2.7.2 References

Armstrong, D. A., P. A. Dinnel, J. M. Orensanz, J.L. Armstrong, T. L. McDonald, R. F. Cusimano, R. S. Nemeth, M. L. Landolt, J. R. Skalski, R. F. Lee, and R. J. Huggett. Status of Selected Bottomfish and Crustacean Species in Prince William Sound Following the Exxon Valdez Oil Spill. IN: Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters, ASTM STP 1219, pp. 485-547, Peter G. Wells, James N. Butler, and Jane S. Hughes, Eds., American Society for Testing and Materials, Philadelphia, 1995.

California Department of Fish and Game. Quick approval process for dispersant use in waters off California. Unpublished, undated document. Person. Comm. from Michael Sowby, CDFG, Oil Spill Prevention and Response Office to Mark Helvey, NMFS, March, 1998.

Southern California Coastal Water Research Project. 1992. Hazardous spills in the Southern California Bight. *In:* J. Cross (ed.) Annual Report 1990-91 and 1991-92, pp. 29-38. SCCWRP, Westminster, CA. 92683.

4.2.8 Coastal Development Impacts

Coastal development involves changes in land use by the construction of urban, suburban, commercial, and industrial centers and the corresponding infrastructure. Vegetated and open forested areas are removed by cut-and-fill activities for enhancing the development potential of the land. Portions of the natural landscape are converted to impervious surfaces resulting in increased runoff volumes. Runoff from these developments include heavy metals, sediments, nutrients and organics, including synthetic and petroleum hydrocarbons, yard trimmings, litter, debris, and pet droppings. As residential, commercial, and industrial growth continues, the demand for water escalates. As ground water resources become depleted or contaminated, greater demands are placed on surface water through dam and reservoir construction or other methods of freshwater diversion. The consumptive use of redistribution of significant volumes of surface freshwater causes reduced river flows that can affect salinity regimes as saline waters intrude further upstream.

4.2.8.1 Adverse Impacts

Development activities within watersheds and in coastal marine areas may impact fish habitat on both long-term and short term scales. Runoff of toxics reduces the quality and quantity of water column and benthic EFH for CPS by the introduction of pesticides, fertilizers, petrochemicals, construction chemicals (e.g., concrete byproducts, seals and paints).

4.2.8.2 References

Baird, RC. 1996. Toward new paradigms in coastal resource management: Linkages and institutional effectiveness. Spagnolo, RJ; Ambrogio, E; Rielly, FJ Jr (eds). Estuaries, 19(2A): 320-335.

Drinkwater, KF and K.T. Frank. 1994. Effects of river regulation and diversion on marine fish and invertebrates. Aquat. Conserv.: Mar. Freshwat. Ecosyst. 4(2): 135-151.

McLusky, DS, D. M. Bryant, and M. Elliot. 1992. The impact of land-claim on macrobenthos, fish and shorebirds on the Forth Estuary, eastern Scotland. Aquat. Conserv.: Mar. Freshwat. Ecosyst. 2 (3): 211-222.

Paul, JF; K. J. Scott, A. F. Holland, S. B. Weisberg, J. K. Summers and A. Robertson. 1992. The estuarine component of the US E.P.A.'s Environmental Monitoring and Assessment Program. Papers from the First International Ocean Pollution Symposium, 28th April 1991--2nd May 1991. University of Puerto Rico, Puerto Rico, (Part Two). Chem. Ecol.7 (1-4): 93-116.

Rozengurt, M.A., I. Haydock, and B.P. Anderson. 1994. Running on entropy: The effect of water diversion on the coastal zone. 37th Conference of the International Association for Great Lakes Research and Estuarine Research Federation: Program and Abstracts., Buffalo, NY (USA). 166pp.

Turek, J. G., T. E. Bigford, and J. S. Nichols. 1987. Influence of freshwater inflows on estuarine productivity. NOAA Tech. Memo. NMFS-F/NEC-46. 26p.

U.S. Environmental Protection Agency. 1993. Guidance for specifying management measures for sources of nonpoint pollution in coastal waters. Office of Water. 840-B-92-002. 500+p.

5.0 CONSERVATION AND ENHANCEMENT MEASURES

5.1 Background

Section 600.815 (a) (7) of the EFH regulations states that FMPs must describe options to avoid, minimize, or compensate for the adverse effects and promote the conservation and enhancement of EFH. Generally, nonwater dependent actions should not be located in EFH if such actions may have adverse impacts on EFH. Activities that may result in significant adverse affects on EFH, should be avoided where less environmentally harmful alternatives are available. If there are no alternatives, the impacts of these actions should be minimized. Environmentally sound engineering and management practices should be employed for all actions which may adversely affect EFH. Disposal or spillage of any material (dredge material, sludge, industrial waste, or other potentially harmful materials) which would destroy or degrade EFH should be avoided. If avoidance or minimization is not possible, or will not adequately protect EFH, compensatory mitigation to conserve and enhance EFH should be recommended. FMPs may recommend proactive measures to conserve or enhance EFH. When developing proactive measures, the Council may develop a priority ranking of the recommendations to assist federal and state agencies undertaking such measures.

5.2 Measures

Established policies and procedures of the Council and the NMFS provide the framework for conserving and enhancing essential fish habitat. Components of this framework include adverse impact avoidance and minimization; provision of compensatory mitigation whenever the impact is significant and unavoidable; and incorporation of enhancement. New and expanded responsibilities contained in the Magnuson-Stevens Act will be met through appropriate application of these policies and principles. In assessing the potential impacts of proposed projects, the Council and NMFS are guided by the following general considerations:

- The extent to which the activity would directly and indirectly affect the occurrence, abundance, health, and continued existence of fishery resources.
- The extent to which the potential for cumulative impacts exists.
- The extent to which adverse impacts can be avoided through project modification, alternative site selection or other safeguards.
- The extent to which the activity is water dependent if loss or degradation of EFH is involved.
- The extent to which mitigation may be used to offset unavoidable loss of habitat functions and values.

The following activities have been identified as potentially, directly or indirectly, affecting the habitat utilized by all or some CPS: dredging, fills/dredge material disposal, oil/gas exploration/production, water intake structures, aquaculture, wastewater discharge, discharge of oil or release of hazardous substances, and coastal development. The following measures are suggested in an advisory, not mandatory, capacity as proactive conservation measures that would aid in minimization or avoidance of the adverse effects of these nonfishing activities on essential fish habitat.

5.2.1 Dredging

1. To the maximum extent practicable, new, as opposed to maintenance dredging, should be avoided. Activities that require dredging (such as placement of piers, docks, marinas, etc.) should be sited in deep water areas or designed in such a way as to alleviate the need for maintenance dredging. Projects should be permitted only for water dependent purposes, when no feasible alternatives are available.
2. Where the dredge equipment employed could cause significant long term impacts due to entrainment of prey species, dredging in estuarine waters shallower than 20 feet in depth should be performed during the time frame when prey species are least likely to be entrained.

3. All dredging permits should reference latitude-longitude coordinates of the site so information can be incorporated into GIS for tracking cumulative impacts. Inclusion of aerial photos may also be required to help geo-reference the site and evaluate impacts over time.

4. Sediments should be tested for contaminants as per the Environmental Protection Agency and U.S. Army Corps of Engineers requirements to determine proper removal and disposal procedures.

5. The cumulative impacts of past and current dredging operations on EFH should be considered and described by federal, state, and local resource management and permitting agencies and considered in the permitting process.

6. Where a dredging equipment type is used that is expected to create significant turbidity (e.g., clamshell), dredging should be conducted using adequate control measures to minimize turbidity.

5.2.2 Fills/Dredge Material Disposal

1. Upland dredge disposal sites should be considered as an alternative to offshore disposal sites. Fills should not be allowed in areas with subaquatic vegetation or other areas of high productivity. Survey should be undertaken to identify least productive areas prior to disposal. Use of clean dredge material meeting Army Corps of Engineers and state water quality requirements for beach replenishment and other beneficial uses (e.g., creation of eelgrass beds) is encouraged.

2. The cumulative impacts of past and current fill operations on EFH should be addressed by federal, state, and local resource management and permitting agencies and considered in the permitting process.

3. Any disposal of dredge material in EFH should meet applicable state and/or federal quality standards for such disposal.

4. When reviewing open water disposal permits for dredged material, state and federal agencies should identify the direct and indirect impacts such projects may have on EFH. Benthic productivity should be determined by sampling prior to any discharge of fill material. Sampling design should be developed with input from state and federal resource agencies.

5. The areal extent of the disposal site should be minimized. However, in some cases, thin layer disposal may be less deleterious. All non-avoidable, adverse impacts (other than insignificant impacts) should be fully mitigated.

6. All spoil disposal permits should reference latitude-longitude coordinates of the site so information can be incorporated into GIS systems. Inclusion of aerial photos may also be required to help geo-reference the site and evaluate impacts over time.

5.2.3 Oil/Gas Exploration/Production

1. Benthic productivity should be determined by sampling prior to any exploratory operations. Areas of high productivity should be avoided to the maximum extent possible. Sampling design should be developed with input from state and federal resource agencies.

2. Mitigation should be fully addressed for impacts.

3. Containment equipment and sufficient supplies to combat spills should be on site at all facilities that handle oil or hazardous substances.

4. Each facility should have a "Spill Contingency Plan" and all employees should be trained in how to respond to a spill.

5. To the maximum extent practicable, storage of oil and hazardous substances should be located in an area that would prevent spills from reaching the aquatic environment.

5.2.4 Water Intake Structures

1. New facilities that rely on surface waters for cooling should be located in areas of low productivity or areas not prone to congregating CPS and their prey. New discharge points should be located in areas that have low concentrations of living marine resources, or they should incorporate cooling towers that employ sufficient safeguards to ensure against release of blow-down pollutants into the aquatic environment in concentrations that exceed state and/ or federal limits established pursuant to state and/ or federal NPDES regulations.

2. All intake structures should be designed to minimize entrainment or impingement of prey species. Power plant intake structures should be designed to meet the "best technology available" requirements as developed pursuant to Section 316b of the Clean Water Act.

3. Discharge temperatures (both heated and cooled effluent) should comply with applicable temperature limits established pursuant to state and/ or federal NPDES regulations.

5.2.5 Aquaculture Facilities

1. Facilities should be located in upland areas as often as possible. Tidally influenced wetlands should not be enclosed or impounded for mariculture purposes. This includes hatchery and grow-out operations. Siting of facilities should also take into account the size of the facility, the presence or absence of submerged aquatic vegetation, proximity of wild fish stocks, migratory patterns, and competing uses. Areas of high productivity should be avoided to the maximum extent possible.

2. Water intakes should be designed to avoid entrainment and impingement of fish species.

3. Water discharge should be treated to avoid contamination of the receiving water, and should be located only in areas having good mixing characteristics.

4. Where cage mariculture operations are undertaken, water depths and circulation patterns should be investigated and should be adequate to preclude the buildup of waste products, excess feed, and chemical agents.

5. Any net pen structure should have small enough webbing to prevent entanglement by prey species.

6. Measures should be taken to avoid escapement of farmed animals.

7. Mitigation should fully address all impacts.

5.2.6 Wastewater Discharge

1. New outfall structures should be placed offshore sufficiently far enough to prevent discharge water from impacting productive areas. Discharges should be managed to comply with applicable state and/or federal NPDES permit requirements, including compliance with applicable technology-based and water quality-based effluent limits.

2. The establishment of management programs to address non-point source/stormwater pollution water quality issues on a watershed basis is supported and encouraged.

5.2.7 Discharge of Oil or Release of Hazardous Substances

1. Containment equipment and sufficient supplies to combat spills should be on-site at all facilities that handle oil or hazardous substances.

2. Facilities should have a "Spill Contingency Plan", where required by applicable local, state, or federal requirements, and employees identified in the plan as having responsibility for responding to a spill should receive appropriate training.

3. To the maximum extent practicable, storage of oil and hazardous substances should be located in an area that would prevent spills from reaching the aquatic environment.

5.2.8 Coastal Development Impacts

1. Prior to installation of any piers or docks benthic productivity should be determined and areas with high productivity avoided. Sampling design should be developed with input from state and federal resource agencies.

2. Fueling facilities should be equipped with all necessary safeguards to prevent spills. A spill response plan should be developed and gear necessary for combating spills should be located on sight.

3. Filling of any aquatic areas should be curtailed as much as reasonably possible.

5.3 References

Botkin, D., K. Cummins, T. Dunne, H. Regier, M. Sobel, L. Talbot, and L. Simpson. 1995. Status and Future of salmon of Western Oregon and Northern California: Findings and Options. Report #8. The Center for the Study of the Environment, Santa Barbara, California. 300 pp.

Chambers, J.R. 1992. Coastal degradation and fish population losses. Pages 45-51 in R.H. Stroud, editor. Stemming the tide of coastal fish habitat loss. Proceedings of a symposium on conservation of coastal fish habitat. National Coalition for Marine Conservation, Inc., Savannah Georgia.

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries, Volume II: species life history summaries. ELMR Report No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 329 pp.

Fawcett, J.A. and H.S. Marcus. 1991. Are port growth and coastal management compatible? Coastal Management, Vol. 19, pp. 275-295.

Fedler, A.J. and S.L. Crookshank. 1992. Measuring the value of coastal fisheries habitat. Pages 23-30 in R.H. Stroud, editor Stemming the tide of coastal fish habitat loss. Proceedings of a symposium on conservation of coastal fish habitat. National Coalition for Marine Conservation, Inc., Savannah Georgia.

Good, J.W. 1987. Mitigating estuarine development impacts in the Pacific Northwest: from concept to practice. Northwest Environmental Journal. Volume 3, Number 1.

Hinman, K.A. 1992. Pages 5-6 in R.H. Stroud, editor Stemming the tide of coastal fish habitat loss. Proceedings of a symposium on conservation of coastal fish habitat. National Coalition for Marine Conservation, Inc., Savannah Georgia.

Hoss, D.E. and G.W. Thayer. 1993. The importance of habitat to the early life history of estuarine dependent fishes. American Fisheries Society Symposium 14:147-158.

Herke, W.H. and B.D. Rogers. 1993. Maintenance of the estuarine environment. Pages 263-286 in C.C. Kohler and W.A. Hubert, editors. Inland fisheries management in North America. American Fisheries Society, Bethesda, Maryland.

Kagan, R.A. 1991. The dredging dilemma: economic development and environmental protection in Oakland Harbor. Coastal Management, Vol. 19, pp. 313-341.

Peters, D.S. and F. A. Cross. 1992. What is coastal fish habitat? Pages 17-22 in R.H. Stroud, editor Stemming the tide of coastal fish habitat loss. Proceedings of a symposium on conservation of coastal fish habitat. National Coalition for Marine Conservation, Inc., Savannah, Georgia.

Resource Agency of California. 1995. California's ocean resources: an agenda for the future. The Resources Agency of California. 231 pp.

Simenstad, C.A., K.L. Fresh, and E.O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. Pages 343-364 in Estuarine Comparisons. Academic Press, Inc.

Simenstad, C.A., L.F. Small, and C.D. McIntire. 1990. Consumption processes and food web structure in the Columbia River estuary. Prog. Oceanog. Vol. 25, pp. 271-297.

Simenstad, C.A., C.D. Tanner, F. Weinmann, and M. Rylko. 1991. The estuarine habitat assessment protocol. Puget Sound Notes. No. 25 June 1991.

Sogard, S.M. and K.W. Able. 1991. A comparison of eelgrass, sea lettuce macroalgae and marsh creeks as habitats for epibenthic fishes and decapods. Estuarine, Coastal and Shelf Science. **33**, 501-519.

Wyllie-Echeverria, S. and R.C. Phillips. 1994. Pages 1-4 in Wyllie-Echeverria, S., A.M. Olson and M.J. Hershman (eds), Seagrass science and policy in the Pacific Northwest: proceedings of a seminar series (SMA 94-1) EPA 910/R-94-004. 63 pp.

Zedler, J.B., C.S. Nordby, and B.E. Kus. 1992. The ecology of the Tijuana Estuary, California: A National Estuarine and Research Reserve. NOAA Office of Coastal Resource Management, Sanctuaries and Reserves Division, Washington, D.C.

TABLE 4.0-1 Adverse nonfishing activities, impacts and conservation/enhancement measures for CPS EFH.

ACTIVITY	**IMPACTS** (Potential)	**CONSERVATION MEASURES** (Advisory)
1. Dredging	• Bottom-dwelling organisms • Turbidity plumes • Bioavailability of toxics • Damage to sensitive habitats	• Curtail/minimize new dredging activities as practicable • Take actions to prevent impacts to flora/fauna • Geo-reference all dredge sites • Contaminant assays • Address cumulative impacts • Minimize turbidity
2. Dredge Material Disposal/fills	• Bottom-dwelling organisms • Turbidity plumes • Toxics becoming biologically available • Damage sensitive habitats • Loss of habitat function	• Place dredge spoils upland if possible;avoid fills in productive areas • Address cumulative impacts • Meet applicable quality requirements for disposal of dredge material in EFH • Identify direct and indirect impacts on EFH • Minimize areal extent of the disposal site • Geo-reference the site
3. Oil/gas Exploration/ production	• Seismic energy release • Discharge of exploratory drill muds and cuttings • Resuspension of fine-grained mineral particles • Composition of the substrate altered	• Avoid areas of high productivity • Provide mitigation • On-site containment equipment • Maintain "spill contingency plan" • Keep oil and hazardous substances from reaching the Aquatic environment
4. Water Intake Structures	• Entrapment, impingement, and entrainment • Loss of prey species	• Locate new facilities away from productive areas • Minimize entrainment or impingement of prey species per CWA 316(b). • Discharge temperatures to meet applicable discharge Limits
5. Aquaculture	• Discharge of pollutants from the facility • Escapement	• Minimize water/habitat quality impacts • Avoid entrainment and impingement losses • Treat and mix water discharges • Preclude waste product buildups • Prevent entanglement of prey species • Prevent escapement • Mitigate impacts
6. Wastewater Discharge	• Wastewater effluent with high contaminant levels • High nutrient levels downcurrent of outfall • Biocides to prevent biofouling • Thermal effects • Turbidity plumes • Stormwater runoff	• Avoid areas of high productivity with new discharge points • Watershed management programs
7. Oil Discharge/ Hazardous Substances Release	• Direct physical contact • Indirect exposure resulting • Cleanup	• Maintain on-site containment equipment and supplies • On-site "Spill Contingency Plan" • Prevent spills from reaching the aquatic environment.
8. Coastal Development Impacts	• Contaminant runoff • Sediment runoff • Filling of aquatic areas	• Shoreline construction should avoid productive areas • Prevent fuel spillage • Curtail fills in estuaries, wetlands, and bay

6.0 COASTAL PELAGIC SPECIES HABITAT/LIFE HISTORY DESCRIPTIONS

6.1 Northern Anchovy

6.1.1 Distribution and Habitat

Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia, to Magdalena Bay, Baja California and anchovy have recently colonized the Gulf of California. The population is divided into northern, central and southern subpopulations, or stocks. The southern subpopulation is entirely within Mexican waters. The central subpopulation, which supports significant commercial fisheries in the U.S. and Mexico, ranges from approximately San Francisco, California, to Punta Baja, Baja California. The bulk of the central subpopulation is located in the Southern California Bight, a 20,000-square-nautical-mile area bounded by Point Conception, California, in the north and Point Descanso, Mexico, (about 40 miles south of the U.S.-Mexico boarder) in the south.

Northern anchovy in the central subpopulation are typically found in waters that range from 12°C to 21.5°C; however, laboratory defined lethal temperatures occur at seven degrees Celsius and 29°C (Brewer 1976). There is a great deal of regional variation in age composition and size, with older and larger anchovy found farther offshore and to the north (Parrish et al. 1985). The pattern is accentuated in warm years and during the summer (Methot 1989).

There is a great deal of regional variation in age composition and size with older and larger individuals further offshore and to the north (Parrish et al. 1985). These patterns are accentuated during warm years such as El Niño and when abundance is high (Methot 1989). The geographic distribution of northern anchovy has been more consistent over time and is more nearshore than the geographic distribution of Pacific sardine. In the Oregon to Vancouver Island region northern anchovy must overwinter in upper mixed layer temperatures as low as eight degrees Celsius to nine degrees Celsius; short term laboratory lethal temperatures for northern anchovy are seven degrees Celsius (Brewer 1976).

Eggs and larvae are found near the surface, generally at depths of less than 50 meters and in the same areas as spawning adults. Anchovy eggs are most abundant at about 14°C. All life stages are found in the surface waters of the EEZ.

Methot found that near shore habitat areas (<90 meters) between Pt. Conception, California and Pt. Banda, Baja California represented 23% of the available habitat for central stock juvenile northern anchovy . Densities of juvenile anchovy in near shore areas were about ten times higher than in other habitat areas. He concluded that near shore habitats supported at least 70% of the juvenile anchovy population (Methot 1981, Smith 1985).

6.1.2 Life History

Northern anchovy are small, short-lived fish typically found in schools near the surface. Northern anchovy rarely exceed four years of age and 18 cm total length, although individuals as old as seven years and 23 cm have been recorded. Natural mortality is thought to be $M = 0.6$ to $0.8\ year^{-1}$, which means that 45% to 55% of the total stock would die each year of natural causes if no fishing occurred. Northern anchovy eat phytoplankton and zooplankton by either filter feeding or biting, depending on the size of the food.

Anchovy spawn during every month of the year, but spawning increases in late winter and early spring and peaks from February to April. Preferred spawning temperature is 14°C and eggs are most abundant at temperatures of 12°C to 16°C. Females spawn batches of eggs throughout the spawning season at intervals as short as seven to ten days. The eggs, found near the surface, are typically ovoid and translucent and require two to four days to hatch, depending on water temperatures. Both the eggs and larvae are found near the surface. Anchovy in the central subpopulation are all sexually mature at age two. The fraction of one-year-olds that is sexually mature in a given year depends on water temperature and has been observed to range from 47% to 100% (Methot 1989). This phenomenon affects estimates of spawning population.

6.1.3 Fisheries

Northern anchovy in the central subpopulation are harvested by commercial fisheries in California and Mexico for reduction, human consumption, live bait, dead bait, and other nonreduction commercial uses. Anchovy landed in Mexico are used primarily for reduction, although small amounts are probably used as bait.

The northern subpopulation supports a small bait fishery (one to four boats) off Oregon and Washington. The small quantities of the northern subpopulation are taken for use as bait.

Anchovy landed by the reduction fisheries are converted to meal, oil, and soluble protein products sold mainly as protein supplements for poultry food and also as feed for pigs, farmed fish, fur-producing animals, laboratory animals, and household pets. Meal obtained from anchovy is about 65% protein (meal from other fishes is 50% to 55% protein).

Anchovy harvested by the live bait fishery in California are not landed but are kept alive for sale to anglers as bait and chum (in contrast anchovy sold as "live" bait off Oregon and Washington may be killed at time of sale). Transactions between buyers and sellers of live bait take place either at sea or at bait wells tied up at docks. Bait dealers generally supply party boats on a contract basis and receive a percentage of the fees paid by passengers. Bait is also sold by the scoop to anglers in private vessels.

Anchovy landed by the nonreduction (other than live bait) fishery are used as dead frozen bait, fresh fish for human consumption, canned fish for human consumption, animal food, and anchovy paste.

6.1.4 Relevant Trophic Information

Northern anchovy are subject to natural predation throughout all life stages. Eggs and larvae fall prey to an assortment of invertebrate and vertebrate planktivores. As juveniles, anchovy are vulnerable to a wide variety of predators, including many recreationally and commercially important species of fish. As adults, anchovy are fed upon by endangered salmon stocks, endangered birds (California brown pelican *Pelecanus occidentalis californicus* and least tern *Sterna albifrons browni)* numerous fishes (some of which have recreational and commercial value) mammals, and birds. Links between brown pelican breeding success and anchovy abundance have been documented (Anderson et al. 1980, 1982; Jacobson and Thomson 1989).

6.2 Jack Mackerel

Biological information about jack mackerel is available in MacCall et al. (1980), MacCall and Stauffer (1983), and in references cited below.

6.2.1 Distribution and Habitat

Jack mackerel are a pelagic schooling fish that ranges widely throughout the northeastern Pacific, from the Pacific coast to an offshore limit approximated by a line running from Cabo San Lucas, Baja California, to the eastern Aleutian Islands, Alaska. Much of the range lies outside the 200-mile U.S. EEZ (MacCall and Stauffer 1983).

Small jack mackerel (10 cm to 30 cm FL and up to six years of age) are most abundant in the Southern California Bight, where they are often found near the mainland coast and islands and over shallow rocky banks. Older, larger fish (50 cm to 60 cm FL and 16 years to 30 years) range from Cabo San Lucas, Baja California, to the Gulf of Alaska, where they are generally found offshore in deep water and along the coastline to the north of Point Conception. Large fish rarely appear in southern inshore waters. Fish of intermediate lengths (30 cm to 50 cm TL; nine years to 20 years of age) were found in considerable numbers during the spring of 1991 around the 200-mile limit of the U.S. EEZ off southern California; fish off five years to nine years of age were the most numerous and fish ten years to 20 years old were common (Nebenzahl 1997).

Jack mackerel sampled over several years by trawl surveys off Oregon and Washington ranged from 30 cm to 62 cm and four years to 36 years old. More than half of the fish sampled were greater than 20 years old and fish greater than 30 years old were common (Nebenzahl 1997). As with other CPS finfish, older and larger fish are most common further north and offshore. Jack mackerel differ from the other CPS species in that they are quite long lived and more commonly found offshore. Jack mackerel older than 30 years are common in the northern portion of their range (Nebenzahl 1997). Spawning occurs farther offshore than for other CPS (Jacobson et al. 1997).

Jack mackerel off southern California move inshore and offshore as well as north and south. They are more available on offshore banks in late spring, summer and early fall than during the remainder of the year. In southern California waters, jack mackerel schools are often found over rocky banks, artificial reefs, and shallow rocky coastal areas. They remain near the bottom or under kelp canopies during daylight and venture into deeper surrounding areas at night. Young juvenile fish sometimes form small schools beneath floating kelp and debris in the open sea.

6.2.2 Life History

Jack mackerel grow to about 60 cm and live 35 years or longer. Estimates of natural mortality are uncertain, but the natural mortality rate (M) averaged over the life span of a typical fish is probably less than 0.20 year to 0.25 $year^{-1}$. This means that about 18% to 22% of the total stock would die each year of natural causes if no fishing occurred.

Small jack mackerel taken off southern California and northern Baja California eat large zooplankton (copepods, pteropods, and euphausiids), juvenile squid, and anchovy. Larvae feed almost entirely on copepods.

Although immature jack mackerel can be found off southern California at all times of the year, 50% or more of all females reach sexual maturity during their first year of life. Older jack mackerel, in samples taken about 200 miles offshore from Southern California, spawned about every five days and the average female may spawn as many as 36 times per year Macewicz and Hunter (1993).

The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July (MacCall and Prager 1988). Young spawners off southern California begin spawning later in the year than older spawners. Little is known of the maturity cycle of large fish offshore, but peak spawning appears to occur later in more northerly waters.

Large predators like tunas and billfish eat jack mackerel, but except as young-of-the-year and yearlings, jack mackerel are probably a minor forage source for smaller predators. Older jack mackerel probably do not contribute significantly to food supplies of marine birds, because they are too large to be eaten by most bird species and school inaccessibly deep. Little information is available on predation of jack mackerel by marine mammals. Jack mackerel are not often eaten by California sea lions, *Zalophus californianus*, or northern fur seals, *Callorhinus ursinus*.

6.2.3 Fishery Utilization

The southern California segment of the stock has been fished since the late 1940s, when jack mackerel served as a substitute for the failing sardine fishery. Purse seiners prefer Pacific (chub) mackerel, because jack mackerel tend to occur further from port and over rocky bottoms where there is increased risk of damage to nets. Mason (1991) describes the history of management for the jack mackerel fishery off southern California.

Offshore, large adult jack mackerel are sometimes taken incidentally in trawls for Pacific whiting. During the 1970s, foreign trawl fisheries may have caught 1,000 mt to 2,000 mt annually, but catches by foreign and joint-venture fishers in the 1980s ranged from nil to about 100 mt.

6.3 Pacific Sardine

Biological information about Pacific sardine *Sardinops sagax caerulea* is available in Frey (1971), Clark and Marr (1955), Ahlstrom (1960), Murphy (1966), MacCall (1979), and in the references cited below. Other common names for Pacific sardine include California pilchard, pilchard (in the northern part of its range), and sardina monterey (in the southern part of its range).

6.3.1 Distribution and Habitat

Sardines as a group of species are small pelagic schooling fish that inhabit coastal subtropical and temperate waters. The genus *Sardinops* is found in eastern boundary currents of the Atlantic and Pacific, and in western boundary currents of the Indo-Pacific oceans. Recent studies indicate that sardines in the Alguhas, Benguela, California, Kuroshio, and Peru currents, and off New Zealand and Australia are a single species (*Sardinops sagax*, Parrish et al. 1989) but stocks in different areas of the globe may be different at the subspecies level (Bowen and Grant 1997).

Pacific sardines are pelagic at all life history stages. They occur in estuaries, but are most common in the near shore and offshore domains along the coast. Pacific sardine are highly mobile and move seasonally along the coast (Radovich 1983). Older adults may move from spawning grounds in southern California and northern Baja California to feeding grounds off the Pacific northwest and Canada. Younger adults (ages two to four) appear to migrate to feeding grounds primarily in central and northern California. Juveniles occur in near shore waters off of northern Baja California and southern California (Clark 1940). Eggs and larvae occur nearly everywhere adults are found and eggs are most abundant between 14°C and 15°C (Lluch-Belda et al. 1991; Lo et al. 1994). When abundance is high, eggs and larvae may be concentrated 50 km to 150 km offshore of the area north of Point Conception with lesser quantities found in the region offshore of the Channel Islands. When abundance is low, eggs and larvae may be concentrated nearer shore and further south. These patterns probably depend on both sea surface temperatures and sardine abundance because they are accentuated during warm years and when abundance is high.

Sardine have at times been the most abundant fish species in the California Current (Barnes et al. 1992). When abundance is high and environmental conditions are favorable, Pacific sardine are distributed from the tip of Baja California (23° N latitude) to southeastern Alaska, and throughout the Gulf of Mexico. When abundance is low, as during the late 1960s and 1970s, sardine are not found in commercial quantities north of Point Conception and may be restricted to waters off southern and central Baja California. Dramatic changes in distribution, depending on environmental conditions and abundance (which are tightly linked) occur in sardine populations around the world (Lluch-Belda et al. 1989).

It is generally accepted that sardine off the West Coast of North America form three subpopulations or stocks. A northern subpopulation (northern Baja California to Alaska), a southern subpopulation (off Baja California), and a Gulf of California subpopulation were distinguished on the basis of serological techniques (Vrooman 1964). A recent electrophoretic study (Hedgecock et al. 1989) showed, however, no genetic variation among sardines from central and southern California, the Pacific coast of Baja California or the Gulf of California. A fourth, far northern, subpopulation has also been postulated (Radovich 1982). Although the ranges of the northern and southern subpopulations overlap, the stocks may move north and south at similar times and not overlap significantly. The northern stock is exploited by U.S. fisheries and is included in this FMP.

Pacific sardine probably migrated extensively during historical periods when abundance was high, moving north as far as British Columbia in the summer and returning to southern California and northern Baja California in the fall. Tagging studies (Clark and Janssen 1945) indicate that the older and larger fish moved farther north. Migratory patterns were probably complex and the timing and extent of movement were affected by oceanographic conditions (Hart 1973) and stock biomass. During the 1950s to 1970s, a period of reduced stock size and unfavorably cold sea surface temperatures, the stock apparently abandoned the northern portion of its range. At present, the combination of increased stock size and warmer sea surface temperatures are causing the stock to reoccupy grounds off northern California, Oregon, Washington, and British Columbia. Abandonment and recolonization of the higher latitude portion of their range has been associated with changes in abundance of sardine populations around the world (Parrish et al. 1989).

6.3.2 Life History

Pacific sardines may reach 41 cm, but are seldom longer than 30 cm. They may live as long as 13 years, but individuals in historical and current California commercial catches are usually younger than five years. In contrast, the most common ages in the historical Canadian sardine fishery were six years to eight years. There is a good deal of regional variation in size at age and size at age increases from south to north (Phillips 1948). Size and age at maturity may decline with a decrease in biomass, but latitude and temperature also are important (Butler 1987). At low biomass levels, sardines appear to be fully mature at age one, whereas at high biomass levels only some of the two-year-olds are mature (MacCall 1979).

Age-specific mortality estimates are available for the entire suite of life history stages (Butler et al. 1993). Mortality is high at the egg and yolk sac larvae stages (instantaneous rates in excess of 0.66 d^{-1}). Adult natural mortality rates has been estimated to be M=0.4.$year^{-1}$ (Murphy 1966; MacCall 1979) and 0.51 $year^{-1}$ (Clark and Marr 1955). A natural mortality rate of $M = 0.4\ year^{-1}$ means that 33% of the sardine stock would die each year of natural causes if there were no fishery.

Pacific sardines spawn in loosely aggregated schools in the upper 50 meters of the water column. Spawning occurs year-round in the southern stock and peaks April through August between Point Conception and Magdalena Bay, and January through April in the Gulf of California (Allen et al. 1990). Off California, sardine eggs are most abundant at sea surface temperatures of 14°C to 16°C and larvae are most abundant at 13°C to 16° C. Temperature requirements are apparently flexible, however, because eggs are most common at 17°C to 21°C and in the Gulf of California and at 22°C to 25°C off Southern Baja (Lluch-Belda et al. 1991).

The spatial and seasonal distribution of spawning is influenced by temperature. During periods of warm water, the center of sardine spawning shifts northward and spawning extends over a longer period of time (Butler 1987; Ahlstrom 1960). Recent spawning has been concentrated in the region offshore and north of Point Conception (Lo et al. 1996). Historically, spawning may also have been fairly regular off central California. Spawning was observed off Oregon, and young fish were seen in waters off British Columbia in the early fishery (Ahlstrom 1960) and during recent years (Hargreaves et al. 1994). The main spawning area for the historical population off the U.S. was between Point Conception and San Diego, California, out to about 100 miles offshore, with evidence of spawning as far as 250 miles offshore (Hart 1973)

Sardines are oviparous multiple-batch spawners with annual fecundity that is indeterminate and highly age or size dependent. Butler et al. (1993) estimate that two year old sardines spawn on average six times per year whereas the oldest sardines spawn 40 times per year. Both eggs and larvae are found near the surface. Sardine eggs are spheroid, have a large perivitelline space, and require about three days to hatch at 15°C.

Sardine are planktivores that consume both phytoplankton and zooplankton. When biomass is high, Pacific sardine may consume a significant proportion of total organic production in the California Current system. Based on an energy budget for sardine developed from laboratory experiments and estimates of primary and secondary production in the California Current, Lasker (1970) estimated that annual energy requirements of the sardine population would have been about 22% of the annual primary production and 220% of the secondary production during the 1932 to 1934, a period of high sardine abundance.

6.3.3 Fishery Utilization

The sardine fishery first developed in response to demand for food during World War I. Landings increased from 1916 to 1936, and peaked at over 700,000 mt. The Pacific sardine supported the largest fishery in the western hemisphere during the 1930s and 1940s, with landings along the coast in British Columbia, Washington, Oregon, California, and Mexico. The fishery declined, beginning in the late 1940s and with some short-term reversals, to extremely low levels in the 1970s. There was a southward shift in the catch as the fishery decreased, with landings ceasing in the northwest in 1947 to 1948, and in San Francisco in 1951 to 1952. Sardines were primarily used for reduction to fish meal and oil and as canned food, with small quantities taken for live bait. An extremely lucrative dead bait market developed in central California in the 1960s.

In the early 1980s, sardine began to be taken incidentally with Pacific (chub) mackerel and jack mackerel in the southern California mackerel fishery and primarily canned for pet food, although some were canned for human consumption. As sardine continued to increase in abundance, a directed fishery was reestablished. Sardine landed in the directed sardine fisheries off southern and central California are mostly canned for human consumption and sold overseas, with minor amounts sold fresh for human consumption and animal food. Small quantities are harvested for dead bait and live bait. Sardines landed in Mexico are used primarily for reduction.

6.3.4 Relevant Trophic Information

Pacific sardines are taken by a variety of predators throughout all life stages. Sardine eggs and larvae are consumed by an assortment of invertebrate and vertebrate planktivores. Although it has not been demonstrated in the field, anchovy predation on sardine eggs and larvae was postulated as a possible mechanism for increased larval sardine mortality from 1951 to 1967 (Butler 1987). There have been few studies about sardine as forage, but juvenile and adult sardines are consumed by a variety of predators, including commercially important fish (e.g., yellowtail, barracuda, bonito, tuna, marlin, mackerel, hake, salmon, and sharks), seabirds (pelicans, gulls, and cormorants) and marine mammals (sea lions, seals, porpoises, and whales). In all probability, sardine are fed on by the same predators (including endangered species) that utilize anchovy (Table 1.1.2-1). It is also likely that sardines will become more important as prey as their numbers increase. For example, while sardine were abundant during the 1930s, they were a major forage species for both coho and chinook salmon off Washington (Chapman 1936).

6.4 Pacific (Chub) Mackerel

Pacific (chub) mackerel (*Scomber japonicus*) found off the Pacific coast of the U.S. are often called "blue" or "chub" mackerel and are the same species as mackerel of various names found elsewhere in the Pacific, Atlantic and Indian oceans (Collett and Nauen 1983). A synopsis of the biology of Pacific (chub) mackerel is available in Schaefer (1980) and references cited below. The northeastern Pacific stock (see below) is included in this fishery management plan.

6.4.1 Distribution and Habitat

Pacific (chub) mackerel in the northeastern Pacific range from Banderas Bay, Mexico, to southeastern Alaska, including the Gulf of California (Hart 1973). They are common from Monterey Bay, California, to Cabo San Lucas, Baja California, but are most abundant south of Point Conception. Pacific (chub) mackerel usually occur within 20 miles of shore but have been taken as far offshore as 250 miles (Fitch 1969; Frey 1971; Allen et al. 1990; MBC 1987).

There are three spawning stocks along the Pacific coasts of the U.S. and Mexico: one in the Gulf of California, one in the vicinity of Cabo San Lucas, and one extending along the Pacific coast north of Punta Abreojos, Baja California (Collette and Navem 1983; Allen et al. 1990; MBC 1987). The latter "northeastern Pacific" stock is harvested by fishers in the U.S. and Mexico and included in this FMP.

Pacific (chub) mackerel adults are found in water ranging from 10°C to 22.2°C (MBC 1987), and larvae may be found in water around 14°C (Allen et al. 1990). As adults, Pacific (chub) mackerel may move north in summer and south in winter between Tillamook, Oregon, and Magdalena Bay, Baja California. Northerly movement in the summer peaks during El Niño events (MBC 1987). There is an inshore-offshore migration off California, with increased inshore abundance from July to November and increased offshore abundance from March to May (Cannon 1967; MBC 1987). Adult Pacific (chub) mackerel are commonly found near shallow banks. Juveniles are found off sandy beaches, around kelp beds, and in open bays. Adults are found from the surface to depths of 300 meters (Allen et al. 1990). Pacific (chub) mackerel often school with other pelagic species, particularly jack mackerel and Pacific sardine.

6.4.2 Life History

The largest recorded Pacific (chub) mackerel was 63 cm long and weighed 2.8 kg, but Pacific (chub) mackerel taken by commercial fishing seldom exceed 40 cm or one kg (Hart 1973; Roedel 1938). The oldest recorded age for a Pacific (chub) mackerel was 11 years, but most caught commercially are less than four years old (Fitch 1951). Some Pacific (chub) mackerel mature as one-year-olds, and all are sexually mature by age four (Prager and MacCall 1988). The annual rate of natural mortality (M) is thought to be about 0.5 $year^{-1}$, which means that 39% of the stock would die each year of natural causes in the absence of fishing (Parrish and MacCall 1978).

Pacific (chub) mackerel larvae eat copepods and other zooplankton including fish larvae (Collette and Nauen 1983; MBC 1987). Juveniles and adults feed on small fishes, fish larvae, squid and pelagic crustaceans such as euphausids (Clemens and Wilby 1961; Turner and Sexsmith 1967; Fitch 1969; Fitch and Lavenberg 1971; Frey 1971; Hart 1973; Collette and Nauen 1983).

Pacific (chub) mackerel in the northeastern Pacific stock spawn from Eureka, California, south to Cabo San Lucas in Baja California (Frey 1971; MBC 1987) between three and 320 km from shore. They seldom spawn north of Point Conception (Fritzsche 1978; MBC 1987) although young of year mackerel have been recently reported as far north as Oregon and Washington due, perhaps, to current warm sea surface temperatures. Spawning peaks from late April to July (MacCall and Prager 1988). Like most CPS, Pacific (chub) mackerel have indeterminate fecundity and seem to spawn whenever sufficient food is available and appropriate environmental conditions prevail. Actively spawning fish appear capable of spawning every day or every other day (Dickerson et al. 1992).

Pacific (chub) mackerel larvae are subject to predation from a number of invertebrate and vertebrate planktivores. Juveniles and adults are eaten by larger fishes, marine mammals, and seabirds. Predators include porpoises, California sea lions (*Zalophus californianus*), brown pelican (*Pelecanus occidentalis*), striped marlin (*Terapturus audax*), black marlin (*Makaira indca*), sailfish (*Istiophorus platypterus*), bluefin tuna (*Thunnus thynnus*), white sea bass *(Atractoscion nobilis)*, yellowtail (*Seriola dorsalis*), giant sea bass (*Stereolepis gigas*), and various sharks (MBC 1987). Although consumed in significant numbers by a wide variety of predators, Pacific (chub) mackerel are likely not as important as forage than Pacific sardine or northern anchovy which are smaller in size (i.e., available to a wider variety of predators) and often more abundant.

6.4.3 Fishery Utilization

Pacific (chub) mackerel in the northeastern Pacific are harvested by commercial fisheries in California and Mexico; some recreational harvest also occurs. Pacific (chub) mackerel are sold as fresh fish, canned for human consumption and pet food, and reduced to fish meal and oil.

Pacific (chub) mackerel are often taken by anglers and in considerable numbers, though seldom as a target species (Allen et al. 1990). During 1980 to 1989, the recreational catch averaged 1,330 mt per year (Wolf 1989) and Pacific (chub) mackerel was numerically the most important species taken in the California commercial passenger fishing boat fleet during the period of 1978 to 1989.

6.5 Market Squid

Market squid (*Loligo opalescens)* along the west coast of North America were studied extensively during 1960 through 1980 (Recksiek and Frey 1978; Symposium of the 1978 CalCOFI Conference[1]), but little research applicable to fisheries management has been carried out since then. Recent increases in squid landings (see below) have stimulated a variety of new research projects but results have not yet been published.

6.5.1 Distribution and Habitat

Adult and juvenile market squid (Dickerson and Leos 1992) are distributed throughout the California and Alaska current systems from the southern tip of Baja California, Mexico (23° N latitude) to southeastern Alaska (55° N latitude). They are most abundant between Punta Eugenio, Baja California and Monterey Bay, central California. Market squid are harvested near the surface and generally considered pelagic, but are actually found over the continental shelf from the surface to depths of at least 800 meters. They prefer

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1/ See papers by various authors published during 1979 *in*: Calif. Coop. Oceanic Fish. Invest. Rep. 20: 21-71.

oceanic salinities and are rarely found in bays, estuaries, or near river mouths (Jefferts 1983). Adults and juveniles are most abundant between temperatures of ten degrees Celsius and 16°C (Roper et al. 1984).

Spawning squid concentrate in dense schools near spawning grounds, but habitat requirements for spawning are not well understood. Spawning occurs over a wide depth range, but the extent and significance of spawning in deep water is unknown. Known major spawning areas are shallow semi-protected near shore areas with sandy or mud bottoms adjacent to submarine canyons where fishing occurs. In these locations, egg deposition is between five meters (Jefferts 1983) and 55 meters (Roper and Sweeney 1984), and most common between 20 meters and 35 meters. Off California, squid and squid eggs have been taken in bottom trawls at depths of about 800 meters near Monterey (Bob Leos, California Department of Fish and Game, pers. comm.) and have been observed at 180 meters near the Channel Islands (Roper and Sweeney 1984). Factors that determine spawning grounds have not been precisely identified. Hatchlings (called "paralarvae") are presumably dispersed by currents. Their distribution after leaving the spawning areas is largely unknown.

Attempts to differentiate squid stocks using anatomical and genetic characters have been inconclusive. Thus, the number of market squid stocks or subpopulations along the Pacific coast is unknown.

6.5.2 Life History

Market squid are small short-lived molluscs reaching a maximum size of 30 cm total length, including arms (Roper and Sweeney 1984). Age and growth studies suggest than some individuals may live up to two years, but most mature and spawn when about one year old (Spratt 1979). In the laboratory squid have been reared to maturity and spawned at six months of age. Histological examination of squid testes and ovaries using electron microscopy suggests that squid spawn once over a short time period before dying (Greib 1978; Knipe 1978), although this is a topic of current research and some debate.

Spawning occurs year-round (Jefferts 1983). Peak spawning usually begins in southern California during the fall-spring season. Off central California, spawning normally begins in the spring-fall season. Squid spawning has been observed off Oregon during May through July. Off Washington and Canada, spawning normally begins in late summer. Year-round spawning likely reduces effects of poor temporary local conditions for survival of eggs or hatchlings. Year-round spawning suggests that stock abundance is not dependent on spawning success during a single short season or a single spawning area.

Males on spawning grounds are larger than females. Males reach 19 cm dorsal mantle length, a maximum weight of 130 grams and have larger heads and thicker arms than females. Females reach 17 cm dorsal mantle length and a maximum weight of 90 grams. Mating has been observed on spawning grounds just prior to spawning, but may also occur before squid move to the spawning grounds. Males deposit spermatophores into the mantle cavity of females and eggs are fertilized as they are extruded (Hurley 1977). Females produce 20 egg to 30 egg capsules and each capsule contains 200 eggs to 300 eggs that are suspended in a gelatinous matrix within the capsule. Females attach each egg capsule individually to the substrate. As spawning continues, mounds of egg capsules covering more than 100 m^2 may be formed.

Spawning is continuous and eggs of varying developmental stages may be present at one site. Eggs take three months to hatch at seven degrees Celsius to eight degrees Celsius, one month at 13°C and 12 days to 23 days at ten degrees Celsius (Jefferts 1983). Newly hatched squid (called "para larvae") are about 2.5 mm to three mm in length and resemble miniature adults. Hatchlings are dispersed by currents and their distribution after leaving the spawning areas is largely unknown.

Few organisms eat squid eggs although bat stars and sea urchins have been observed doing so (Jefferts 1983). Like northern anchovy and Pacific sardine (Table 1.1.2-1), market squid are probably important as forage to a long list of fish, birds, and mammals including threatened, endangered, and depleted species (Morejohn et al. 1978). Some of the more important squid predators are king salmon, coho salmon, lingcod, rockfish, harbor seals, California sea lions, sea otters, elephant seals, Dall's porpoise, sooty shearwater, Brandt's cormorant, rhinoceros auklet, and common murre.

Squid feed on copepods as juveniles gradually changing to euphausiids, other small crustaceans, small fish, and other squid as they grow (Karpov and Cailliet 1978).

6.5.3 Fishery Utilization

Market squid are harvested commercially primarily off southern and central California although some catch occurs throughout their range. Fishing occurs on spawning grounds and occurs during the spawning season. Peak catches occur off southern California during the winter, off Central California during the late spring and summer, and later in the summer off Oregon to Alaska.

Commercial squid fishing vessels use purse seines primarily, although scoop nets are also used in the southern California fishery. Lights are usually used to bring the squid schools up near the surface where they are more easily captured by seine or scoop net. Purse seines used for squid typically do not hang as deep as purse seines used for other species so contact with the bottom is reduced. However, squid eggs are occasionally observed in purse seines when the seines contact the bottom. Egg mortality associated with purse seining for squid has not been quantified.

The California squid fishery accounts for most of the coast wide landings. Minor amounts of market squid are landed in Canada, Washington, and Oregon . The size of the Mexican fishery is unknown but is thought to be minor. The California annual squid catch set records of 56, 70, and 80 thousand mt during 1994 to 1996.

In California, most squid marketed for human consumption is frozen, but minor amounts are canned or sold fresh. Historically, the domestic demand for frozen squid has been relatively small, and most of the increased production from California during 1994 to 1996 was frozen and exported to Europe, Spain, and China. Squid is also frozen for bait and supplied to domestic commercial and sport fishers and is an important source of live bait for the California sport fishing industry.

6.6 References

Allen, M. J., R. J. Wolotira, Jr., T. M. Sample, S. F. Noel, and C. R. Iten. 1990. West coast of North America coastal and oceanic zones strategic assessment. Data atlas. Invertebrates and fish. N.O.A.A. Seattle, WA

Barnes, J. T., L. D. Jacobson, A. D. MacCall, and P. Wolf. 1992. Recent population trends and abundance estimates of the Pacific sardine (*Sardinops sagax*). CalCOFI Rep. 33: 60-75.

Bentley, P.J., R. L. Emmett, N.C.H. Lo, and H.G. Moser. 1994. Egg production of Pacific sardine (*Sardinops sagax*) off Oregon in 1994. Calif. Coop. Oceanic. Fish. Invest. Rep. 37: 193-200.

Brewer, G.D. 1976. Thermal tolerance and resistance of the northern anchovy *Engraulis mordax*. Fish. Bull. U.S. 74: 433-445.

Chamberlain, D.W. 1975. The role of fish cannery waste in the ecosystem, p. 1-22. *In*: D. Soule and M. Oguri (eds.). Marine Studies of San Pedro Bay. Part VIII.. Allan Hancock Foundation and California Sea Grant Program, University of Southern California.

Collette, B. B., and C. E. Nauen. 1983. Scombrids of the world. FAO Fish. Synop. 125. 137 p.

Fitch, J. E. 1969. Offshore fishes of California. 4th revision. Calif. Dep. Fish and Game, Sacramento, CA. 79 p.

Hart, J. L. 1973. Pacific fishes of Canada. Fish. Res. Board Can., Bull. 180. 740 p.

Hedgecock, D., E. S. Hutchinson, G. Li, F. L. Sly, and K. Nelson. 1989. Genetic and morphometric variation in the Pacific sardine, *Sardinops sagax caerulea*: comparisons and contrasts with historical data and with variability in the northern anchovy, *Engraulis mordax.* Fish. Bull. 87: 653-671.

Jacobson, L. D., N. C. H. Lo, and M. Yaremko. 1997. Status of the northern anchovy (*Engraulismordax*) stock (central subpopulation) during the 1996-1997 season. NMFS, SWFSC, Admin. Rep. DR. JACOBSON-97-08.

Jefferts, K. 1983. Squid distribution, biology, and life history. p. 3-10. In Proceedings of the West Coast Squid Symposium. Newport, Oregon. Oregon State Univ. Sea Grant Rep.

Lo, N.C.H., Y.A. Green-Ruiz, M Jacob-Cervantes, H.G. Moser, and R. J. Lynn. Egg production and spawning biomass of Pacific sardine (*Sardinops sagax*) in 1994, determined by the daily egg production method. Calif. Coop. Oceanic. Fish. Invest. Rep. 37: 160-174.

Nebenzahl, D.A. 1997. Age, growth, and population structure of jack mackerel (*Trachurus symmetricus*) from the northeastern Pacific ocean. Master's thesis, San Francisco State Univ., San Francisco, CA.

Lluch-Belda, D., R. J. M. Crawford, T. Kawasaki, A. D. MacCall, R. H. Parrish, R. A. Schwartzlose, and P. E. Smith. 1989. World-wide fluctuations of sardine and anchovy stocks: The regime problem. S. Afr. J. Mar. Sci. 8: 195-205.

MacCall, A. D., and G. D. Stauffer. 1983. Biology and fishery potential of jack mackerel (*Trachurus symmetricus*) CalCOFI Rep. 24: 46-56.

MBC Applied Environmental Sciences. 1987. Ecology of important fisheries species offshore California. OCS-Study, MMS 86-0093. 252 p.

Mais, K.F. 1974. Pelagic fish surveys in the California Current. Calif. Dept. Fish. and Game Fish. Bull. 162: 79p.

Methot, R. D. 1981. Growth rates and age distributions of larval and juvenile northern anchovy, Engraulis mordax, with inferences on larval survival. Ph.D. thesis, University of California, San Diego, CA.

Methot, R. D. 1989. Synthetic estimates of historical abundance and mortality for northern anchovy. Am. Fish. Soc. Symp. Ser. 6: 66-82.

Parrish, R. H., D. L. Mallicoate, and K. F. Mais. 1985. Regional variations in the growth and age composition of northern anchovy, Engraulis mordax. Fish. Bull. 83: 483-496.

Pearcy, W., J. Fisher, R. Brodeur, and S. Johnson. 1985. Effects of the 1983 El Niño on coastal neckton off Oregon and Washington. p. 188-204. In: El Niño North: Niño effects in the eastern subarctic Pacific Ocean. W.S. Wooster and D.L. Fluharty [ed.] Washington Sea Grant Program. Univ. of Washington, Seattle.

Prager, M.H., and A.D. MacCall. 1993. Detection of contaminant and climate effects on spawning success of three pelagic fish stocks off southern California: northern anchovy *Engraulis mordax*, Pacific sardine *Sardinops sagax*, and chub mackerel *Scomber japonicus*. Fish. Bull. U.S. 91: 310-327.

Roper, C.F.E and M.J. Sweeney. 1984. FAO Species Catalogue Vol.3 Cephalopods of the world. FAO Fisheries Synopsis 125:3. 277p.

Scofield, W. L. 1951. Purse seines and other roundhaul nets in California. Calif. Dept. of Fish and Game Fish Bulletin no. 81.

Lluch-Belda D., D.B. Lluch-Cota, S. Hernandez-Vazquez, C. Salinas-Zavala and R.A. Schwartzlose. 1991. Sardine and anchovy spawning as related to temperature and upwelling in the California Current System. Calif. Coop. Oceanic. Fish. Invest. Rep. 32: 105-111.

Smith, P.E. 1985. Year-class strength and survival of O-group clupeioids. Can. J. Fish. Aquat. Sci. 42 (Suppl. 1): 69-82.

Soule, D.F., and M. Oguri. 1973. Introduction. In: D. Soule and M. Oguri (eds.). Biological investigations, p. 1-20. Marine Studies of San Pedro Bay, California. Part XVI. Allan Hancock Foundation and California Sea Grant Program, Institute of Marine and Coastal Studies, University of Southern California.

Soule, D.F., and M. Oguri. 1976. Executive summary, p. iv. *In*: D. Soule and M. Oguri (eds.). Bioenhancement studies of the receiving waters in outer Los Angeles Harbor. Marine Studies of San

Pedro Bay, California. Part 12. Allan Hancock Foundation and California Sea Grant Program, Institute of Marine and Coastal Studies, University of Southern California.

Soule, D.F., and M. Oguri. 1979. Ecological changes in the outer Los Angeles-Long Beach harbors following initiation of secondary treatment and cessation of fish cannery waste effluent. *In*: Marine studies of San Pedro Bay, California. Part 16. Allan Hancock Foundation and California Sea Grant Programs, Institute of Marine and Coastal Studies. University of Southern California: 597 p.

Soule, D.F., and M. Oguri. 1980. The marine environment in Los Angeles and Long Beach harbors during 1978. Marine studies of San Pedro Bay, California. Part 17. Allan Hancock Foundation, California Sea Grant Program, Institute of Marine and Coastal Studies, University of Southern California, and U.S. Army Corps of Engineers: 688 p. + appendix.

Soule, D.F., and M. Oguri. 1982. Evaluation of the outer Los Angeles Harbor benthos in 198 compared with conditions from 1971-78 investigations. Special report part B. Harbors Environmental Projects, University of Southern.

Vetter, R., L. Robertson, and C.A. Kimbrell (In prep.). Effects of dispersed paper waste on the filter-feeding capacity, ingestion of paper and growth of Pacific sardine, *Sardinops sagax*. Southwest Fisheries Science Center, La Jolla, CA.

TABLE 6.1 Summary of habitat information for northern anchovy.

Life Stage	Diet	Season	Location	Water Column	Oceanographic Features
Eggs and larvae	Yolk sac and planktivorous	Year-round, peaks from Feb. to April	Surface waters of the EEZ	Near surface, < 50m	12°C to 21.5°C
Adults	Phytoplankton, zooplankton	Year-round	Surface waters of the EEZ	Near surface, < 50m	12° C to 21.5°C

TABLE 6.2 Summary of habitat information for jack mackerel.

Life Stage	Diet	Season	Location	Water Column	Oceanographic Features
Eggs and larvae	Yolk sac; larvae consume copepods	Feb. to Oct.with peak from March to July	Pelagic, schooling	Pelagic	10°C to 26°C
Juveniles	N/A	Year-round	Sometimes in small schools under floating kelp and debirs	Pelagic	10° C to 26°C
Adults	Zooplankton (copepods, pteropods and euphausids, juvenile squid, and northern anchovy	Year-round	Inshore and offshore; sometimes over rocky bottoms	Pelagic	10°C to 26°C

TABLE 6.3 Summary of habitat information for Pacific sardine.

Life Stage	Diet	Season	Location	Water Column	Oceanographic Features
Eggs and larvae	Yolk sac and planktivorous	Year-round, with peak in April-August	Pelagic, 50-150 km offshore	Upper 50 m	Eggs: 14°C to 16°C Larvae: 14°C to 16°C
Juveniles	Planktivorous	Year-round	Pelagic	Above thermocline	10° to 26°C
Adults	Phytoplankton and zooplankton	Year-round	Pelagic, sometimes in estuaries	Above theromcline	10° C to 26°C

TABLE 6.4 Summary of habitat information for Pacific (chub) mackerel.

Life Stage	Diet	Season	Location	Water Column	Oceanographic Features
Eggs and larvae	Yolk sac; copepods and fish larvae	Peaks from late April to July	N/A	Surface	14°C
Juveniles	Small fishes, fish larvae, squid, and pelagic crustaceans such as euphausids	Inshore-offshore migration off CA July to Nov.; increased offshore abundance March to May	Off sandy beaches, around kelp beds, and in open bays	N/A	10°C to 26°C
Adults	Small fishes, fish larvae, squid, and pelagic crustaceans such as euphausids	Inshore-offshore migration off CA July to Nov.; increased offshore abundance March to May	Usually within 20 miles of shore, but as far as 250 miles offshore; near shallow banks	Surface to 300 m	10°C to 22.2°C

TABLE 6.5 Summary of habitat information for market squid, continued.

Life Stage	Diet	Season	Location	Water Column	Oceanographic Features
Eggs and para larvae (newly hatched squid)	N/A	Year-round	Shallow semi-protected nearshore areas with sandy or mud bottoms adjacent to submarine canyons; distribution of paralarvae is largely unknown		10°C to 26°C
Juvenile	Copepods	N/A	N/A	N/A	10°C to 26°C
Adult	Euphausiids and other small crustaceans, small fish and other squid	Spawn year	Rarely found in bays, estuaries or near river mouths	Surface to 800 m	10°C to 26°C

7.0 RESEARCH NEEDS

Research in general needs to address additional life history information, nonfishing impacts and the potential for conservation and enhancement measures. In addition, because potential overfishing of northern anchovy, Pacific sardine, market squid, or other species could adversely affect the EFH for other species such as Pacific (chub) mackerel, jack mackerel, and market squid; the dynamics of predator-prey relationships within the context of an ecosystem perspective should be investigated.

Studies on effects of fishing activities (e.g., mid-water trawling, processing discards) on the EFH of CPS should be considered.

Consideration should be given to research necessary to describe, identify, and map EFH based on at least level 2 and level 3 information, and ideally, level 4 information. More specific information on the preferred habitats of CPS is needed for more narrowly identifying areas of EFH (not the whole EEZ).

Review and revision of the EFH components of this FMP should be undertaken as necessary. Part of this review should address the specific research needs identified below for each species:

7.1 Northern Anchovy

Northern anchovy is a well studied species and no areas of concern or important research gaps related to EFH have been identified.

7.2 Jack Mackerel

Migrations for feeding and spawning are not well known. Adult jack mackerel may migrate southwards into California during the winter to spawn, however it is also possible that many older jack mackerel overwinter in the region north of 39° N latitude, particularly in offshore regions. Better information on the seasonal distribution and migratory behavior of jack mackerel would be useful. There is no evidence of stock structure in jack mackerel along the West Coast.

7.3 Pacific Sardine

No areas of concern or important research gaps related to EFH have been identified for Pacific sardine with the exception of the debate over how many sardine stocks exist along the West Coast during periods of high and low abundance.

7.4 Pacific (Chub) Mackerel

No areas of concern or important research gaps related to EFH have been identified for Pacific (chub) mackerel.

7.5 Market Squid

Market squid are poorly understood, relative to CPS finfish. As described above, impacts on EFH are most likely during fishing which occurs almost entirely on spawning aggregations in shallow water. There are two areas of potential concern that have not been quantified: damage to substrate used to attach eggs, and damage to egg masses.

Information about how squid spawning grounds are distributed with depth and their locations along the coast is required; information on spawning grounds in deep water and to the north of central California is particularly meager. In addition, information about egg survival and paralarvae production per unit area in different types of spawning habitats is needed for understanding potential impacts of fishing in shallow water.

Dispersal of adults and paralarvae along the West Coast (i.e., stock structure) is required for determining how local impacts might be mitigated by recruitment from other areas in this short lived species.

Egg mortality associated with purse seining for squid has not been quantified.

Factors that determine spawning grounds have not been precisely identified.

APPENDIX E
REFERENCES

REFERENCES

Ahlstrom, E. H. 1960. Synopsis on the biology of the Pacific sardine (*Sardinops caerulea*). Proc. World Sci. Meet. Biol. Sardines and Related Species, FAO, Rome, 2: 415-451

Ainley, D. G., and R. J. Boekelheide [ed.] 1990. Seabirds of the Farallon Islands: Ecology, dynamics, and structure of an upwelling-system community. Stanford University Press, Stanford. 488 p.

Ainley, D. G., H. R. Huber, and K. M. Bailey. 1982. Population fluctuations of California sea lions and the Pacific whiting fishery off central California. Fish. Bull. 80: 253-258.

Ainley, D. G., and G. L. Hunt. 1991. Status and conservation of seabirds in California. ICBP Tech. Publ. 11: 103-114.

Ainley, D. G., and T. J. Lewis. 1974. The history of Farallon Island marine bird populations, 1843-1972. Condor 76: 432:446.

Allen, M. J., R. J. Wolotira, Jr., T. M. Sample, S. F. Noel, and C. R. Iten. 1990. West coast of North America coastal and oceanic zones strategic assessment: Data Atlas. N.O.A.A. Seattle, WA. Invertebrate and fish 145:

Alverson, D. L., and W. T. Pereya. 1969. Demersal fish explorations in the northeastern Pacific Ocean -an evaluation of exploratory fishing methods and analytical approaches to stock size and yield forecasts. J. Fish. Res. Board Can. 26: 1985-2001.

Anderson, D. W., F. Gress, and K. F. Mais. 1982. Brown pelicans: influence of food supply on reproduction. Oikos 39: 23-31.

Anderson, D. W., F. Gress, K. F. Mais, and P. R. Kelly. 1980. Brown pelicans as anchovy stock indicators and their relationships to commercial fishing. CalCOFI Rep. 21: 54-61.

Antonelis, G. A. Jr., and C. H. Fiscus. 1980. The Pinnipeds of the California current. CalCOFI Rep. 21: 68-78.

Antonelis, G. A., Jr., C. H. Fiscus, and R. L. DeLong. 1984. Spring and summer prey of California sea lions, *Zalophus californianus*, at San Miguel Island, California, 1978-79. Fish. Bull. 82: 67-76.

Antonelis, G. A. Jr., M. S. Lowry, D. P. DeMaster, and C. H. Fiscus. 1987. Assessing northern elephant seal feeding habits by stomach lavage. Marine Mammal Science 3: 308-322.

Antonelis, G. A. Jr., and M. A. Perez. 1984. Estimated annual food consumption by northern fur seals in the California current. CalCOFI Rep. 25: 135-145.

Bailey, K. M., R. C. Francis, and P. R. Stevens. 1982. The life history and fishery of Pacific whiting, *Merluccius productus*. CalCOFI Rep. 23: 81-98.

Baltz, D. M., and G. V. Morejohn. 1977. Food habits and niche overlap of seabirds wintering on Monterey Bay, California. Auk 94: 526-543.

Barlow, J. 1988. Harbor Porpoise, *Phocoena phocoena*, Abundance estimation for California, Oregon, and Washington: I. Ship Surveys. Fish. Bull. 86(3): 417-432.

Barlow, J. 1995. The abundance of cetaceans in California waters. Part I: ship surveys in summer and fall of 1991. Fish. Bull. 93: 1-14.

Barlow, J., K.A. Forey, P.S. Hill, R.L. Brownell, Jr., J.V. Carretta, D.P. DeMaster, F. Julian, M.S. Lowry, T. Ragen, and R.R. Reeves. 1997. U.S. pacific marine mammal stock assessments. NOAA Tech. Mem. NMFS NOAA-TM-NMFS-SWFSC-248. 223p.

Barnes, J. T. 1995. Compensation of displaced gill netters pursuant to Proposition 132. Calif. Dept. Fish. Game, Mar. Res. Div., Admin. Rep. 95-03: 18p.

Barnes, J. T., L. D. Jacobson, A. D. MacCall, and P. Wolf. 1992. Recent population trends and abundance estimates of the Pacific sardine (*Sardinops sagax*). CalCOFI Rep. 33: 60-75.

Baumgartner, T., A. Soutar, and V. Ferriera-Bartrina. 1992. Reconstruction of the history of pacific sardine and northern anchovy populations over the past two millenia from sediments of the Santa Barbara Basin, California. CalCOFI Rep. 33: 24-40.

Beach, R. J., A. C. Geiger, S. J. Jeffries, and S. D. Treacy. 1981. Marine Mammal - Fisheries interactions on the Columbia River and adjacent waters, 1981. NWAFC Processed Rept. 82-04. 186 p.

Beddington, J. R., and J. G. Cooke. 1983. The potential yield of fish stocks. FAO Fish. Tech. Pap. 242.

Beddington, J. R., and R. M. May. 1977. Harvesting natural populations in a randomly fluctuating environment. Science, July 29: 463-465.

Bonnot, P. 1928. Report on the seals and sea lions of California. Calif. Dept. Fish and Game, Fish Bull. 14: 1-62.

Boveng, P. 1988. Status of the pacific harbor seal population on the U. S. west coast. NMFS, SWFSC Admin. Rep. LJ-88-06. 43 p.

Bowen, B. W., and W.S. Grant. 1997: Phylogeography of the sardines (*Sardinops* spp.): Assessing biogeographic models and population histories in temperate upwelling zones. Evolution 51, 1601-1610

Bramel, B., and M. Kronman. 1991. Adapting lampara nets to small gill net vessels. A report to California's Office of Environmental Protection. 58 p.

Brewer, G.D. 1976. Thermal tolerance and resistance of the northern anchovy *Engraulis mordax*. Fish. Bull. U.S. 74: 433-445.

Briggs, K. T., and E. W. Chu. 1987. Trophic relationships and food requirements of California seabirds: updating models of trophic impact, p. 279-304 In: J. P. Croxall [ed.] Seabirds: feeding ecology and role in marine ecosystems. Cambridge Univer. Press.

Briggs, K. T., W. B. Tyler, D. B. Lewis, and D. R. Carlson. 1987. Bird communities at sea off California: 1975 to 1983. Studies Avian Biology 11: 1-74.

Brownell, R. L. Jr. 1964. Observations of odontocetes in central Californian waters. Norsk Hvalfangst-Tidende 3: 60-66.

Bureau of the Census. 1991. 1990 Census of population and housing. Summary population and housing characteristics. California. U.S. Dept. of Commerce. Economics and Statistics Administration Bureau of the Census. 1990 CPH-1-6.

Butler, J. L. 1987. Comparisons of the larval and juvenile growth and mortality rates of Pacific sardine and northern anchovy and implications for species interactions. PhD. thesis, Univ. Calif. San Diego. 242 p.

Butler, J.L., P.E. Smith, and N.C.H. Lo. 1993. The effect of natural variability of life-history parameters on anchovy and sardine population growth. CalCOFI Rep. 34: 104-111-15.

California Department of Fish and Game. 1970. The California marine fish catch for 1968 and historical review 1916-1968. Fish Bull. 149.

California Department of Fish and Game. 1986. Review of some California fisheries for 1985. CalCOFI Rep. 27: 7-15.

California Department of Fish and Game. 1991a. Review of some California fisheries for 1990. CalCOFI Rep. 32: 7-20.

California Department of Fish and Game. 1991b. Marine resources protection act of 1990. Annual report 1990-91. 14 p.

California Department of Fish and Game Code. 1991. Gould publications, Altamonte Springs, FL. 618 p.

California Legislature Senate Committee on Governmental Organization. 1986. Interim hearing on problems relating to the commercial fishing industry and economic development in the Los Angeles harbor area. Los Angeles Harbor Dept. 102 p.

Cannon, R. 1967. How to fish the Pacific Coast. 3rd edition. Lane Books, Menlo Park, CA. 160 p.

Centaur Associates. 1984. Cumulative socioeconomic impacts of oil and gas development in the Santa Barbara channel region: a case study. U. S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region.

Chapman W.M. 1936. The pilchard fishery of the state of Washington in 1936 with notes on the food of the silver and chinook salmon off the Washington coast. Dept. of Fisheries, State of Washington, Biological Rept. 36. 30p.

Chavez, H., S. Silva and J. Sunada. 1977. The fishery for northern anchovy, *Engraulis mordax*, off California and Baja California in 1975. CalCOFI Rep. 19: 147-165.

Clark, F. N. 1939. Can the supply of sardines be maintained in California waters? Calif. Fish and Game 25: 172-176.

Clark, F. N., and J. F. Janssen. Jr. 1945. Movements and abundance of the sardine as measured by tag returns. Calif. Div. Fish Game Fish. Bull. 61: 7-42.

Clark, F. N., and J. C. Marr. 1955. Population dynamics of the Pacific sardine. CalCOFI Prog. Rep. 1 July 1953-31 March 1955: 11-48.

Clark, I. N., P. J. Major, and N. Mollet. 1988. Development and implementation of New Zealand's ITQ management system. Mar. Resour. Econ. 5: 325-349.

Clark, W. G. 1991. Groundfish exploitation rates based on life history parameters. Can. J. Fish. Aquat. Sci. 48: 734-750.

Clemmens, W. A., and G. V. Wilby. 1961. Fishes of the Pacific coast of Canada. Fish. Res. Board Can., Bull. 68. 443 p.

Collette, B. B., and C. E. Nauen. 1983. Scombrids of the world. FAO Fish. Synop. 125. 137 p.

Conrad, J. M. 1991. A bioeconomic analysis of the northern anchovy. NMFS, Southwest Fisheries Science Center Admin. Rep. LJ-91-26: 34 p.

Cooperrider, C. L. 1987. Commercial passenger fishing vessel landings of widow rockfish *Sebastes entomelas* in central California. p. 49-52. In: Lenarz, W. H., and D. R. Gunderson (ed.), Widow rockfish. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 48.

Copes, P. 1986. A critical review of the individual quota as a device in fisheries management. Land Econ. 62: 278-291.

Crawford, R. J. M., and P. A. Shelton. 1978. Pelagic fish and seabird interrelationships off the coasts of South West and South Africa. Biol. Conserv. 14: 85-109.

Cushing, D. H. 1971. The dependence of recruitment of parent stock on different groups of fishes. J. Cons. Int. Explor. Mer. 33: 340-362.

Demory, R. 1987. The widow rockfish fishery in Oregon, 1963-80. p. 9. In: Lenarz, W. H., and D. R. Gunderson (ed.), Widow rockfish. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 48.

Deriso, R. B. 1985. Risk adverse harvesting strategies. Lect. Notes Biomath. 61: 65-74.

Deriso, R. B. 1993. A report on integrated assessment of Pacific sardine. In: Hester, F. J. Project report on Pacific sardine (*Sardinops sagax*) resource research, 1991/1992, phase III. LMR Fisheries Research, Inc., San Diego, CA. 45 p.

Dickerson, T., and R. Leos. 1992. California market squid. *In*: W.S. Leet, C.M. Dewees, and C.W. Haugen. California's living marine resources and their utilization. California Sea Grant Extension Publication UCSGEP-92-12. 257p.

Dohl, T. P., R. C. Guess, M. L. Duman, and R. C. Helm. 1983. Cetaceans of central and northern California, 1980-1983: status, abundance, and distribution. Center for Marine Studies, University of Calif., Santa Cruz. Prepared for Pacific OCS Region, Minerals Management Service, U.S. Department of Interior, Contract #14-12-0001-29090. 284 p.

Dorsey E. M., S. J. Stern, A. R. Hoelzel, and J. Jacobsen. 1990. Minke whales (*Balaenoptera acutorostrata*) from the west coast of North America: Individual recognition and small-scale site fidelity. Rep. Int. Whal. Commn. Special issue 12: 357-368.

Environmental Perspectives. 1989. Final environmental impact report (including draft EIR). Fort Macarthur Educational Complex at the Fort Macarthur upper reservation. Master plan of facilities. Los Angeles Unified School District.

Fitch, J. E. 1951. Age composition of Southern California catch of Pacific mackerel 1939-1940 through 1950-1951. Calif. Dep. Fish and Game, Fish. Bull. 83: 77 p.

Fitch, J. E. 1969. Offshore fishes of California. 4th revision. Calif. Dep. Fish and Game, Sacramento, CA. 79 p.

Fitch, J. E., and R. L. Brownell, Jr. 1968. Fish otoliths in cetacean stomachs and their importance in interpreting feeding habits. J. Fish. Res. Bd. Canada, 25: 2561-2574.

Fitch, J. E., and R. J. Lavenberg. 1971. Marine food and game fishes of California. Univ. Calif. Press, Berkley, CA. 179 p.

Forney, K.A., J. Barlow, and J. V. Caretta. 1995. The abundance of ceteceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fish. Bull. 93: 15-26.

Fowler, C. W. (in press). Northern fur seals of the Pribilof Islands. In: The northern fur seal. Species of the fauna of the USSR and the contiguous countries. USSR Academy of Sciences, Nauka, Moscow.

Frey, H. W. [ed.] 1971. California's living marine resources and their utilization. Calif. Dept. Fish and Game 148 p.

Fritzsche, R. A. 1978. Development of fishes in the Mid-Atlantic Bight, Vol. 5. Chaetodontidae through Ophdiidae. U.S. Fish Wildl. Serv., Washington, D.C. FWS/OBS-78/12. 340 p.

Furness, R. W., and D. G. Ainley. 1984. Threats to seabird populations presented by commercial fisheries. ICBP Tech. Publ. 2: 701-708.

Gearin, P. J., and M. A. Johnson. 1991. Harbor porpoise food habits in Washington state. Abstracts: Ninth Biennial Conference on the Biology of Marine Mammals, December 5-9, 1991, Chicago, Illinois. p. 26.

Glantz, M. H., and J. D. Thompson [ed.] 1981. Resource mangement and environmental uncertainty: Lessons from coastal upwelling fisheries. Wiley, New York. 491 p.

Grieb, T.M., and R.D. Beeman. 1978. A study of spermatogenesis in the spawning population of the squid, *Loligo opalescens.* Calif. Fish and Game, Fish Bull. 169: 11-21.

Gulland, J. A. 1970. Preface. In: J. Gulland [ed.] The fish resources of the oceans. FAO Fish. Tech. Paper 97: 1-4.

Hacker, E. S. 1986. Stomach content analysis of short-finned pilot whales (*Globicephala macrorhynchus*) and northern elephant seals (*Mirounga angustirostris*) from the southern California Bight. NMFS, SWFSC Admin. Rep. LJ-86-08C. 34 p.

Hall, D. L., R. Hilborn, M. Stocker, and C. J. Walters. 1988. Alternate harvest strategies for Pacific herring (*Clupea harengus pallasi*). Can. J. Fish. Aquat. Sci. 45: 888-897.

Hansen, L. J. 1990. California coastal bottlenose dolphins. p. 403-420. In: S. Leatherwood and R. Reeves, [ed.] The bottlenose dolphin. Academic Press, San Diego, CA.

Hargreaves, N.B., D.M. Ware, and G.A. McFarlane. 1994. Return of the Pacific sardine (*Sardinops sagax*) to the British Columbia coast in 1992. Can. J. Fish. Aquat. Sci. 51: 460-463.

Hart, J. L. 1973. Pacific fishes of Canada. Fish. Res. Board Can., Bull. 180. 740 p.

Hedgecock, D., E. S. Hutchinson, G. Li, F. L. Sly, and K. Nelson. 1989. Genetic and morphometric variation in the Pacific sardine, *Sardinops sagax caerulea*: comparisons and contrasts with historical data and with variability in the northern anchovy, *Engraulis mordax*. Fish. Bull. 87: 653-671.

Heyning, J. E., and W. F. Perrin. 1991. Re-examination of two forms of common dolphins (*genus Delphinus*) from the eastern North Pacific; evidence for two species. NMFS Admin. Rep. LJ-91-28, 37 p.

Hewitt, R. P. 1988. Historical review of the oceanographic approach to fishery research. CalCOFI Rep. 29: 27-41.

Hightower, J. E. 1990. Multispecies harvesting policies for Washington-Oregon-California rockfish trawl fisheries. Fish. Bull. (U.S.) 88: 645-656.

Hilborn, R. 1985. A comparison of harvest policies for mixed stock fisheries. Lect. Notes Biomath. 61: 75-87.

Hill, K.T., M. Yaremko, L.D. Jacobson, N.C.H. Lo, and D.A. Hanan. 1998. Stock assessment and management recommendations for Pacific sardine (Sardinops sagax) in 1997. Calif. Dept. Fish. Game. Marine Region Admin. Rep. 98-5. 53 pp.

Hitz, C. R. 1970. Operation of the Soviet trawl fleet off the Washington and Oregon coasts during 1966 and 1967. p. 53-75. In: *Pacific hake*. U.S. Department of the Interior, FWS, BCF, circular 332.

Huber, H. R., S. Jeffries, R. Brown, and R. DeLong. 1992. Abundance of harbor seals in Washington and Oregon. Annual Report, MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA. Silver Spring, MD.

Hunt, G. L., and J. Butler. 1980. Reproductive ecology of Western Gulls and Xantus' Murrelets with respect to food resources in the Southern California Bight. CalCOFI Rep. 21: 62-67.

Huppert, D. D. 1981. Economic analysis for northern anchovy management. p.41-80. In: L. G. Anderson [ed.] Economic analysis for fisheries management plans. Ann Arbor Science Publishers, Ann Arbor, MI.

Hurley, A.C. 1977. Mating behavior of the squid, *Loligo opalescens*. Marine Behav. Phys. 4: 195-203.

ICF Technology, San Diego, and Knecht, Cicin-Sain and Associates, Santa Barbara. 1988. Toward a more abundant ocean: improving fisheries management in California. Development of alternative management approaches. Prepared for National Coalition for Marine Conservation-Pacific Region. 2: 51 p.

Idyll, C.P. 1973. The anchovy crisis. Sci. American 228: 145-149.

Jacobson, L. D. 1993. ADEPT: software for VPA analysis using Gavaris's procedure. NMFS, SWFSC Admin. Rep. LJ-93-15.

Jacobson, L. D., and N. C. Lo. 1991. Spawning biomass of the northern anchovy in 1991. NMFS, SWFSC Admin. Rep. LJ-91-19: 53 p.

Jacobson, L.D. and N.C.H. Lo. 1993. Spawning Biomass of the Northern Anchovy in 1993. NMFS, SWFSC Administrative Report LJ-93-13. 41 p.

Jacobson, L. D., and C. J. Thomson. 1989. Evaluation of options for managing northern anchovy--a simulation model. NMFS, SWFC Admin. Rep. LJ-89-26: 98 p.

Jacobson, L. D., and C. J. Thomson. 1993. Opportunity cost and the decision to fish for northern anchovy. N. Am. J. Fish. Mgmt. 13: 27-34.

Jacobson, L. D., N. C. H. Lo, and J. T. Barnes. 1994. A biomass-based assessment model for northern anchovy, *Engroulis mordax*. Fish. Bull. 92: 711-724.

Jacobson, L. D., and C. H. Lo. 1993. Spawning biomass of the northern anchovy in 1993. NMFS, SWFSC, Admin. Rep. LJ-93-13.

Jacobson, L. D., N. C. H. Lo, S. F. Herrick Jr., T. Bishop. 1995. Spawning biomass of the northern anchvoy in 1995 and status of the coastal pelagic species fishery during 1994. NMFS, SWFSC, Admin. Rep. LJ-95-11.

Jacobson, L.D., and A. D. MacCall. 1995. Stock-recruitment models for Pacific sardine (*Sardinops sagax*). Can. J. Fish. Aquat. Sci. 52: 566-567.

Jacobson, L. D., N. C. H. Lo, and M. Yaremko. 1997. Status of the northern anchovy (*Engraulis mordax*) stock (central subpopulation) during the 1996-1997 season. NMFS, SWFSC, Admin. Rep. LJ-97-08.

Jefferts, K. 1983. Squid distribution, biology, and life history, p.3-10. *In*: Proceedings of the West Coast Squid Symposium. Oregon State University Sea Grant. Newport, OR.

Jones, R. E. 1981. Food habits of smaller marine mammals from northern California. Proceedings of the Ca. Acad. of Sci. 42(16): 409-433.

Kajimura, H. 1984. Opportunistic feeding of the northern fur seal, *Callorhinus ursinus*, in the Eastern North Pacific Ocean and Eastern Bering Sea. NOAA Tech. Rep. NMFS SSRF-779. 49 p.

Kajimura, H., C. H. Fiscus, and R. K. Stroud. 1981. Food of Pacific white-sided dolphin *Lagenorhynchus obliquidens*, Dall's porpoise *Phocoenoides dalli* and northern fur seal, *Callorhinus ursinus*, off California and Washington with appendices on size and food of Dall's porpoise from Alaska Waters. NOAA Tech. Memo. NMFS/F/NWC2. 30 p.

Karpov, K.A., and G. Cailliet. 1978. Feeding dynamics of *Loligo opalescens*. Calif. Fish and Game, Fish Bull. 169:45-66.

Kato, S., and J. E. Hardwick. 1975. The California squid fishery. FAO Fish. Rep. (170) Suppl. 107-147.

Kearney/Centaur Division. 1987a. Baseline socioeconomic profiles of coastal counties in the central California planning area. U. S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region, OCS Study MMS 87-0053.

Kearney/Centaur Division. 1987b. Baseline socioeconomic profiles of coastal counties in the southern California planning area. U. S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region, OCS Study MMS 87-0054.

Keeney, R. L., and H. Raiffa. 1976. Decisions with multiple objectives: preferences and value tradeoffs. John Wiley and Sons, New York.

Kieckhefer, T. R. 1991. Feeding ecology of humpback whales in and around the Gulf of the Farallons, California. Abstracts: Ninth Biennial Conference on the Biology of Marine Mammals, December 5-9, 1991, Chicago, Illinois. p. 39.

Klingbeil, R. A. 1983. Pacific mackerel: A resurgent resource and fishery of the California current. CalCOFI Rep. 24: 35-45.

Knipe, J.W., and R.D. Beeman. 1978. Histological observations on oogenesis in *Loligo opalescens*. Calif. Fish and Game, Fish Bull. 169: 23-34.

Lasker R. 1970. Utilization of zooplankton energy by a Pacific sardine population in the California Current, p. 265-284. *In*: J.H. Steele (ed.). Marine Food Chains. Oliver and Boyd Ltd., Edinburgh.

Leatherwood, S. 1975. Some observations of feeding behavior of bottle-nosed dolphins (*Tursiops truncatus*) in the northern Gulf of Mexico and (*Tursiops cf T. gilli*) off southern California, Baja California, and Nayarit, Mexico. Mar. Fish. Rev. 37(9): 10-16.

Leatherwood, S., R. R. Reeves, W. F. Perrin, W. E. Evans, and L. Hobbs. 1982. Whales, dolphins, and porpoises of the eastern north Pacific and adjacent Arctic waters: A guide to their identification. NOAA Tech. Rep. NMFS Circ. 444, 245 p.

Leatherwood, S., and W. A. Walker. 1982. Population biology and ecology of the Pacific white-sided dolphin Lagenorhynchus *obliquidens* in the Northeastern Pacific. Part 1: Distribution, seasonal movements and abundance with a bibliography and summary of specimen material. NMFS Admin. Rep. LJ-82-18C, 45 p.

Le Boeuf, B. J., and M. L. Bonnell. 1980. Pinnipeds of the California islands: Abundance and distribution. p. 475-493. In: D. M. Power [ed.] The California islands: Proceedings of a multydisciplinary symposium. Santa Barbara Museum of Natural History.

Lluch-Belda, D., R. J. M. Crawford, T. Kawasaki, A. D. MacCall, R. H. Parrish, R. A. Schwartzlose, and P. E. Smith. 1989. World-wide fluctuations of sardine and anchovy stocks: The regime problem. S. Afr. J. Mar. Sci. 8: 195-205.

Lluch-Belda, D., D.B. Lluch-Cota, S. Hernandez-Vazquea, C.A. Salina-Zavala. 1991. Sardine and anchovy spawning as related to temperature and upwelling in the California Current system. CalCOFI Rep. 32: 105-111.

Lo, N. C. H., and R. D. Methot. 1989. Spawning biomass of the northern anchovy in 1988. Calif. Coop. Oceanic Fish. Invest. Rep. 30: 18-31.

Lo, N. C.H., L. D. Jacobson, and J. L. Squire. 1992. Indices of relative abundance from fish spotter data. Can. J. Fish. Aquat. Sci. 229: 2515-2526.

Lo, N.C.H., Y.A. Green-Ruiz, M.J. Cervantes, H.G. Moser, and R.J. Lynn. 1996. Egg production and spawning biomass of Pacific sardine (*Sardinops sagax*) in 1994, determined by the daily egg production method. CalCOFI Rep. 37: 160-174.

Loughlin, T. R., and P. A. Livingston. 1986. Summary of joint research on the diets of northern fur seals and fish in the Bering Sea during 1985. NWAFC Processed Report 86-19. 92 p.

Loughlin, T. R., and R. L. Merrick. 1989. Comparison of commercial harvest of walleye pollock and northern sea lion abundance in the Bering Sea and Gulf of Alaska, pp 679-700, In: Proceedings of the international symposium on the biology and management of walleye pollock, November 14-16, 1988, Anchorage, AK. Univ. Alaska Sea Grant Rep. AK-SG-89-01.

Loughlin, T. R., A. S. Perlov, and V. A. Vladimirov. 1990. Survey of northern sea lions (*Eumetopias jubatus*) in the Gulf of Alaska and the Aleutian Islands during June 1989. U.S. Dep. Comm., NOAA Tech. Memo. NMFS F/NWC-176. 26 p.

Lowry, M. S., C. W. Oliver, C. Macky, and J. B. Wexler. 1990. Food habits of California sea lions *Zalophus californianus* at San Clemente Island, California, 1981-86. Fish. Bull. 88: 509-521.

Lowry, M. S., B. S. Stewart, C. B. Heath, P. K. Yochem, and J. M. Francis. 1991. Seasonal and annual variability in the diet of California sea lions *Zalophus californianus* at San Nicolas Island, California, 1981-86. Fish. Bull. 89: 331-336.

MacCall, A. D. 1979. Population estimates for the waning years of the Pacific sardine fishery. CalCOFI Rep. 20: 72-82.

MacCall, A. D. 1984. Seabird-fishery trophic interactions in eastern boundary currents: California and Peru, p. 136-149. In: D. N. Nettleship, G. A. Sanger, and P. F. Springer [eds.]. Marine birds: their feeding ecology and commercial Fisheries relationships. Minister Supply Serv., Ottawa.

MacCall, A. D. 1990. Dynamic geography of marine fish populations. University of Washington Press. 153 p.

MacCall, A. D., H. W. Frey, D. D. Huppert, E. H. Knaggs, J. A. McMillan, and G. D. Stauffer. 1980. Biology and economics of the fishery for jack mackerel in the northeastern Pacific. NOAA Tech. Mem. NMFS NOAA-TM-NMFS-SWFC-4: 79 p.

MacCall, A. D., R. A. Klingbeil, and R. D. Methot. 1985. Recent increased abundance and potential productivity of Pacific mackerel (*Scomber japonicus*). Calif. Coop. Oceanic Fish. Invest. Rep. 26: 119-129.

MacCall, A. D., and M. H. Prager. 1988. Historical changes in abundance of six fish species off southern California, based on CalCOFI egg and larva samples. CalCOFI Rep. 29: 91-101.

MacCall, A. D., and G. D. Stauffer. 1983. Biology and fishery potential of jack mackerel (*Trachurus symmetricus*) CalCOFI Rep. 24: 46-56.

MacCall, A. D., G. D. Stauffer and J. P. Troadec. 1976. Southern California recreational and commercial marine fisheries. Mar. Fish. Rev. 38(1): 1-32.

Malme, C. I., P. W. Smith, Jr., and P. R. Miles. 1986. Characterization of geophysical acoustic survey sounds. U. S. Dept. of Interior, Minerals Management Service, Pacific OCS Region, OCS Study MMS-86-0032. Los Angeles, California. 91 p.

Moloney, D. G., and P. H. Pearse. 1979. Quantitative rights as an instrument for regulating commercial fisheries. J. Fish. Res. Board Can. 36: 859-866.

Morejohn, G.V., J.T. Harvey, and L. Krasnow. 1978. The importance of *Loligo opalescens* in the food web of marine invertebrates in Monterey Bay, California. Calif. Fish and Game, Fish Bull. 169: 67-98.

Mason, J. E. 1991. Variations in the catch of jack mackerel in the southern California purse seine fishery. CalCOFI Rep. 32: 143-151.

MBC Applied Environmental Sciences. 1987. Ecology of important fisheries species offshore California. OCS-Study, MMS 86-0093. 252 p.

Mead, G. W. 1953. The food habits of the northern fur seal in Japanese waters, with a study of the fishes found on the feeding grounds. Ph.D. Thesis, Stanford University, California, 138 p.

Mendelssohn, R. 1982. Discount factors and risk aversion in managing random fish populations. Can. J. Fish. Aquat. Sci. 39: 1252-1257.

Merrick, R. L., L. M. Ferm, R. D. Everitt, R. R. Ream, and L. A. Lessart. 1991. Aerial and ship-based surveys of northern sea lions (*Eumetopias jubatus*) in the Gulf of Alaska and Aleutian Islands during June and July 1990. U.S. Dept. Comm., NOAA Tech. Memo. NMFS F/NWC-196. 34 p.

Merrick, R. L., T. R. Loughlin, and D. G. Calkins. 1987. Decline in abundance of the northern sea lion, *Eumetopias jubatus*, in Alaska, 1956-86. Fish. Bull. 85: 351-365.

Methot, R. D. 1989. Synthetic estimates of historical abundance and mortality for northern anchovy. p. 66-82. In: E. Edwards and B. Megrey [ed.] Mathematical analysis of fish stock dynamics: reviews, evaluations and current applications. Am. Fish. Soc. Symp. Ser. No. 6. American Fisheries Society, Bethesda, MD.

Murphy, G. I. 1966. Population biology of the Pacific sardine (*Sardinops caerulea*). Proc. Cal. Acad. Sci. 34: 1-84.

Myers, R. A., W. Blanchard, and K. R. Thompson. 1990. Summary of north atlantic fish recruitment 1942-1987. Can. Tech. Rep. Fish Aquat. Sci. No. 1743: 108 p.

National Marine Fisheries Service. 1984. Marine recreational fishery statistics survey, Pacific coast, 1981-1982. Current Fishery Statistics 8323.

National Marine Fisheries Service. 1985a. Marine recreational fishery statistics survey, Pacific coast, 1983-1984. Current Fishery Statistics 8325.

National Marine Fisheries Service. 1985b. Marine recreational fishery statistics survey, Pacific coast, 1985. Current Fishery Statistics 8328.

National Marine Fisheries Service. 1987. Marine recreational fishery statistics survey, Pacific coast, 1986. Current Fishery Statistics 8393.

National Marine Fisheries Service. 1991. Cruise report, Soviet Research Trawler Novodrutsk. Southwest Fisheries Science Ceter, La Jolla, CA.

Nebenzahl, Deborah A., 1997. Age, growth, and population structure of jack mackerel (Trachurus symmetricus) from the northeastern Pacific Ocean. MS Thesis. San Francisco State University. 93 p.

Nelson, M. O. 1970. Pacific hake fishery in Washington and Oregon coastal waters. p. 43-52. In: *Pacific hake*. U.S. Department of the Interior, FWS, BCF, circular 332.

Norris, K. S., and J. H. Prescott. 1961. Observations on Pacific cetaceans of California and Mexican waters. Univ. Calif. Publ. Zool. 63: 291-401.

Orbach, M. K., and J. Beckwith. 1980. A report on the adaptation of Indochinese refugees to the fishing industry and community of Monterey Bay. Center for Coastal Marine Studies, UC Santa Cruz. 38 p.

Osuna, O. A. P., and A. A. Avalos. 1976. Estadisticas basicas de la explotacion de sardina en el noroeste de Mexico. Instituto Nacional de Pesca. INP/SI:i79.

Parma, A. M., and R. B. Deriso. 1990. Experimental harvesting of cyclic stocks in the face of alternative recruitment hypotheses. Can. J. Fish. Aquat. Sci. 47: 595-619.

Parrish, R. H., A. Bakun, D. M. Husby, and C. S. Nelson. 1982. Comparative climatology of selected environmental processes in relation to eastern boundary current pelagic fish reproduction. FAO, Fish. Rep. 291: 731-777.

Parrish, R. H., and A. D. MacCall. 1978. Climate variation and exploitation in the Pacific mackerel fishery. Calif. Dep. Fish Game, Fish. Bull. 167. 110p.

Parrish, R. H., D. L. Mallicoate, and K. F. Mais. 1985. Regional variations in the growth and age composition of northern anchovy, *Engraulis mordax*. Fish. Bull. 83: 483-496.

Parrish, R. H., C. S. Nelson and A. Bakun. 1981. Transport mechanisms and reproductive success of fishes in the California current. Biol. Oceanogr. 1(2): 175-203.

Parrish, R. H., R. Serra, and W. S. Grant. 1989. The monotypic sardines, *Sardina* and *Sardinops*: their taxonomy, distribution, stock structure and zoogeography. Can. J. Fish. Aquat. Sci. 46: 2019-2036.

Pearcy, W., J. Fisher, R. Brodeur, and S. Johnson. 1985. Effects of the 1983 El Niño on coastal neckton off Oregon and Washington. p. 188-204. In: El Niño North: Niño effects in the eastern subarctic Pacific Ocean. W.S. Wooster and D.L. Fluharty [ed.] Washington Sea Grant Program. Univ. of Washington, Seattle.

Pearson, W. H., J. R. Skalski, and C. I. Malme. 1987. Effects of sounds from a geophysical device on fishing success. U. S. Dept. of Interior, Minerals Management Service, Pacific OCS Region, OCS Study MMS-87-0020. Los Angeles, California. 293 p.

Perrin, W. F. and B. G. Noetzel. 1970. Economic study of the San Pedro wetfish boats. U. S. Fish and Wildlife Service, Fishery Industrial Research 6: 105-138.

PFMC. 1983. Northern Anchovy Fishery Management Plan (Amendment No. 5). Portland, Oregon.

PFMC. 1990. Final amendment 4, supplemental environmental impact statement, regulatory impact review, and initial regulatory flexibility analysis to the Pacific coast groundfish plan. Pacific Fishery Management Council, Portland, OR.

PFMC. 1990a. Sixth amendment to the northern anchovy fishery management plan. Pacific Fishery Management Council, Portland, OR.

PFMC. 1990b. Ammendment 4 to the Pacific coast groundfish fishery management plan. Pacific Fishery Management Council, Portland, OR.

PFMC. 1990c. Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Pacific Fishery Management Council, Portland, OR.

PFMC. 1991. Review concerning consistency of the California Proposition 132 with the groundfish fishery management plan. 6 p.

PFMC. 1992. Status of the Pacific coast groundfish fishery through 1992 and recommended acceptable biological catches for 1993. Pacific Fishery Management Council, Portland, OR.

PFMC. 1993. Draft individual quota (IQ) program. Appendix A, B and C to Amendment 8 of the Pacific Coast Groundfish Fishery Management Plan (August 26, 1983). Pacific Fishery Management Council, Portland, OR.

PFMC. 1993. Fishery management plan for the California, Oregon and Washington groundfish fishery as amended through Amendment 7. Pacific Fishery Management Council, Portland, OR.

Phillips, J. B. 1948. Growth of the sardine, *Sardinops caerulea*, 1941-42 through 1946-47. Calif. Div. Fish Game Fish Bull. 71: 33 p.

Pope, J. G. 1972. An investigation of the accuracy of virtual population analysis using cohort analysis. Int. Comm. for the Northwest Atlantic Fish. Res. Bull. 9:65-74.

Prager, M. H., and A. D. MacCall. 1988. Revised estimates of historical spawning biomass of the pacific mackerel, Scomber japonicus. CalCOFI Rep. 29: 81-90.

Quirollo, L. F. 1987. Review of data on historical catches of widow rockfish in northern California. p. 7-8. In: Lenarz, W. H., and D. R. Gunderson (ed.), Widow rockfish. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 48.

Radovich, J. 1981. The Collapse of the California Sardine Fishery: What Have We Learned? In Glantz, M. H. and J. D. Thompson (ed.). Resource Management and Environmental Uncertainty. John Wiley & Sons, New York.

Radovich, J. 1982. The collapse of the California sardine fishery: what have we learned? CalCOFI Rep. 23: 56-78.

Radtke, H., and W. Jensen. 1987. The west coast seafood industry: its importance to the west coast economy in 1986. Report prepared for Pacific Marine Fisheries Commission. Portland, OR. 53 p.

Restrepo, V.R., G.G. Thompson, P.M. Mace, W.L. Gabriel, L.L. Low, A.D. MacCall, R.D. Methot, J.E. Powers, B.L. Taylor, P.R. Wade, and J.F. Witzig. In press. Technical guidance on precautionary approaches to implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. NOAA Technical Memorandum.

Rettig, R. B., and J. C. Ginter (eds.). 1978. Limited entry as a fishery management tool. Univ. of Washington Press, Seattle, WA.

Reckseik, C. W. and H. W. Frey (eds). 1978. Biological, oceanographic, and acoustic aspects of the market squid, *Loligo opalescens* Berry. Calif. Dept. Fish and Game, Fish Bull. 169. 185p.

Reinstedt, R. A. 1978. Where have all the sardines gone? A pictorial history of Steinbeck's Cannery Row and old Monterey's fisherman's wharf and sardine industry. Ghost Town Publications, Carmel, CA. 167 p.

Rice, D. W. 1977. Synopsis of biological data on sei whale and Bryde's whale in the eastern north Pacific. Rep. Int. Whal. Commn. (Special Issue 1): 92-97.

Richardson, S. L. 1981. Spawning biomass and early life of northern anchovy, *Engraulis mordax*, in the northern subpopulation off Oregon and Washington. Fishery Bulletin 78: 855-876.

Roedel, P. 1938. Record-size mackerel in Santa Monica Bay. Calif. Fish Game 24: 423.

Roper, C.F.E, and M.J. Sweeney. 1984. FAO Species Catalogue. Vol. 3. Cephalopods of the world. FAO Fisheries Synopsis 125. 277p.

Rosenberg, A., P. Mace, G. Thomson, G. Darcy, W. Clark, J. Collie, W. Gabriel, A. MacCall, R. Methot, J. Powers, V. Restrepo, T. Wainwright, L. Botsford, J. Hoenig, and K. Stokes. 1994. Scientific review of definitions of overfishing in U.S. Fishery Management Plans. NOAA Tech. Memo. NMFS-F/SPO-17.

Ruppert, D., R. L. Reish, R. B. Deriso, R. J. Carroll. 1984. Optimization using stochastic approximation and Monte Carlo simulation (with application to harvesting of Atlantic menhaden). Biometrics 40: 535-545.

Schaffner, F. 1982. Aspects of the reproductive ecology of the elegant tern (*Sterna elegans*) in San Diego Bay. Unpubl. MS Thesis, San Diego State University.

Scofield, W. L. 1938. Sardine oil and our troubled waters. Calif. Fish and Game 24: 210-223.

Scofield, W. L. 1951. Purse seines and other roundhaul nets in California. Calif. Dept. of Fish and Game Fish Bulletin no. 81.

Seagars, D. J. 1984. The Guadalupe fur seal: a status review. NMFS, Admin. Rep. SWR-84-6. 29 p.

Sinclair, E. H. 1988. Feeding habits of northern fur seal (*Callorhinus ursinus*) in the Eastern Bering Sea. MS Thesis, Oregon State University, Oregon, 94 p.

Schaefer, K.M. 1980. Synopsis of biological data on the chub mackerel, *Scomber japonicus* Houttunyn, 1782 in the Pacific Ocean. *In*: Synopses of Biological Data on Eight Species of Scombrids. Ed. W.H. Bayliff. Inter-American Tropical Tuna Commission. La Jolla CA. USA.

Sissenwine, M. P., and P. M. Mace. 1992. ITQs in New Zealand: the era of fixed quota in perpetuity. Fish. Bull., U.S. 90: 147-160.

Smith, P. E. 1972. The increase in the spawning biomass of northern anchovy, *Engraulis mordax*. Fishery Bulletin 70: 849-874.

Smith, P. E. 1978. Biological effects of ocean variability: time inferred from fish scales in anaerobic sediments off California. CalCOFI Rep. 13: 63-70.

Soutar, A., and J. D. Isaacs. 1974. Abundance of pelagic fish during the 19th and 20th centuries as recorded in anaerobic sediment off the Californias. Fish. Bull. 72: 257-273.

Spalding, D. J. 1964. Comparative feeding habits of the fur seal, sea lion, and harbour seal on the British Columbia coast. Fish. Res. Bd. of Canada Bulleton 146: 1-52.

Spratt, J.D. 1979. Age and growth of market squid, *Loligo opalescens* Berry, from statoliths. Calif. Coop. Oceanic Fish. Invest. Rep. 20: 58-64.

Squire, J. L. Jr. 1972. Apparent abundance of some pelagic marine fishes off the southern and central California coast as surveyed by an airborne monitoring program. Fish. Bull. 70: 1005-1019.

Squire, J. L. Jr. 1983. Abundance of pelagic resources off California, 1963-78, as measured by an airborne fish monitoring program. NOAA Technical Report NMFS SSRF-762: 75 p.

Stewart, B. S. and R. L. DeLong. 1991. Double migrations and sexual segregation of foraging northern elephant seals. Abstracts: Ninth Biennial Conference on the Biology of Marine Mammals, December 5-9, 1991, Chicago, Illinois. p. 67.

Stewart, B. S. and P. K. Yochem. 1985. Feeding habits of harbor seals (*Phoca vitulina richardsi*) at San Nicolas Island, California, 1980-1985. (Abstr.) Sixth Biennial Conf. on the Bio. of Mar. Mamm., November 22-26, 1985.

Stroud, R. K., C. H. Fiscus, and H. Kajimura. 1981. Food of the Pacific white-sided dolphin, *Lagenorhynchus obliquidens*, Dall's porpoise, *Phocoenoides dalli*, and northern fur seal, *Callorhinus ursinus* off California and Washington. Fish. Bull 78: 951-959.

Sverdurp, H. U., M. W. Johnson, and R. H. Fleming. 1942. The Oceans, their physics, chemistry, and general biology. Prentis-Hall, Inc. NJ. 1087 p.

Swan, J. G. 1893. Notes on the fisheries and fishery industries of Puget Sound. Bull. U.S. Fish. Comm. Vol. 13, 371-80.

SWFSC. 1991. Cruise report: Soviet research trawler, Novodrutsk. Southwest Fisheries Science Center Cruise Report. 10 p.

Tagart, J. V. 1987. Description of the Washington State fishery for widow rockfish. p. 11-12. In: Lenarz, W. H., and D. R. Gunderson (ed.), Widow rockfish. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 48.

Thomson, C. J. 1990. The market for fish meal and oil in the United States: 1960-1988 and future prospects. CalCOFI Rep. 31: 124-131.

Thomson, C. J., C. Cooney, and J. Morgan. 1989. Status of the California coastal pelagic fisheries in 1988. NMFS, SWFC Admin. Rep. LJ-89-14.

Thomson, C. J., and S. J. Crooke. 1991. Results of the Southern California sportfish economic survey. NOAA NMFS Technical Memorandum, NOAA-TM-NMFS-SWFSC-164. 264 p.

Thomson, C. J., T. Dickerson, G. Walls, and J. Morgan. 1991. Status of the California coastal pelagic fisheries in 1990. NMFS, SWFSC Admin. Rep. LJ-91-22: 27 p.

Thomson, C. J., and D. D. Huppert. 1987. Results of the Bay Area sportfish economic study (BASES). NOAA NMFS Technical Memorandum NOAA-TM-NMFS-SWFSC-78, 70 p.

Thomson, C. J., G. Walls, and J. Morgan. 1993. Status of the California coastal pelagic fisheries in 1992. NMFS, SWFSC Admin. Rep. LJ-93-14.

Thomson, C. J., T. Bishop, and J. Morgan. 1994. Status of the California coastal pelagic fisheries in 1993. NMFS, SWFSC Admin. Rep. LJ-94-14.

Tillman, M. F. 1977. Estimates of population size for the North Pacific Sei whale. Rep. Int. Whal. Commn. (Special Issue 1): 98-106.

Tovar, H., V. Guillen, and M. E. Nakama. 1987. Monthly population size of three guano species off Peru, 1953 to 1982. ICLARM Studies and Reviews 15: 208-218.

Townsend, R. E. 1990. Entry restrictions in the fishery: a survey of the evidence. Land Econ. 66: 359-378.

Tracey, S. D. 1985. Feeding habits of marine mammals from Grays Harbor, Washington to Netarb Bay, Oregon, p. 149-219. In: R. J. Beach, A. C. Geiger, S. J. Jeffries, S. D. Tracey, and B. L. Troutman. Marine mammals and their interactions with fisheries of the Columbia River and adjacent waters, 1981-1982. NWAFC Processed Report 85-04.

Troadec, J. P., W. G. Clark, and J. A. Gulland. 1980. A review of some pelagic fish stocks in other areas. Rapp. P.-v. Réun. Cons. int. Explor. Mer, 177: 252-277.

Turner, C. H. and J. C. Sexsmith. 1967. Marine baits of California. First revision. Calif. Dep. Fish Game, Sacramento, CA. 70 p.

Ueber, E. 1988. The traditional central California setnet fishery. Mar. Fish. Rev. 50: 40-48.

Urban, J., and A. Aguayo. 1987. Spatial and seasonal distribution of the humpback whale, *Megaptera novaeangliae*, in the Mexican Pacific. Marine Mammal Science 3: 333-344.

U.S. Bureau of the Census. 1977. County business patterns, 1975, California. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1982. County business patterns, 1980, California. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1987. County business patterns, 1985, California. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1988. County business patterns, 1986, California. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1989. County business patterns, 1987, California. U.S. Government Printing Office. Washington, D.C.

U.S. Bureau of the Census. 1990. County business patterns, 1988, California. U.S. Government Printing Office. Washington, D.C.

Vrooman, A. M. 1964. Serologically differentiated subpopulations of the Pacific sardine, *Sardinops caerulea*. J. Fish. Res. Bd. Canada, 21: 691-701.

Walford, L. A., and K. Mosher. 1941. Extension of pilchard spawning to north Pacific waters indicated. Pacific Fisherman. February, p. 47.

Walker, W. A. 1981. Geographical variation in morphology and biology of bottlenose dolphins (*Tursiops*) in the eastern North Pacific. NMFS Admin. Rep. LJ-81-03C, 17 p.

Walker, W. A., K. R. Goodrich, S. Leatherwood, and R. K. Stroud. 1984. Population biology and ecology of the Pacific white-sided dolphin, *Lagenorhynchus obliquidens*, in the Northeastern Pacific. Part II: Biology and geographical variation. NMFS Admin. Rep. LJ-84-34C, 39 p.

Wells, R. L., L. J. Hansen, A. Baldridge, T. P. Dohl, D. L. Kelly, and R. H. Defran. 1990. Northward extension of the range of bottlenose dolphins along the California coast. p. 421-431. In: S. Leatherwood and R. Reeves [ed.] The bottlenose dolphin. Academic Press, Inc., New York, New York.

Wilen, J. E. 1988. Limited entry licensing: a retrospective assessment. Mar. Res. Econ. 5: 313-324.

Wolf, P. 1989. Status of the Pacific mackerel populations, 1989. Calif. Dep. Fish Game, Legislative Rep. 20 p.

Wolf, P., and P. E. Smith. 1986. The relative magnitude of the 1985 Pacific sardine spawning biomass off southern California. CalCOFI Rep. 27: 25-31.

Wolf, P., P. E. Smith, and C. L. Scannell. 1987. The relative magnitude of the 1986 Pacific sardine spawning biomass off California. CalCOFI Rep. 28: 21-26.

Wolf, P. 1992. Recovery of the Pacific sardine and the California sardine fishery. CalCOFI Rep. 33: 76-86.

Yaremko, M., and J.T. Barnes. In press. Status of the Pacific mackerel resource during 1997 and management recommendations for the fishery. Calif. Fish. Game Admin. Rept.